Self-Control or Social Control?
Peer Effects on Temptation Consumption

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Abstract

This paper examines the effect of peer networks on self-control problems. I construct a theoretical model to describe the way in which peer networks influence consumption behaviors through social norms, which guide people to conform to their friends' behavior. Using data from a monthly survey conducted in 16 villages in Thailand from 1999 through 2004, I empirically examine peer effects on temptation consumption patterns, and test the mechanism underlying this relationship. Detailed social network information in the dataset allows the identification of impacts using a friend of a friend (excluded network) as the instrument. The panel nature of this instrument helps the common identification problems, such as reflection, self-selection, and common unobservable shocks, in the social network literature. The empirical results provide evidence that peer decisions significantly impact individuals' temptation consumption such as alcohol and gambling, as well as savings. These peer effects are driven primarily by social norms, rather than risk sharing.

1 Introduction

A common theme in the behavioral economics literature is that individuals have self-control problems—people are tempted to do things that provide immediate satisfaction, rather than sacrificing now for the future. Self-control problems are also persistent among the poor and may lead to negative economic outcomes. Poor households spend a considerable amount of disposable income on entertainment and indulgence goods, including temptation goods such as alcohol and tobacco. As shown by Banerjee and Duflo (2007), for example, poor crop farmers also have difficulty saving even small amounts of money upfront for fertilizers to be used later. Behaviors such as these, which impede economic success, are of utmost interest to policymakers, especially in light of the increasing promotion of credit to the poor. Individuals may overborrow when they do not recognize their preferences for immediate payoffs (Heidhues and Kőszegi, 2010). Alcohol consumption, a result of self-control problems, can even further cause self-control problems in other areas by reducing savings based on a recent randomization study done by Schilbach (2015).

Self-control theory, while useful in many settings, does not account for social influences on individual decision making. In this study, I provide a better explanation to the above myopic behaviors by incorporating peer effects into the self-control theory. I first model peer effects into households' maximization problem and conduct empirical tests in the context of a developing country, where self-control problems may have serious economic consequences. The main research questions I address are: (1) Are households' temptation consumption affected by their peers' temptation consumption? (2) If so, what is the mechanism underlying this relationship?

I begin by including social interactions into the temptation model developed by Banerjee and Mullainathan (2010). I define temptation goods as alcohol, tobacco, and gambling, because data about the consumption of these goods can further inform the scholarly understanding of the potential negative consequences of the self-control problems.[1] Temptation consumption, which is one embodiment of the self-control problem, may further perpetuate poverty, as demonstrated by (Mani et al., 2013). The peer effect that I incorporate into the model of self-control theory is derived from the idea that people want to follow social norms and thus suffer disutility when deviating from that of their peers. My model predicts that peers have a stronger effect on the consumption of temptation goods than on non-temptation

[1] Based on Banerjee and Duflo (2007), alcohol and tobacco are the top items most households wanted to cut back in the expenditure survey in India. Based on the anecdotal fieldwork evidence, those items are appropriate definition for temptation goods in the context of rural Thailand.

goods, especially among observable goods. My model is also able to demonstrate that in the event of a shock at either the household or network level, poor households will consume proportionately more temptation goods than non-temptation goods. Both of these predictions have important implications for a larger range of phenomena, from saving and investment behaviors to poverty trap.

To test my model predictions empirically and examine spending behaviors, I use data from the Thai Townsend Monthly Project, which includes extensive information about household-level consumption and social relationships. I create household-level social network variables by exploiting the data-associated real-world transactions (e.g., borrowing, lending, gift-giving, and labor sharing described in the survey). The extensive network information available in my data helps circumvent several identification challenges that are common concerns in the social interaction literature.

There are many concerns in identifying peer effects. For example, the reflection problem refers to the inability of econometricians to identify the effects of the peer-group behavior on the actions of individuals because individuals, who comprise the network group, can also affect the group behavior (Manski, 1993). Another identification challenge in the social interaction literature is the inability to separate the effects of peer behavior from unobservable correlated shocks and omitted covariates. For example, households in the same village or join the same organization may suffer from the same unobservable shocks that drive their consumption behaviors.

To address the identification challenges, I apply an instrumental approach to identify peer effects using lagged consumption data from an excluded network—friends' of friends who are not linked directly with the focal individual. This approach eliminates the effects of the endogenous unobservable shocks that happen to individuals as well as their peers because these excluded peers do not directly interact with the focal individuals. Another benefit of my approach is that the instrumental variable is time-varying, and thus any time-invariant covariates will not hinder the identification after controlling for individual, village-year, and seasonal fixed effects. The lagged consumption variables prevent the problem of reverse causation or a joint consumption decision.

Overall, I find that household-level temptation consumption, especially the consumption of more observable goods, is subject to strong peer effects. In particular, I find that one bhat increase in peers' temptation consumption leads to 1.5 bhat increase in individual's temptation consumption. The results also indicate that poor households consume a higher share of temptation goods of their marginal dollar than rich households—temptation consumption has a concave shape. This finding confirms the theoretical assertion that poor households are subject to greater cognitive constraints (Chemin et al., 2013; Mani et al., 2013). Further robustness tests reveal that temptation consumption decisions are more strongly influenced by social norms than risk-sharing. In sum, the results indicate that peer effects exacerbate myopic consumption behaviors and suggest that peer behavior is a previously omitted but important social element in models of individuals' consumption decisions.

My study contributes to the current literature in three ways. First, I enrich the behavioral economics literature by incorporating social network effects into models of self-control problems, which until now have heavily focused on an individualistic perspective. This is the first paper to both theorize and empirically validate the social element in the self-control theory using relatively long-term high-frequency consumption data.[2] Second, I construct refined social network information based on real transactions to produce empirical evidence that peer effects emerge as a result of social norms—people tend to conform with average temptation consumption behaviors among their peers. The empirical results contribute to development economics because the mechanism of peer effects has been largely overlooked in this literature, and researchers have often employed a relatively coarse definition of networks (e.g., ethnicity, last name, village). Third, within the policy discussion, these results deepen the understanding of consumption behavior among the poor and suggest policy applications for future financial instruments, as recent financial tools in the microfinance industry attempt to address the self-control problem. One example is a "commitment saving device," which has been shown to help people who are myopic save more (Ashraf et al., 2006). Another example is the establishment of local saving groups (e.g., self-help group[3] in India), which utilize a collective mechanism to overcome individual-level self-control limitations (Gugerty, 2007). The evidence in this paper suggests the need for caution when relying on peer effects to overcome moral hazard issues, because these effects may entail unintended consequences. Socializing with myopic peers can lead an individual to allocate his financial resources more myopically.

The organization of the paper is as follows: Section 2 provides a literature review, and

[2]There are studies on peer effects on consumption, but mostly using administrative yearly data. As consumption data is very noisy, the unique high frequency data collection process at monthly (and some categories at weekly) basis allows us to credibly analyze temptation consumption.

[3]Self-help group (SHG) is an instrument employed to help villagers to save. The practice, originally promoted by local non-governmental organizations in India, has an anti-poverty agenda. SHGs usually comprise 10-20 people, and are mostly for women. Members make regular contributions to the group savings. When a group accumulates sufficient capital, members can borrow from the fund. SHGs aim to improve the financial situations of poor women and increase their economic mobility, especially in locations where formal financial institutions have little market penetration.

highlights the gap in the existing literature. Section 3 describes the theoretical model and the testable predictions generated by the model. Section 4 outlines the data and the variables of interest. Section 5 explains the empirical strategy, while Section 6 discusses the empirical results. I rule out alternative model explanations in Section 7, and discuss the results of several robustness checks in Section 8. Section 9 concludes.

2 Literature Review

This paper contributes to the broader behavioral economics literature on time inconsistency and self-control. The current literature on the myopic behavior is mainly based on individual psychological mechanisms. Battaglini et al. (2005) is the only theoretical papers on self-control that models the influence of peers on individuals' self-control problem. Their model shows that individuals' self-control problems can be either worsened or improved by the peer effect depending on the type of person: people who have sufficient level of self-control - strong type - can positively benefit from interacting with their peers. There are only few empirical studies directly test peer effects on self control, and all of them focus on student population in a developed country. Battaglini et al. (2017) use data from the National Longitudinal Survey of Adolescent to Adult Health (Add Health) to understand high students' self-control level in peer groups. Limited by the data, they use one hypothetical question - Do you usually go with your "gut feeling?" - to measure students' self-control. Similar to Battaglini et al. (2017), Buechel et al. (2014) relies on laboratory experiments and find that students who are more connected have more self-control. The predictions of the current empirical work are based on the key assumption in Battaglini et al. (2005) that agents' types (high or low self-control) are correlated so that peers' actions are informative and can endogenously affect agents' decisions to be in a social group or not. This assumption may not be appropriate in my context[4], so my model takes a different approach without imposing the correlation of types. My research provides empirical evidence based on a relatively long-term consumption data on this matter.

Another related strand of literature is on psychology and poverty. There is emerging research showing that poverty reduces cognitive resources and thus induces disadvantageous economic behaviors (Chemin et al., 2013; Haushofer, 2011; Haushofer et al., 2011; Haushofer and Fehr, 2014; Mani et al., 2013). For example, Chemin et al. (2013) find that rain deficits

[4]In rural Thailand, peers may not be correlated in terms of their self-control types. Villagers interact with peers in farming activities and various social and religious events. That is why I use financial, gift-giving, and labor sharing relations to determine the relevant peer group.

increase cortisol levels among farmers, especially those who are highly dependent on agriculture. Mani et al. (2013) also find shocking evidence that poor farmers' cognitive function decreases before the harvest cycle, as compared with the same farmers after the harvest, when they are rich. This is because poor farmers' mental resources are preoccupied with poverty-related concerns. Similar indications can be found in Shah et al. (2012), who show, through different experiments, that scarcity can consume mental resources. In this paper, I also find that in the face of negative income shocks, poor households' temptation consumption behaviors, which may be driven by their cognitive distress, are also more severe.

The technology adoption literature provides another source of inspiration for this research. In many studies looking at the factors affecting agricultural technology adoption, networks are found to be a key factor for technology diffusion in traditional societies – farmers' decision to adopt new varieties of crops, fertilizer, or new farming practice is related to others' adoption decision (Bandiera and Rasul, 2006; Conley and Udry, 2010; Foster and Rosenzweig, 1995; Maertens, 2017; Moser and Barrett, 2006; Munshi, 2004). This paper uses this intuition to apply social network analysis on individuals' behaviors in managing finance, particularly focusing on their spending behaviors.

Until now, only some studies try to add peer effects to individuals' financial behaviors in developing countries, all from different angles and mostly related to the usage of microfinance products. For example, Banerjee et al. (2013) worked with a local microfinance institution (MFI) in India to understand the effect of peers on microfinance take-up. They find that microfinance participation is highly influenced by information diffusion from the peers with higher eigenvalue centrality, which is a network theory-based measurement of the importance of a person. Breza (2011) used administrative data from an MFI in India. Her analysis indicates high peer loan repayment positively impacts individuals' loan repayment. Cai and Song (2013) study in China also shows a positive peer effect on insurance product take-up, mainly through information diffusion. Similar to Cai and Song (2013), Bursztyn et al. (2013) analyzed people's asset purchasing decisions by manipulating peers' asset purchasing information along with randomized purchasing opportunities to sort out social utility and social learning mechanisms underlying peer effects. Chen et al. (2011) is one of the few studies looking at peer effects on consumption behaviors in rural china. Different from my interest, they focus on gift-giving spending on special occasions as weddings, childbirth ceremonies, and house-moving ceremonies. Although those studies are useful in understanding the decision-making process to promote innovative financial tools[5], the questions remain:

[5]The mechanism of the observed peer effects in the above studies is mostly through information diffusion,

what factors drive the poor mis-allocate their financial resources? Can we find explanations beyond the traditional behavioral theory? This paper focuses on examining peer effects on consumption behavior through risk-sharing or peer pressure, and can enrich this thread of literature by examining people's general behavioral problems in managing finances in developing countries. Previous studies, especially in the randomization setting, use limited peer definition for testing peer effects, while my study categorizes peer networks through different real transaction relationships throughout six years.[6]

The other related literature is peer effects on adolescence' risk taking behavior, such as smoking and alcohol usage (Alexander et al., 2001; Card and Giuliano, 2013; Duncan et al., 2005; Gaviria and Raphael, 2001; Krauth, 2005; Kremer and Levy, 2008; McVicar, 2012; Nakajima, 2007). My scope of analysis is to understand a more general population in a developing country, which may yield guidance on poverty reduction policies. My empirical strategy also differs from what is commonly applied in this literature by exploiting the excluded peer as an Instrumental Variable (IV).[7]

There are also studies focusing on identifying social influence on consumption behaviors on a more general population. But because of the limitation in data collection, most of them use a coarse definition for reference groups based on administrative boundaries in the developed countries. For example,Charles et al. (2009) use the same racial group as the reference group definition in the United States and find that consumption is a way for status seeking. Others also find social influence on households' consumption choice based on different reference group definition such as, postcodes in Netherlands (Kuhn et al., 2011) and city in the U.S. (Ravina, 2005). All these studies suffer from the fact that in the current society, especially in those developed countries studied, people do not form social circles based on geographic or racial boundaries. Unlike in developing countries, people do not even talk to their neighbors, nor do they know or care what their neighbors do. Similar

except for Chen et al. (2011), who found status seeking in gift-giving. Information diffusion is not directly relevant for my context studying temptation goods because those goods are not unfamiliar to the consumers in the study. The local supply of those goods tends to be very stable in the context of rural Thailand, meaning no introduction of new varieties in the market.

[6]Only Banerjee et al. (2013) have collected network information using 13 dimensions, including people whom they go to their home, people whom they would borrow money from, people whom they would have lend material goods, etc. Breza (2011) refers to peers within the same microfinance group. Bursztyn et al. (2013) observe a pair of people who are previously socially connected, and investigate how investor 1's decision may affect investor 2's. Cai and Song (2013) identify peers' learning effect through respondents' potentially listed five close friends.

[7]Among the literature on peer effects and youth's risk taking behaviors, only Duncan et al. (2005) and Kremer and Levy (2008) utilized a randomly assigned roommate situation to achieve a clean causal social interaction effect

to our empirical strategy, Giacomo De Giorgi (2017) use a finer reference group definition to understand peer effects on consumption. They use the so-called distance-3 peer—my co-workers' spouses' co-workers—to instrument peer effects on household consumption from Danish's tax record data. Even though this excluded network approach provides them with the non-overlapping network structure to deal with several identification issues, I argue that as most people usually are not friends with everyone else in the same firm, their definition of the reference group may not capture the real interaction of the peers. Idiosyncratic firm-level shocks, served as the instrument, between the distance-3 notes may still be correlated as spouses usually work in similar industries. Also, people may actually friends with their excluded peers as they often socialize outside of the firm. The definition based on where people work does not provide enough social network information to validate the exclusion restriction. The contribution of my study is that I analyze detailed and diverse consumption categories with an important rural population in a developing country, and that I have captured the true social network relationship beyond the natural physical boundaries (ex: in my case, village) based on long-term real-world transactions.

This paper applies a methodologically innovative IV strategy proposed by Bramoullé et al. (2009) and De Giorgi et al. (2010). They prove that the information from the excluded network (i.e., people's friends' of friends, who are not directly linked with themselves) can be a feasible instrument to solve the reflection (Manski, 1993) and correlated effect (group shock) problems. Peer participation in certain activities is highly endogenous to individuals' participation—it is hard to rule out common unobservable shocks that may happen to a group. For example, in a classroom context, teacher quality is usually the group-level unobservable variable when studying peer effects on students' achievement. In my study, as individuals do not directly interact with the excluded peers, they are not likely to be subject to common group shocks. Ecen in some inevitable situations, for example, weather or economic shocks within the village, those shocks are taken care by the village-time fixed effects. The only way the excluded peers can affect the individual's behavior is through the common peers they know. Another identification challenge, the reflection problem, rises when individuals are exactly the elements that compose the group—reference peer groups do not vary at the individual level. So the peer group's behavioral variable (e.g., temptation consumption) cannot be separately identified from the exogenous covariates (e.g., average group characteristics)—known as contextual effects. Studies using village, ethnicity, or race as the definition of network are not free from this criticism. With this regard, the non-overlapping network information across households in my study can prevent the reflection problem.

New studies take various approaches to the econometric problems. Banerjee et al. (2013) take advantage of a MFI's distributional algorithm information, which makes their identification less subject to this endogenous effect. In their study, since the MFI always targets the same type of people for distributing the initial information, this selection is independent from the social interaction within the village. Breza (2011) has an innovative identification strategy using the timing of the loan to instrument peer's incentive to repay. Cai and Song (2013) solve the endogeneity problem by conducting a randomized experiment where they offer a subset of farmers financial education and examine peer effects on those who are not treated. Bursztyn et al. (2013) also use randomization to understand how investors' asset purchasing decisions can be influenced by information and social utility. The present study does not benefit from randomization but presents a unique opportunity to apply the IV strategy using the information from the excluded network.

In conclusion, this study has several contributions: It adds an important piece to the behavioral economics literature on self-control problems by incorporating peer effects, which are often neglected. In addition, it is the first paper to empirically test peer effects on myopic consumption behaviors using real-world social-network data and consumption data in a developing country. There are very few studies looking at peer effects on individuals' spending behaviors in the developing countries; instead, most of them focus on behaviors in adopting/using microfinance products. My paper also analyzes diverse monthly consumption categories using social network information based on real long-term transactions. Previous studies either use a more coarse social network definition or analyze only a few consumption categories. Finally, the IV strategy plausibly resolves the endogeneity problem, helping to sort out one channel from the other.

3 Social Norm Model

This section presents individuals' consumption behaviors modified by a social norm model. In my model, individuals suffer from disutility when their temptation consumption deviates from the average peers' behavior. The model yields several predictions. First, an individual's temptation consumption is positively related with his peers'. Second, the observability of the goods matters in the social norm model. In addition, individuals' temptation consumption still comoves with their peers', even controlling for the total consumption of peers. Lastly, in the event of negative shocks, peers have positive effects on individuals' consumption.

3.1 Individual Maximization Problem

I assume that there is no information asymmetry within the network among different consumption goods because people in the same social network group have very close financial and social relationships. This assumption can be relaxed later by varying the observability of the goods.

The basic setup follows the model created by Banerjee and Mullainathan (2010). This model provides insights for understanding self-control problems through goods-specific preferences, and it yields similar predictions to a hyperbolic discounting model. Individual i maximizes a utility function that depends on two kinds of separable consumption—temptation goods (z_i) and goods without temptation (x_i). Temptations are consumption urges. For example, alcohol and tobacco are the type of goods that the present self would gain utility by consuming them, but do not gain utility from thinking about future self's consumption in them. This feature yields good-specific impatient behaviors biased toward the present since any temptation consumption left for the future would be viewed as a waste from the present self's point of view. This assumption is reasonable because Schilbach (2015) conducted a randomized experiment in India to offer incentives for sobriety and found that low-income groups exhibits high demand for commitment to increase their sobriety.

This model also assumes a concave temptation function ($z(.)$). This assumption also implies different levels of myopia for the rich and the poor[8]—the poor behave as if they were more myopic than the rich. This set-up allows us to capture the fact that the poor may discount their lives very differently from the rich because of the larger uncertainty in life.

To simplify the maximization problem, individual i lives for only two periods. There are no savings in the last period. The period 1 self maximizes $u(x_1) + v(z_1) + \delta u(x_2)$, where δ is the discount factor. The period 1 self gains utility from both goods consuming in the first period, but gets discounted utility from x goods consuming only in the second period. This setup fits the property of the temptation goods, which individuals cannot resist "now," but do not appreciate the future self to consume. The temptation goods generate utility only

[8] I did not use the standard hyperbolic discounting model, or Battaglini et al.'s (2005) self-control model, because I do not have the direct behavioral variables to conduct relevant empirical tests derived from these models. In Battaglini et al.'s (2005) model, they separate people into different types—people with strong will who are less subject to self-control and people with weak willpower who more easily have self-control problems. They derive equilibrium group behavior by incorporating peer interactions into the model. This model is theoretically useful and related to my research question, but there is not enough information in these data to conduct empirical tests based on this model. At the same time, based on my fieldwork experience, the temptation framework is more reflective of the reality, which can also be viewed as an extreme version of hyperbolic preferences over temptation goods.

at the point of consumption. There is a disagreement of the composition of consumption between the current self and the future self. From period 1 self's point of view, any money left for temptation spending in the second period would be a waste.

Apart from utility gaining from consumption, individual i also cares about how he appears within a group. People worry about behaving differently than the majority. In other words, people gain "social rewards" by conforming with others. This conforming behavior is examined within the social group that people belong to. Thus, I use the deviation function, denoted as $\Phi(.)$, to capture the deviating payoff from the group behavior. The behavior of the majority can be viewed as a "social norm."

Therefore, individual i in a social network group g has the following maximization problem:

$$\max_{x_{1i},z_{1i}} u(x_{1i}) + v(z_{1i}) + \chi[\Phi(z_{1i}, \overline{z_{1-ig}})] + \delta u(x_{2i}(c_{2i})) \tag{1}$$
$$\text{s.t. } A_{2i} = (1+r)(\theta_{1i}y_{1i} - x_{1i} - z_{1i})$$

where $u'()$ and $v'() > 0$; $u''()$ and $v''() < 0$. At the same time, $v''()$ is assumed to be smaller than $u''()$. Both goods have a concave shape, but temptation goods have a more concave shape than non-temptation goods. It means that, as income/consumption increase, the marginal utility from temptation goods decreases much faster for temptation goods than non-temptation goods. This assertion indicates that the proportional spending on temptation goods over total spending should decrease as the total consumption increases. Temptation goods give people large marginal utility for the first few units (say, drinking sips of alcohol or eating a portion of a donut), but the marginal utility decreases drastically after the immediate urge is satiated.

In the constraint equation, A_{2i} is the savings available for the second period; r is the asset return; c_{2i} is the total consumption in the second period; y_{1i} denotes i's income at period 1; θ_{1i} represents exogenous idiosyncratic shock on i's income at period 1. In the second period, the period 2 self will maximize utility from consuming both goods and deviation payoff as defined before. At the last period, this consumption decision is subject to a budget constraint (i.e., $z_{2i} + x_{2i} = c_{2i}$, where $c_{2i} = A_{2i} + y_{2i}$). I can also write x_{2i} and z_{2i} into functions $x_{2i}(c_{2i})$ and $z_{2i}(c_{2i})$. χ describes the observability of the behavior, and is positive. The third term is associated with the payoff of self-image. $\overline{z_{1-ig}}$ is the average temptation consumption of i's group member at period 1 except individual i's. Here, I assume that people weight each member's behavior in the group equally. In other words, they would like to appear to be social by acting in line with the group expectation. Peer's temptation consumption is assumed to be exogenous, and depends on the income shock of the social network group. The assumption of this deviation function is that $\frac{\partial\Phi(z_i,\bar{z}_{-ig})}{\partial|z_i-\bar{z}_{-ig}|} < 0$—the more individual i deviates from the group behavior, the larger the disutility is.

To simplify the maximization problem, let $\Phi(z_i,\overline{z_{-ig}})$= - $\frac{1}{2}(z_i-\ \overline{z_{-ig}})^2$. This functional form is also used in Akerlof and Kranton (2002), where it captures student's utility loss from deviating from the predetermined ideal effort of the social category they belong. If the majority of group members consume a great deal of temptation goods, individual i will have an undesirable feeling about himself if he consumes a small amount. The quadratic form weights deviation above and below equally, and can be imagined as social distance. Thus, if the behavior is highly observable (χ is large), an individual's temptation consumption is expected to be in accordance with his peers' behavior. The maximization problem can be written as

$$\max_{x_{1i},z_{1i}} u(x_{1i}) + v(z_{1i}) + \chi\left[-\frac{1}{2}(z_{1i}-\overline{z_{1-ig}})^2\right] + \delta u(x_{2i}(c_{2i})) \tag{2}$$

$$\text{s.t. } A_{2i} = (1+r)(\theta_{1i}y_{1i} - x_{1i} - z_{1i})$$

Because $x_{2i}(c_{2i}) = x_{2i}(A_{2i}+y_{2i}) = x_{2i}[(1+r)(\theta_{1i}y_{1i}-x_{1i}-z_{1i})+y_{2i}]$, and at the same time, $z_{2i}+x_{2i} = c_{2i}$, the first-order conditions with respect to z_{1i} and x_{1i} are:

$$v'(z_{1i}) - \chi(z_{1i}-\overline{z_{1-ig}}) + \delta u'(x_{2i})\left(\frac{\partial x_{2i}}{\partial c_{2i}}\right)\left(\frac{\partial c_{2i}}{\partial z_{1i}}\right) = 0 \tag{3}$$

$$u'(x_{1i}) + \delta u'(x_{2i})\left(\frac{\partial x_{2i}}{\partial c_{2i}}\right)\left(\frac{\partial c_{2i}}{\partial x_{1i}}\right) = 0 \tag{4}$$

Assuming a constant absolute risk aversion (CARA) functional form helps clarify the comparative static. $u(x) = -\frac{1}{\theta_x}e^{-\theta_x x}$ and $v(z) = -\frac{1}{\theta_z}e^{-\theta_z z}$. In addition, since $\frac{\partial c_{2i}}{\partial z_{1i}} = -(1+r)$ and $\frac{\partial x_{2i}}{\partial c_{2i}} + \frac{\partial z_{2i}}{\partial c_{2i}} = 1$, equation 3 becomes

$$z_{1i} - \frac{1}{\chi}e^{-\theta_z z_{1i}} = \overline{z_{1-ig}} - \frac{1}{\chi}(1+r)\delta e^{-\theta_x x_{2i}}\left(1-\frac{\partial z_{2i}}{\partial c_{2i}}\right) \tag{5}$$

3.2 Predictions

The model generates the following comparative statics, where the full proofs refer to Section 9.

Prediction 1: *An increase in peers' temptation consumption will lead to an increase in individual i's temptation consumption as long as the behavior is observable* ($\frac{\partial z_{1i}}{\partial \overline{z_{1-ig}}} > 0$ *if*

$\chi > 0$).

The main interest here is to analyze $\frac{\partial z_{1i}}{\partial \overline{z_{1-ig}}}$. The prediction is driven by the deviation function. As long as the consumption behaviors are observable, an increase in peers' temptation consumption will lead to an increase in individual i's temptation consumption because people suffer from behaving differently from their group norm.

Prediction 2: *Peer effect is stronger in temptation consumption, rather than in non-temptation consumption* $\left(\frac{\partial z_{1i}}{\partial \overline{z_{1-ig}}} > \frac{\partial x_{1i}}{\partial \overline{x_{1-ig}}}\right)$.

On the contrary, individuals' non-temptation consumption is not affected by their peers based on the implication of equation 4. This prediction is straightforward by my model construction. Suppose that peers' consumption on temptation ($\overline{z_{1-ig}}$) and non-temptation goods ($\overline{x_{1-ig}}$) are exogenous, individual's non-temptation consumption would not be affected by their peers.

Prediction 3: *Peer effects on temptation consumption are stronger when peers' consumption behaviors are more observable* $\left(\frac{\partial^2 z_{1i}}{\partial \overline{z_{1-ig}} \partial \chi} > 0\right)$.

This observability can be used to distinguish the magnitude of peer effects between consuming different types of goods. If peers' temptation consumption behaviors are more observable (higher χ), individuals' temptation consumption correlates more with their peers'. Based on the model prediction, social norms do not apply universally, but seem to be attached with the visibility of that behavior.

Prediction 4:
When individuals are poor, negative idiosyncratic shocks will increase total consumption ($\frac{\partial z_{1i}}{\partial \theta_{1i}} < 0$, *and* $\frac{\partial x_{1i}}{\partial \theta_{1i}} < 0$ *as consumption (c) is small);*
If one poor peer encounters adverse shock, other things being equal, this negative peer's shock has a positive impact on temptation consumption.[9]

Another focus is the comparative static of consumption with respect to shocks – θ_{1i}. Assuming that θ_{1i} is exogenous, it is possible that an individual would consume more temptation goods when encountering negative income shock. That is, $\frac{\partial z_{1i}}{\partial \theta_{1i}} < 0$ over a certain range of consumption. The reason for this property can be seen from equation 3 without applying any functional form in the mathematical appendix in Section 9.

[9] I can show this intuition based on specific assumptions, but the aggregate effect of peers' shock cannot be generally proved.

The intuition can be viewed as increasing psychological barriers for the poor. The negative shock would make poor people be more desperate and less patient in consuming more now, rather than saving for the future. Many studies have found that poverty (or broadly speaking, scarcity) is associated with higher stress level, leading to worse cognitive performances (Chemin et al., 2013; Haushofer, 2011; Haushofer et al., 2011; Mani et al., 2013; Shah et al., 2012).

Following a similar logic, if one poor peer encounters negative income shock, assuming other things being equal, this effect will push up peers' average temptation consumption. Based on prediction 1, this increase in peers' average temptation consumption will further increase own temptation consumption.

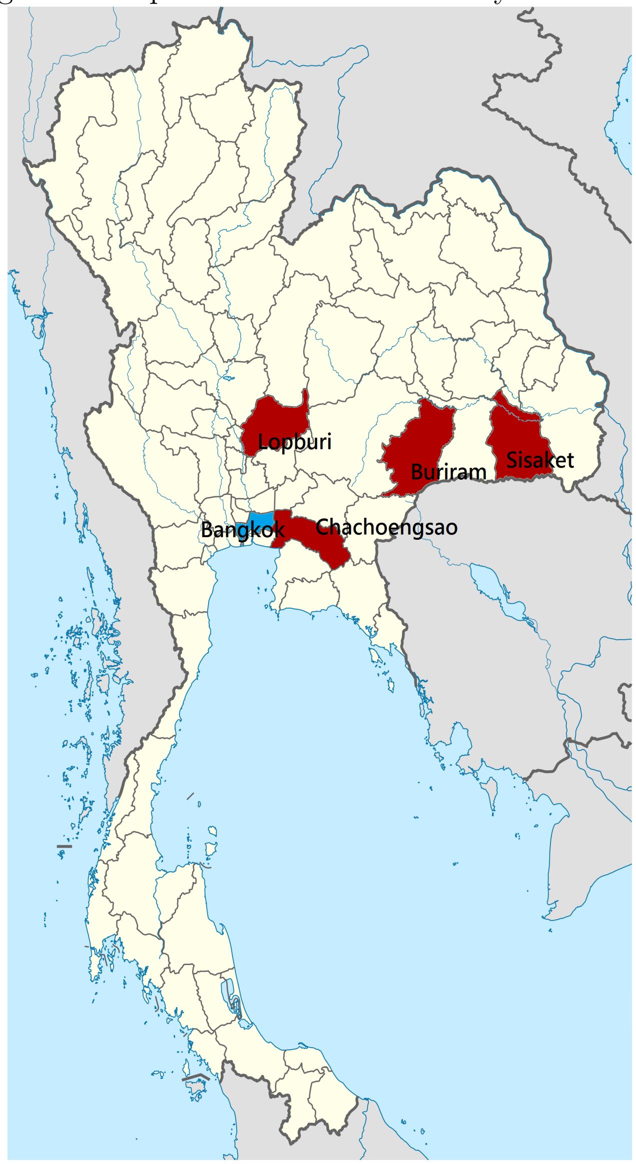
In conclusion, I will be able to distinguish the mechanisms using the following predictions (An alternative risk-sharing mechanism is presented in the robustness check section. The comparison of predictions is in Table 1): (1) Peer effects happen mainly through temptation consumption. After controlling for peers' total consumption, peer effects on temptation consumption should still be significant based on the social norm model. (2) Peer effects are stronger in temptation goods than that in non-temptation goods. (3) The observability of consumption should matter if peer effects are through social norms. (4) Individuals' negative shock will have a counterintuitive positive effect on consumption because of the concave shape of temptation consumption among the poor. Poor peers encountering negative shocks should also create a similar positive effect on temptation consumption through social norm mechanism.

4 Dataset and Variables of Interest

4.1 Dataset Description

The study uses data from the 1999 to 2004 monthly waves of the Townsend Thai Monthly Survey. The continuously observed sample size is 480 in all 72 months. The survey was conducted in 16 villages, four in each of four separate provinces. As Figure 1 shows, two provinces (Chachoengsao and Lopburi) are close to Bangkok, and the other two (Buriram and Sisaket) are in the northeastern rural region close to the Cambodian border. The success rate of the survey (the number of households that were successfully surveyed out of the total number of households in each month) is at least 93%. However, because some households migrate permanently during the survey period, they are replaced by other randomly selected households in order to make the sample representative of the village.

Figure 1: Map of Thailand with Surveyed Provinces



The data include households' demographic characteristics, expenditure, and income. There is also detailed information on financial, gift exchange, and labor-sharing relationships. All these transactional relationships are time-varying. The monthly temporal scale is a valuable feature of the dataset since consumption data are difficult to recall, and the frequent data collection reduces measurement error. In addition, the expenditure information is comprehensive, including categories such as various food items, oil and fat, sugar and sweet, beverages, alcohol, tobacco, gambling, etc.

4.2 Social Network Data

One of the main strengths of this study is the actual, rather than a proxy for, social network with whom people truly interact. I categorize household-level social networks using their transactions, including borrowing and lending, gift-giving, and labor sharing over a long period of time. This definition of the peer group is appropriate because financial transfers and gift-giving in Thai villages are prevalent among family and friends (Kinnan and Townsend, 2012). Also, in the data, households exchange labors to their neighbors, relatives, and friends[10]. Households who have ever had any of these relationships within the survey period are categorized as being connected. The social network is defined by the aggregation of all the transaction relations a household i has through financial relationships, gift exchange, and labor-sharing relationships over the survey period. Because transactions do not necessarily occur instantaneously, collapsing the time variation of these three available relations in the data helps us capture the most of the peers with whom households have close relationship.

This time-invariant definition captures all the social relations people may have even though there is no transaction observed in a specific period. I construct a matrix called $\mathbf{G}$, where $\mathbf{G}_{ij} = 1$ if household i is linked with j, for any $j \neq$ i. Since there is no further information to establish the weight of the peers, I put the same weight on each linked pair. Here I assume symmetry ($\mathbf{G}_{ij} = \mathbf{G}_{ji}$). If a household is linked in one direction, I assume that they can be linked in the other way around. For example, i reports that he/she has borrowed from j, so j should be within i's social network ($\mathbf{G}_{ij} = 1$). However, it may happen that j did not report i in any of the social relations. It is very likely that i is indeed within j's social network as well, but j forgets to report his relationship with i. It is less possible that i lies about his relationship with j. Although Schechter and Yuskavage (2011) show empirically that social networks with reciprocated relationships may have different features from those with unreciprocated relationships, their result does not provide a prior on how this might affect temptation consumption. In addition, their definition of reciprocal is whether money flows in both directions, while mine is whether both parties agree on the relationship. This asymmetry assumption is reasonable to capture maximum network interactions based upon the best available information in this data.

This definition of the reference group is credible comparing to the existing consumption literature with several reasons. First, the network is measured based on the "revealed

[10]In the data, households were asked to identify those who they have labor sharing relationship with, and then explain the nature of the relationship, for example, neighbor, relatives, or friend. Households are not directly asked to list their friends in the survey.

transactions," rather than stated relations or naturally formed boundaries. Based on our real-world transaction relations, I can capture those who people spend time with through labor sharing relations, and those who people actually care enough to involve monetary transactions with. This reference group definition is appropriate for examining consumption behaviors as people may not be friends or be influenced by the people from those naturally formed relations, such as neighbors, blood relations, or co-workers as defined in the literature. The repeated monthly observations also reduce the recalling measurement errors happened in stated relations. Second, the richness of the household-level network information improves the identification. The household-varied network definition ensures our social network groups not perfectly overlapped, and the network structure beyond the village definition allows me to control for unobservable village-level time-varying shocks. The high frequency collection of the data makes sure that using the excluded network is a valid IV approach. One concern in Giacomo De Giorgi (2017)'s excluded peers definition is that people may actually know each other if they socialize beyond the firm's context. Even though our network definition can still exist measurement errors, it is reassuring that if two households have never had any transactions with each other in any of the 72 months, they are not likely to know or even care with each other to exhibit a peer effect—the exclusion restriction condition of using excluded peers' consumption as an IV is satisfied. Third, our network measure in the context in a developing country is relatively more credible than that in a developed world. In the context of developing countries, for example, in rural Thailand, people seldom socialize with those who are far away because of monetary or technological barriers. So the social relations captured within a village in my context is more complete than that in an urban developed world[11].

4.3 Key Variables of Interest

The key outcome variable is the expenditure on temptation goods. Since the detailed monthly survey provides the possibility of separating consumption into different categories, I use household's expenditure on alcoholic beverages (at home), alcoholic beverages (consumed away from home), tobacco, lottery, and gambling.

The key explanatory variable is consumption spending of the people within the network. I calculate mean temptation consumption within household i's network ($\overline{z_{-ig}}$) as the proxy

[11] With the prevalence of social media, people can socialize on line with others in another country. So in this context, social network measure is harder because even if we capture everyone's network information within a city, we still miss a large amount of the information outside of this geographic boundary.

for this. The mean temptation consumption for household i's network is the aggregate household j's temptation consumption conditional on the information of $\mathbf{G}$ and divided by the network sample. Other explanatory variables, for example, peers' shock variable, are defined similarly. Peers' health shock, which is used as a proxy for income shock θ, is the aggregate household j's days of sickness per capita conditional on the information of $\mathbf{G}$ and divided by the network sample size.

4.4 Summary Statistics

Summary statistics from the Thai dataset are presented in Table 2. It is worth noting that households spend a significant amount on temptation goods, which consists of seven percent of total consumption on average. The yearly expenditure on temptation goods is equivalent to households' average yearly spending on education. Figure 3 shows that there is variation among different households in terms of their spending on temptation goods.

Among the total 480 observations, 374 people can be linked with at least one peer within the same tambon (an administrative level above village). On average, the network size is five, mostly neighbors and relatives.

Table 3 shows simple correlations of the characteristics between villagers and their peers. People within the same network have similar income level, household size, and percentage of their agricultural income. The correlation on the percentage of agricultural income is especially strong. This implies that people tend to have networks composed of individuals with the same occupation. This may be because people who have labor-sharing relationships are specialized in the same economic activity. In terms of idiosyncratic health shock, peers' health shock is much less correlated.

5 Empirical Strategy

5.1 General

The focus of the analysis is the relationship between peers' and individuals' spending on temptation goods. The equation of interest is

$$temp_{ivst} = \alpha_0 + \alpha_1 temp_{G_i vst} + \alpha_2 X_{G_i vst} + \alpha_3 X_{ivst} + h_i + season_s + f_{vt} + \epsilon_{ivst} \tag{6}$$

$temp_{ivst}$ is the per capita monthly consumption of temptation goods of household i in village v season s at time t, with a peer group G_i, on alcoholic beverages (at home), alcoholic beverages (consumed away from home), tobacco, lottery, and gambling. $temp_{G_ivst} = \frac{\sum_{j \in G_i, j \neq i} temp_{jvst}}{N_{G_i}}$ is the average consumption of temptation goods of i's peer group net of i's spending; N_{G_i} is the number of peers of household i, which is a fixed composition over time. The group-level temptation consumption does not include self's consumption. Mace (1991) uses this same strategy to test risk-sharing theory.[12] Here because of CARA definition, as well as all the zeros in temptation consumption, all the consumption variables are in levels instead of logs. X_{G_ivst} is a vector of group characteristics—also known as the contextual effect. X_{ivst} is a vector of controls for household characteristics. ϵ_{ivst} is the error term.

I further control for different fixed effects: h_i are household fixed effects in order to control for time-invariant household fixed demographic characteristics; $season_s$ are seasonal fixed effects, which can eliminate any seasonal consumption pattern that could be confounded with the peer effects of interest; for example, people may consume more alcohol during a certain festival that happens at a certain season of the year. Village-year fixed effects (f_{vt}) are also taken into account to prevent from capturing a systematic consumption pattern at the village-year level. After controlling for these necessary covariates, my identification comes from a household's peers' time-variant change in consumption within the same village-season-year.

The parameter of interest is α_1, which is expected to be greater than zero. However, α_1 may not be identified under this equation because of endogeneity. This reflection problem may happen when the endogenous effect $temp_{G_i}$ is a linear combination of all other regressors, and thus the endogenous effect is entangled with the exogenous effect, also called the contextual effect in the literature (Brock and Durlauf, 2001; Manski, 1993). For example, if people within a small village are peers, we will not be able to identify α_1 because the group characteristics cannot be distinguished from the endogenous group behavior. In that case, α_1 cannot be distinguished from α_2, and is not identified.

In addition, it is likely that people select their peers/friends. The peer effect may be subject to unobservable individual characteristics because individuals' decisions on peer selection will explain why they behave similarly to their peers. For example, if individuals with self-control problems like to be with people who consume a great deal of temptation goods, researchers may mistakenly think that peers' behaviors have perverse effects on individuals. The other issue is the omitted group-level unobservables. This can be viewed as a correlated effect. That is, the observed network effect may simply confound with the common group

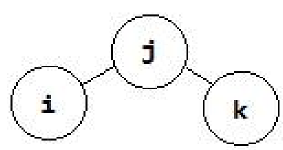
[12]It is comparable at the end to rule out risk-sharing explanation using the same specification, but different empirical predictions (see more in Section 7.1).

shock that network members encounter and cannot be observed by econometricians. For example, if people within the same social network celebrate a special event that may affect everyone's consumption behavior. Econometricians failing to observe that common group shock may misinterpret this consumption comovement as peer effects. In addition, the decision of individuals and the peers' decision can be made simultaneously, which can also lead to the failure of identification.

5.2 Instrumental Approach

De Giorgi et al. (2010) and Bramoullé et al. (2009) propose an innovative approach to solve the problem of reflection and endogeneity. The main idea is to use household i's excluded peers as an IV strategy. As Figure 2 shows, households i and j interact with each other; households k and j interact with each other, but households k and i do not interact with each other. i's peer group (defined as G_i) includes all j. The excluded peer, household k, is in the network group with j, but not in the network group with i. Thus, i's excluded peer group (defined as K_i) includes all k, where k has to satisfy $k \in G_j$ and $k \notin G_i$. The information of the excluded peer group K_i can thus be used as the instrument since j's peer group does not coincide with i's peer group.

Figure 2: Network illustration



As long as individuals' relevant peer groups are not totally overlapped, I can identify peer effect using this strategy. If all social groups have the same size, or totally overlapped, peer effects are not identified (Bramoullé et al., 2009). Since in my analysis each individual has different peer groups and each group has different sizes, $temp_{G_i}$ cannot be a linear combination of all other regressors. This solves the reflection problem.

In addition, this strategy can eliminate the correlated effect because i and the excluded peer k do not directly interact with each other. The excluded peer will not be correlated with the unobservable shocks at the group level as the excluded group K_i is not subject to the unobservable effect within i's network. This property makes the excluded peer's information fulfill the exclusion restriction requirement. Even under the weaker assumption that i and j have a stronger interaction with each other than i and k, the peer effect can still be identified.

De Giorgi et al. (2010) show that even with some extent of measurement error (i.e., k may in fact interact with i), the estimation is still unbiased. Also, any unobservable shocks at the village level can be taken care by the village-time fixed effects.

To further address the simultaneity problem, I use lagged consumption behaviors as the instrument. It is plausible to assume that an individual's contemporary decision cannot affect peers' previous consumption. Also, for the lagged instrument to work, I need an assumption that this spillover effect of consumption behaviors take some time for one to adopt. The monthly lag is a reasonable assumption because empirical data shows that consumers' utility can exhibit some level of habit formation—a theory which captures the fact that current utility depends on current consumption relative to the lagged consumption, and thus cause the delay of consumption response to shocks (Fuhrer, 2000). I use habit formation to justify my empirical strategy, but do not explicitly incorporate it into the theoretical model because this part of modeling is beyond the scope of this paper. Nevertheless, I test this assumption using a more symmetric time frame in the robustness check section.

With respect to self-selection into groups, I assume that social group formation in the village is not perfectly linear with an individual's decision making on consumption conditional on the observables. Since the selection criteria of the social group are based on financial, gift-giving, and labor-sharing relations, it is unlikely that these relations coincide with people's consumption behavior after controlling for household characteristics.

The first-stage regression for the peer group is

$$temp_{G_ivst} = \beta_0 + \beta_1 Z_{K_ivst-1} + \beta_2 X_{G_ivst} + \beta_3 X_{ivst} + h_i + season_s + f_{vt} + \eta_{G_ivst} \tag{7}$$

where $temp_{G_ivst}$ is the average spending amount on temptation goods of i's peer group G_i in village v season s at time t; Z_{k_ivst} is the average temptation consumption of individual i's excluded peer group K_i in village v season s at time $t-1$; X_{G_ivst} are peer attributes; X_{ivst} are appropriate household controls; h_i are household fixed effects; $season_s$ are seasonal fixed effects; f_{vt} are village-year fixed effects; and η_{G_ivst} is the error term.

The second-stage regression is

$$temp_{ivst} = \delta_0 + \delta_1 te\hat{m}p_{G_ivst} + \delta_2 X_{G_ivst} + \delta_3 X_{ivst} + h_i + season_s + f_{vt} + \varepsilon_{ivt} \tag{8}$$

$temp_{ivst}$ is the per capita monthly temptation consumption of household i in village v season s at time t; h_i are household fixed effects; $season_s$ are seasonal fixed effects; f_{vt} are village-year fixed effects. The rest of the variables are the same as in equation 9. The main interest is δ_1, which is hypothesized to be greater than zero.

5.3 Empirical Predictions for Social Norm Mechanism

In addition to the prediction on δ_1, the theory also generates several other predictions, which I reiterate in this section. All the regressions are estimated using the instrumental technique proposed in Section 5.2.

Peer effects on temptation: Based on Prediction 1, peers' temptation consumption should affect individual's. $\delta_1 > 0$ in equation 8. This peer effect should still be significant even after controlling for peers' total consumption. This property can be helpful to distinguish from the alternative mechanism: risk sharing. The predictions of the alternative risk-sharing theory will be presented in Section 7.1. For example, I estimate the following specification:

$$temp_{ivst} = \gamma_0 + \gamma_1 temp_{G_ivst} + \gamma_2 cons_{G_ivst} + \gamma_3 X_{G_ivst} + \gamma_4 X_{ivst} + h_i + season_s + f_{vt} + \varepsilon_{ivst} \quad (9)$$

where $cons_{G_ivst}$ is the average per capita monthly total consumption of household i's peer group G_i in village v season s at time t. Therefore, $\gamma_1 > 0$.

Non-temptation consumption v.s. temptation consumption: Replacing temptation consumption with non-temptation consumption in equation 6 can also help distinguish motivations. Based on Prediction 3, the coefficient of peers' temptation consumption should be greater than that of peers' non-temptation consumption if the mechanism is through social norm. The logic here is that the social-norm model predicts that people imitate peers' temptation consumption, rather than regular (non-temptation) consumption. Run the following regression:

$$nontemp_{ivst} = b_0 + b_1 nontemp_{G_ivst} + b_3 X_{G_ivst} + b_4 X_{ivst} + h_i + season_s + f_{vt} + \xi_{ivst} \quad (10)$$

where $nontemp_{ivst}$ is the per capita monthly non-temptation consumption of household i in village v season s at time t, and $nontemp_{G_ivst}$ is the average per capita non-temptation consumption of household i's peer group G_i in village v season s at time t. b_1 is expected to be less than δ_1.

Observability: According to Prediction 3 from my model, peer effects are stronger for temptation goods that are more observable. Higher observability (χ) of peers' temptation consumption may induce a larger conformity effect on own temptation consumption because of the larger utility loss of deviating from others. For example, alcohol consumption outside is more observable than alcohol consumption at home.

$$\begin{aligned} alcoholTOTAL_{ivst} = & \gamma_0 + \gamma_{temp_H} alcoholHOME_{G_ivst} + \gamma_3 X_{G_ivst} + \gamma_4 X_{ivst} + h_i \\ & + season_s + f_{vt} + \varepsilon_{ivst} \end{aligned}$$

$$
\begin{aligned}
alcoholTOTAL_{ivst} = &\gamma_0 + \gamma_{temp_O} alcoholOUT_{G_i vst} + \gamma_3 X_{G_i vst} + \gamma_4 X_{ivst} + h_i \\
&+ season_s + f_{vt} + \varepsilon_{ivst}
\end{aligned}
$$

where $alcoholHOME_{G_i vst}$ is the average per capita alcohol consumption at home of household i's peer group G_i in village v season s at time t; $alcoholOUT_{G_i vst}$ is the average per capita outside alcohol consumption of household i's peer group G_i in village v season s at time t; $alcoholTOTAL_{ivst}$ is household i's total alcohol consumption, including at home and outside, in village v season s at time t.

In the above equation, the coefficient of peers' temptation consumption outside should be greater than that of peers' temptation consumption at home because the former is more observable than the latter. Thus, γ_{temp_O} is expected to be greater than γ_{temp_H}.

I also run similar specification, but using $alcoholHOME_{ivst}$ as the dependent variable, where $alcoholHOME_{ivst}$ is household i's per capita alcohol consumption at home in village v season s at time t. This specification is to test whether this consumption norm has spillover effects on households' own alcohol consumption at home. I expect similar prediction that γ_{temp_O} is greater than γ_{temp_H}.

Shock event: Idiosyncratic shocks cause different effects on individual's consumption (Prediction 4 in Section 3.2). In the social norm model, the shape of the temptation would matter because people face trade-offs between the present and the future period. At the consumption level where individuals are myopic, positive (negative) shock would have a negative (positive) effect on consumption, especially for the poor (i.e., $\beta_{temp2} > 0$, $b_{nontemp2} > 0$). Here the larger the shock variable ($shock_{ivst}$), the worse the shock is. At the same time, poor peers' shock would have the same effect on temptation consumption through social norms mechanism (i.e. $\beta_{temp1} > 0$):

$$
\begin{aligned}
temp_{ivst} = &\beta_0 + \beta_{temp1} shock_{G_i vst} + \beta_{temp2} shock_{ivst} + \beta_{inc} poor_{ivst} \\
&+ \beta_c poor_{ivst} shock_{ivst} + \beta_3 X_{G_i vst} + \beta_4 X_{ivst} + hi + season_s + f_{vt} + \epsilon_{ivst}
\end{aligned}
$$

$$
\begin{aligned}
nontemp_{ivst} = &b_0 + b_{nontemp1} shock_{G_i vst} + b_{nontemp2} shock_{ivst} + b_{inc} poor_{ivst} \\
&+ b_c poor_{ivt} shock_{ivst} + \beta_3 X_{G_i vst} + b_4 X_{ivst} + hi + season_s + f_{vt} + \epsilon_{ivst}
\end{aligned}
$$

where $shock_{ivst}$ is per capita average days of health shock of household i in village v season s at time t, $shock_{G_i vst}$ is the aggregate days of health shock among household i's peers G_i who are under the poverty line in village v season s at time t, excluding household i's own shock, and $poor_{ivst}$ is household i's poverty status in village v season s at time t. Notice that I do not further control for the number of friends, because it does not change over time and I have controlled for household fixed effects (h_i). But peers' poverty status can be different over time, so I further control for the time-varying number of poor peers as a comparison.

Since idiosyncratic shock has a positive impact on people's consumption when people are poor enough, the shock and poor interaction term should be positive ($\beta_c > 0$ and $b_c > 0$). Poor people appear to be more myopic so that shock would have a positive impact on their consumption.

6 Empirical Results

Almost all the results using the instrumented social network information support the theory of social norm. In most of the cases, the instrument is valid with very high F-statistics in the first stage.[13] The results using instrumental variables are similar to that using OLS. Even though some observations are missing using the excluded network as instruments, this consistency yields high confidence of the results.[14]

6.1 Peer Effects on Temptation and Non-temptation

Table 4 presents the OLS and IV results. The coefficient in column 3 of Table 4 indicates that own temptation consumption is affected by peers, and the magnitude of peer effects on temptation consumption is also remarkable. One extra baht of peers' average monthly spending on temptation goods can lead to 1.5 bahts of individual's temptation consumption in the IV specification using clustered standard errors, wild clustered bootstrap adjustment, and robust standard errors without clustering (not shown here). Because of the weak instrument, I further test the results using the Conditional Likelihood Ratio test, which reports reliable results under a weak instrument. The results remain robust as the CLR test suggests positive confidence intervals.

The coefficients in the IV specification are higher than the OLS coefficient. It means that the correlated effect (in the disturbance term) that OLS coefficients pick up actually runs in the opposite direction from the peer effect. The higher IV is not unique in this study

[13]The exception is in the table analyzing peer effects on temptation and non-temptation consumption. The F-statistics in the first stage are not high because peer effects do not happen in non-temptation consumption. With respect to the weak instrument for temptation consumption, I further use the Conditional Likelihood Ratio (CLR) test to report the robust confidence intervals under weak instrument. According to Andrews et al. (2008), CLR test is more optimal than Anderson and Rubin (AR) statistics and LM statistics, which are both robust statistics under weak instrument.

[14]In order to use a friend of a friend as the instrument, there should exist such kind of third person k between two people, say, i and j. However, there is a missing instrument for the case when i is the only friend of j, and at the same time, j is the only friend of i.

as De Giorgi et al. (2010) also found this similar result. They explain that each unobservable common shock can have a different sign, so OLS coefficients are not unambiguously larger than the IV estimators. In addition, the peer group is not perfectly overlapped, so the simultaneity issue is much eliminated in the OLS case compared with using a totally overlapped social network definition.[15] Caeyers and Fafchamps (2015) further introduce the so-called "exclusion bias" to explain why OLS estimates of endogenous peer effects are larger than their estimated IV counterparts. They illustrate that the exclusion bias occurs naturally when researchers exclude individual itself from its own peers, and this construction will create a downward bias in the OLS estimate, rather than an upward bias. For example, if individual i has a higher than average ability relative to its peers, excluding i will make the average ability of i's peers lower, resulting in a negative correlation between i's characteristics and the average characteristics of i's peers. The other reason of the relatively larger IV estimators than OLS estimators can be due to my weak instrument. This lower correlation between instrumental and instrumented variables can inflate IV estimators. Columns 1 to 4 show that the coefficients of peers' temptation consumption are higher than that of peers' non-temptation consumption. Since the signs of the coefficients using IV and OLS regressions are in the same direction, these results corroborate the social norm mechanism that individuals suffer from disutility when deviating from the average temptation consumption of their peers.

Columns 5 and 6 of Table 4 present the consumption relationship between own and peers, but controlling for peers' total consumption. This test aims to rule out the alternative risk-sharing hypothesis where peer effects should go away once controlling for peers' total consumption (a detailed explanation of the prediction on alternative risk-sharing mechanism is presented in Section 7.1). The results serve as another piece of evidence to support social norm mechanism: peer effects on temptation consumption remain positive and significant when controlling for peers' total consumption. The coefficient on peers' temptation consumption is around 1.6. The coefficient on peers' non-temptation consumption is much smaller and insignificant controlling for peers' total consumption. All the results in Table 4 are consistent with Predictions 1 and 2 in social norm theory.

[15]For example, if one uses village as the social network definition, then, within a network, everyone's social network overlaps entirely. The aggregation of each individual within the network group comprises the group itself.

6.2 Observability

Table 5 presents peer effects of alcohol consumption at home versus alcohol consumption outside. The results support Prediction 3 in the social norm theory—peer effects are much more significant among more observable consumption. Columns 1 to 4 show the effects of peers' alcohol consumption outside versus peers' alcohol consumption at home on household's total alcohol consumption. Columns 1 and 2 present the results from OLS specification, and columns 3 and 4 present the results from IV specification. The results indicate that the coefficients of peers' alcohol consumption outside are stronger than that of peers' alcohol consumption at home—consistent with the social norm theory. It is worth noting that the instrument on peers' alcohol consumption at home is relatively weak, and therefore the coefficient may be inflated. The weak instrument issue is not worrisome nonetheless because peers' alcohol consumption at home is less observable and thus generate smaller peer pressure. By comparing the OLS coefficients in columns 1 and 2, I am confident that peers' alcohol consumption outside have qualitatively stronger influence than peers' alcohol consumption at home. Columns 5 and 6 are the coefficients of peers' alcohol consumption on household's home consumption. As expected, columns 5 and 6 have similar results as in columns 3 and 4, given that this social norm of peers' drinking behavior should have spillover effect on household's home alcohol consumption. Columns 7 and 8 present similar analysis as in columns 3 and 4, but controlling for peers' total consumption. The coefficient on peers' alcohol consumption outside is qualitatively larger and more statistically significant than that at home after controlling for peers' total consumption. Overall, one extra baht of peers' average monthly spending on alcohol outside is associated with 4.3 bahts of individual's monthly spending on total alcohol. Since alcohol consumption outside is likely to be more observable than alcohol consumption at home, the results verify that the deviation function plays a more important role in maximizing individual utility when peers' behaviors are more observable.

6.3 Shock Event

Table 6 presents the effect of peers' idiosyncratic shock on consumption patterns. Here health shock is the proxy for income shock, and is measured as total days of sickness of the household.[16] So the larger the number, the more adverse the shock is. As income may be endogenous to the consumption pattern, health shocks can capture a more exogenous

[16] Health shock is significantly correlated with income. One percentage increase of sickness decreases income by three percent.

variation. Overall, people's consumption pattern in the event of health shocks also supports the predictions in the social norm theory. Since peers' shock variable is not subject to the simultaneity problem, I use the contemporaneous shock variable of i's excluded network to instrument peer effects (the signs and magnitude are the same using shock variables at period $t-1$ as instrument). As health shocks are idiosyncratic and people are less subject to correlated effect, I also present the non-instrumented OLS result as comparison.

According to Prediction 4 in the social norm theory, poor peers' negative shock should have positive effects on own temptation consumption through the conformity effect. The first row in columns 1 3 and 5 should be, in theory, positive and significant. As expected, all of these coefficients are positive. The coefficients in the IV specification are significantly different from zero. Notice that peers' adverse shock has a much stronger positive impact on household's own temptation consumption than that on household's non-temptation consumption. The difference between columns 3, 4 and columns 5, 6 is the extra control for time-varying number of poor peers. Although the number of poor peers may be endogenous, these results in columns 5 and 6 help me to validate that the results in row 1 are not mainly driven by those who have more poor friends in their networks. In conclusion, one extra day of poor peer's sickness within a month can increase household's per capita monthly temptation consumption by one bhat.

Furthermore, own health shock should have a positive effect on both temptation and non-temptation consumption among the poor, meaning that the interaction term of poverty status and health shock in row 4 should be positive. Table 6 shows that poor households appear to be more myopic by consuming more temptation goods, relative to the rich. The positive effect of negative shocks on consumption would be more true among the poor than the rich. In the results using both OLS and IV, the coefficients on $poverty_{ivt} * shock_{ivt}$ in columns 1, 3 and 5 are positive among temptation consumption; however, the coefficients on $poverty_{ivt} * shock_{ivt}$ in columns 2, 4 and 6 are negative among non-temptation consumption. These results indicate that, in the event of negative shocks, the poor would choose to spend much less in non-temptation consumption relative to the rich, while cutting down much less on temptation consumption compared with the rich. Poor households seem to be less resistant to temptation goods. If we view consuming temptation goods as a sign of impatience, the evidence slightly supports income heterogeneity of the myopic behavior. Take column 5 for example, one extra day of sickness can decrease rich households' temptation consumption by 0.182 bahts, while one extra day of sickness only decreases temptation by 0.0874 bahts among the poor households.

7 Robustness Check

7.1 Alternative Model: Risk-Sharing Model

This section contrasts the social norm explanation with an alternative mechanism that could explain the comovement of consumption: risk sharing. A household's social network provides risk-sharing function, which makes people borrow and lend from the same pool of money. There may be a risk of treating risk sharing as peer effects. I present the comparable model of risk sharing, and argue that the social norm model can better explain the observed consumption pattern.

I present here a modified version of Townsend (1994)'s model in order to contrast its predictions with that of the model predicted in Section 3. The individual utility function still depends on temptation goods (z_i) and goods without temptation (x_i). There are different states (s)—good income shock or bad income shock, which happens with probability Π_{st} at time t. λ_i is the weight associated with different individuals, and $\sum_i \lambda_i = 1$. β^t is the discount factor at time t. In addition, there is no saving available. There are N individuals ($i = 1, 2, \ldots, N$ within the risk-sharing network, where i denotes different individuals), and thus $\sum_{i=1}^{N} \lambda_i = 1$. The maximization problem is similar to a social planner's problem, and can be written as:

$$\max_{x_{ist}, z_{ist}} \sum_{s=1}^{S} \Pi_{st} \sum_{t=1}^{T} \beta^t \sum_{i=1}^{N} \lambda_i [u(x_{ist}) + v(z_{ist})] \tag{11}$$

$$\text{s.t. } \textstyle\sum_{i=1}^{N} [x_{ist} + z_{ist}] \leq \sum_{i=1}^{N} \theta_{ist} y_{ist}$$

where β^t is the discount factor at time t; y_{ist} is i's income at state s time t; θ_{ist} represents i's shock on income at state s time t. The first-order condition from the maximization problem yields:

$$(x_{ist}) : \lambda_i \Pi_{st} \beta^t u'(x_{ist}) = \mu_{st}, \forall i, s, t \tag{12}$$

$$(z_{ist}) : \lambda_i \Pi_{st} \beta^t v'(z_{ist}) = \mu_{st}, \forall i, s, t \tag{13}$$

where μ_{st} is the Lagrange multiplier. The above solution further yields:

$$\frac{\lambda_j}{\lambda_i} = \frac{u'(x_{ist})}{u'(x_{jst})} = \frac{v'(z_{ist})}{v'(z_{jst})} = \frac{u'(x_{ist})}{v'(z_{jst})} = \frac{v'(z_{ist})}{u'(x_{jst})} \tag{14}$$

When applying CARA functional form, individuals' consumption co-moves with peers' consumption. I assume $u(c) = -\frac{1}{\theta_x} e^{-\theta_x c}$ and $v(c) = -\frac{1}{\theta_z} e^{-\theta_z c}$. I can get the first order condition focusing on z_{ist} using $\frac{\lambda_j}{\lambda_i} = \frac{v'(z_{ist})}{v'(z_{jst})} = \frac{e^{-\theta_z z_{ist}}}{e^{-\theta_z z_{jst}}}$ and $\frac{\lambda_j}{\lambda_i} = \frac{v'(z_{ist})}{u'(x_{jst})} = \frac{e^{-\theta_z z_{ist}}}{e^{-\theta_x x_{jst}}}$.

Similar to the existing literature, I find that z_{ist} depends only on $\overline{z_{st}}+\overline{x_{st}}$ once controlling for household fixed effects (Fafchamps and Lund, 2003; Mace, 1991; Townsend, 1994). That is, $z^*_{ist} = z^*(\overline{z_{st}} + \overline{x_{st}}, ln\lambda_i - \overline{ln\lambda})$. Notice that peers' total consumption varies by state and time, but the social planners' weight does not depend on time. In the case of the CARA utility function, an individual's temptation consumption depends on the peers' total consumption. Once controlling for peers' total consumption, peers' consumption in specific categories should not matter for individuals' temptation consumption. The result is similar in the constant relative risk aversion (CRRA) utility function.[17]

To summarize, in the risk-sharing model, individuals' consumption comoves with their peers. This risk-sharing mechanism leads to similar peer effects on individuals' temptation consumption as the social norm model. However, this comovement happens not only for individuals' consumption in temptation goods, but also in non-temptation goods. If the utility function is CARA and individuals have similar risk-aversion levels in consuming non-temptation goods and in temptation goods, $\frac{\partial z_{ist}}{\partial(\overline{x_{st}}+\overline{z_{st}})} > 0$. Once we control for the total consumption of peers, this comovement between peers' and individuals' temptation consumption would no longer hold.

It is also informative to compare the impact of shocks within the two frameworks. Since z^*_{ist} depends on $ln\lambda_i - \overline{ln\lambda}$ and $\frac{1}{N}\sum_{i=1}^{N}\theta_{ist}y_{ist}$ in the CARA utility, two properties similar to Fafchamps and Lund (2003) can be concluded: (1) Shocks affecting network members (i.e., $\theta_{gst} = \frac{1}{N}\sum_{i=1}^{N}\theta_{ist}$) will decrease an individual's consumption (both temptation and non-temptation consumption). (2) Idiosyncratic shocks have no impact on individual's consumption (both temptation and non-temptation consumption) once controlling for network shocks.

In conclusion, the social norm model yields different results from the risk-sharing model in Predictions 2–4. Table 1 illustrates the differences. First, both models predict positive correlation between own and peers' temptation consumption. In the second prediction: risk-sharing model predicts that the coefficient on peers' temptation consumption is no longer significant after controlling for peers' total consumption. Third, the coefficient on peers' temptation consumption is the same as that on peers' non-temptation consumption in the risk-sharing model, while the coefficient on peers' temptation consumption is significantly

[17] Applying a CRRA utility function, the utility for consuming non-temptation goods is $u(c) = \frac{c^{-r_x}}{1-r_x}$; utility for consuming temptation goods is $v(c) = \frac{c^{-r_z}}{1-r_z}$. r_x and r_z are the coefficients of relative risk-aversion ($R(c) = cA(c) = \frac{-cu''(c)}{u'(c)}$). At the end, I will get $\ln z^*_{ist} = z^*(\overline{\ln z_{st}} + \overline{\ln x_{st}})$ after controlling for individual fixed effects. Individual i's growth of temptation consumption depends on the growth of total consumption (including both temptation and non-temptation consumption) of the peers.

larger than that on peers' non-temptation consumption in the social norm model. Fourth, there is a significant difference between more observable consumption and less observable consumption in the social norm theory; peer effects would be stronger on alcohol consumption outside than alcohol consumption at home. The risk-sharing model does not distinguish those two consumption behaviors. With respect to the income shock in the fourth prediction, peers' shock will have negative effects on own temptation and non-temptation consumption in the risk-sharing model, but peers' negative income shock, in contrast, will increase own temptation consumption through the social norm mechanism. In the social norm model, idiosyncratic shocks will also have positive effects on the total consumption. In the risk-sharing model, idiosyncratic shocks will not play a role in own consumption if we control for peers' aggregate shock. Our results, consistent with the predictions from the social norm model, validate that social norms would be a more probable explanation than the risk-sharing theory.

7.2 Other Robustness Checks

The previous section contrasts the predictions between the risk-sharing and the social norm model. This section presents several robustness checks. My results support social norms. However, to make sure that I did not process the data differently than the previous literature using the same information, I use village as the social network definition to test the risk-sharing theory. Similar to Townsend (1994), I use the aggregate yearly data to run the analysis on household's idiosyncratic income against household's consumption. If risk sharing is in place and efficient, the coefficient on idiosyncratic income should be small and insignificant.

Table A-1 shows the relationship between own income and consumption. The results in columns 1 and 2 indicate the existence of risk sharing at the village level. The coefficient in column 1, although significant, is quite small. The coefficient in column 2 using first difference specification is small and insignificant. Idiosyncratic income is not correlated with consumption. Yet village is a very crude definition for social network. When it comes to people's consumption behaviors, it is more important to understand the peer groups with whom people have close interaction. Social norm strongly affects villagers' temptation consumption when observing the behaviors of individuals' peer groups.

I further conduct robustness check using variables with a different time frame. This alternative analysis sheds additional light on the mechanism because the lagged instrument may require a habit formation assumption in addition to peer effects. One may also worry about the asymmetry of the timing that I use lagged consumption to instrument peers' current-period consumption at the first stage[18], while using both peers' and own consumption variables at the current period. To test whether the results are still robust with a symmetric time frame, I use consumption at time $t-2$ to instrument peers' consumption at time $t-1$ in the first stage, and then use this predicted $t-1$ variable on own consumption variable at time t. I expect the results to be similar using this symmetric specification because there can be a delay in response to peers' temptation consumption, assuming habit formation in consumers' utility function. Table A-2 shows that using variables with a different time frame, we observe similar peer effects on temptation consumption, and the results are weaker compared to the previous results using instruments at $t-1$ in table 4. In column 3, for example, the coefficient is at the border line of significance. Table A-3 includes results using alcohol consumption with the similar time frame as explained above. The results in this table are consistent and robust as well.

Another caveat of the analysis is that the data are sampled within the village. Identification may be compromised by using sampled networks (Chandrasekhar and Lewis, 2011). They show that even if network members are sampled randomly, this partial sampling will lead to nonclassical measurement errors, and can bias the estimation. Because of the concern of mis-measured social network, I sampled 50 percent of my observations to re-run the analysis. Although I cannot recover all the non-sampled network information, this robustness check can gauge whether the result is strong and stable enough even with some level of missing network information. The results are presented in Table A-4 to Table A-6. All results stay the same. The robustness of the results from 50 percent of the sample reduces the concern of measurement errors of the sampled social network.

Some may challenge the observability test between "alcohol consumption at home" and "alcohol consumption outside"; people may gain individual utility by simply "drinking with their friends." This alternative can contradict with the definition of "temptation" good that people do not gain utility from thinking about future consumption at present. To address this concern, I verify the result using temptation consumption excluding alcohol consumption. The specification I can use is similar to the test in observability. Instead of alcohol consumption, I use $tempExAlcohol_{ivt} = \delta_0 + \delta_{temp_O} tempExAlcohol_{G_ivt} + \delta_3 X_{ivt} + f_{vt} + \xi_{ivt}$, where $tempExAlcohol_{ivt}$ represents an individual's monthly temptation consumption excluding alcohol consumption, and $tempExAlcohol_{G_ivt}$ is i's peers' average monthly temptation consumption excluding alcohol consumption. Then I use the same specification controlling

[18] Initially, I use a lagged variable to eliminate the simultaneous decision making of own and peers.

for peers' average total monthly consumption.

Table A-7 presents the result of peer effects on temptation consumption excluding alcohol consumption. Column 1 indicates that peers' temptation consumption excluding alcohol consumption has a significant impact on an individual's. The coefficient on peers' temptation consumption (excluding alcohol) is around 1.6. The positive sign still holds in column 2 even after controlling for peers' total consumption, although it is only close to 10% significance level. Assuming that people do not gamble or buy lotteries together, the significance of the result using temptation consumption on gambling/lottery buying verifies the social norm hypothesis. Based on the anecdotal evidence, people in those Thai villages usually go gambling by themselves. There are also multiple types of informal gambling, such as buying lotteries, betting on stock prices and fish/chicken fights. Individuals usually give a bet at the local stores. The result further confirms that the peer effects of alcohol consumption are not simply driven by the joy of consuming together.

Temptation spending captures people's myopic consumption allocation. Based on Banerjee and Mullainathan (2010), the concave shape of temptation will have an impact on an individual's saving. So I further test whether peer effects on temptation spending would affect saving behaviors. Based on the availability of the data,[19] I use whether any household members have a saving account to approximate saving behaviors. Table A-8 shows that peers' temptation spending further hinders an individual's saving behavior. The confidence interval using the CLR test falls entirely in the negative range. Although the IV coefficient is not significant, the CLR test gives a more robust result under weak instrument.

8 Conclusion

Self-control problems lead individuals to consume multiple types of temptation goods, and this consumption behavior is primarily influenced by peers; thus, the "self-control" problem is, in essence, a "group-control" problem. To examine peer effects on temptation consumption, I developed a social norm model of individuals-level consumption behaviors. The social norm model asserts that people have a tendency to emulate the temptation consumption of the majority. The extent of this conforming behavior varies with the observability of the consumption. The analysis revealed that even when peers' total consumption is controlled, peer effects can still be found on temptation consumption.

[19] Some households have negative income, so it is not clear whether simply using income minus consumption would yield meaningful results.

Using comprehensive survey data from Thailand, I created instrumental variables to overcome endogeneity and test peer effects on temptation consumption. The data, which were collected on a monthly basis, include important information on social relations, a variety of sources of income, and several types of consumption. The empirical results show that peer effects on temptation consumption are driven mainly by social norms: people's temptation consumption varies with the consumption of their peers because people tend to conform with the behavior of the majority of members of their social networks. The covariation of group members' consumption is significantly more prevalent for temptation goods than for non-temptation goods even when peers' total consumption is controlled. In addition, results differed for goods that are more observable and those that are less observable—individual's public alcohol consumption was more affected by peer pressure than alcohol consumption at home. The data also show that the social norm mechanism is weaker when village-year fixed effects are not accounted for, which implies that there may be time-variant village factors associated with certain consumption patterns. In conclusion, risk sharing is found at the village level (as shown in prior literature), but is only one part of the explanation of the covariation of people's consumption. Social norm theory provides an essential and previously overlooked supplement to the explanation of myopic consumption behavior.

These results raise concerns about group-based financial products in which policymakers use peer pressure to encourage loan repayment and saving commitment. Peer effects may have undesirable consequences for these products. Socializing with peers who engage in undesirable financial behavior can make individuals behave more myopically by consuming more temptation goods, saving less money than they desire, and missing profitable investment opportunities. These outcomes may have particularly negative consequences for vulnerable households. While these group-based microfinance innovations have significant merits, financial institutions should require institutional monitoring of group dynamics and the effects of these dynamics on individual spending behaviors.

9 Mathematical Appendix

Prediction 1: *An increase in peers' temptation consumption will lead to an increase in individual i's temptation consumption as long as the behavior is observable* ($\frac{\partial z_{1i}}{\partial \overline{z_{1-ig}}} > 0$) *if* $\chi > 0$.

The main interest here is to analyze $\frac{\partial z_{1i}}{\partial \overline{z_{1-ig}}}$. Take partial derivative with respect to $\overline{z_{1-ig}}$ from equation 5:

$$\frac{\partial z_{1i}}{\partial \overline{z_{1-ig}}} + \frac{\theta_z}{\chi} e^{-\theta_z z_{1i}} \frac{\partial z_{1i}}{\partial \overline{z_{1-ig}}} = 1$$

$$\Longrightarrow \frac{\partial z_{1i}}{\partial \overline{z_{1-ig}}} = \left[1 + \frac{\theta_z}{\chi} e^{-\theta_z z_{1i}}\right]^{-1}$$

As long as $\chi > 0$, $\frac{\partial z_{1i}}{\partial \overline{z_{1-ig}}} > 0$ ■

Prediction 3: *Peer effects on temptation consumption are stronger when peers' consumption behaviors are more observable* ($\frac{\partial^2 z_{1i}}{\partial \overline{z_{1-ig}} \partial \chi} > 0$).

Since we know that:

$$\frac{\partial z_{1i}}{\partial \overline{z_{1-ig}}} = \left[1 + \frac{\theta_z}{\chi} e^{-\theta_z z_{1i}}\right]^{-1}$$

So,

$$\frac{\partial^2 z_{1i}}{\partial \overline{z_{1-ig}} \partial \chi} = \left[1 + \frac{\theta_z}{\chi} (e)^{-\theta_z z_{1i}}\right]^{-2} \left[\frac{\theta_z}{\chi^2} (e)^{-\theta_z z_{1i}}\right]$$

This is positive because $\left[1 + \frac{\theta_z}{\chi} (e)^{-\theta_z z_{1i}}\right]^{-2} > 0$, and $\frac{\theta_z}{\chi^2} (e)^{-\theta_z z_{1i}} > 0$

The results are very similar in CRRA utility function: Assume $u(x) = \frac{x^{1-\gamma_x}}{1-\gamma_x}$ and $v(z) = \frac{z^{1-\gamma_z}}{1-\gamma_z}$. Equation 5 becomes

$$z_{1i} - \frac{1}{\chi}(z_{1i})^{-\gamma_z} = \overline{z_{1-ig}} - \frac{1}{\chi}(1+r)\delta(x_{2i})^{-\gamma_x} \left(1 - \frac{\partial z_{2i}}{\partial c_{2i}}\right) \tag{15}$$

Thus, as long as χ is greater than zero, the left-hand side of the equation is an increasing function in z_{1i}. Increasing peers' temptation consumption will lead to the increase of individual i's temptation consumption.

Prediction 4:

When individuals are poor, negative idiosyncratic shocks will increase total consumption ($\frac{\partial z_{1i}}{\partial \theta_{1i}} < 0$, *and* $\frac{\partial x_{1i}}{\partial \theta_{1i}} < 0$ *as c is small);*

If one poor peer encounters adverse shock, other things being equal, this negative peer's shock has a positive impact on temptation consumption.

From equation 3, we have:

$$v'(z_{1i}) = \chi(z_{1i} - \overline{z_{1-ig}}) + \delta u'(x_{2i}) \left(\frac{\partial x_{2i}}{\partial c_{2i}} \right) (1+r) \tag{16}$$

First, look at the right-hand side of equation 16. Higher θ_{1i} (positive income shock) will lead to smaller $u'(x_{2i})$, but larger $(1 - \frac{\partial z_{2i}}{\partial c_{2i}})$ (which is equal to $\frac{\partial x_{2i}}{\partial c_{2i}}$). These two countervailing effects result from the initial assumptions of the model: $u'(x_{2i})$ decreases along with the higher θ_{1i} because x_{2i} is a function of c_{2i}, where $c_{2i} = (1+r)(\theta_{1i}y_{1i} - x_{1i} - z_{1i}) + y_{2i}$. Because of the diminishing return of utility, $u'(x_{2i})$ will decrease when c_{2i} is higher. At the same time, this positive shock will increase $(1 - \frac{\partial z_{2i}}{\partial c_{2i}})$ because of the concave shape of temptation goods (i.e. $z''(c) < 0$). Thus, when the second effect dominates, the right-hand side of equation 3 will increase with respect to an increase in θ_{1i} For the left-hand side ($v'(z_{1i})$) to increase, z_{1i} has to decrease. To conclude, $\frac{\partial z_{1i}}{\partial \theta_{1i}} < 0$ when c_{2i} is small.

To see why, among poorer individuals, the second effect ($(1 - \frac{\partial z_{2i}}{\partial c_{2i}})$) dominates the first ($u'(x_{2i})$) on the right-hand side: $\frac{\partial z_{1i}}{\partial \theta_{1i}} < 0$ as long as $[u'(x_{2i})(1 - \frac{\partial z_{2i}}{\partial c_{2i}})]$ is an increasing function of c_{2i}. Suppose $\frac{\partial^2 z_{2i}}{\partial c_{2i}^2}$ is monotone, and $\frac{\partial^3 z_{2i}}{\partial c_{2i}^3} > 0$, there exists a sufficiently low c_{2i}, which makes $[u'(x_{2i})(1 - \frac{\partial z_{2i}}{\partial c_{2i}})]$ an increasing function in c_{2i}. Use the previous functional form to illustrate. $\frac{\partial z_{1i}}{\partial \theta_{1i}} = \frac{-(1+r)\delta}{\chi + \theta_z e^{-\theta_z z_{1i}}}(1+r)y_{1i}[-\theta_x e^{-\theta_x x_{2i}} - \frac{\partial^2 z_{2i}}{\partial c_{2i}^2}]$ Therefore, $\frac{\partial z_{1i}}{\partial \theta_{1i}} < 0$ when $-\theta_x e^{-\theta_x x_{2i}} - \frac{\partial^2 z_{2i}}{\partial c_{2i}^2} > 0$ (that said, $\frac{\partial^2 z_{2i}}{\partial c_{2i}^2} < -\theta_x e^{-\theta_x x_{2i}}$). Since $\frac{\partial^3 z_{2i}}{\partial c_{2i}^3} > 0$, $c < max\{\frac{\partial^2 z_{2i}}{\partial c_{2i}^2} + \theta_x e^{-\theta_x x_{2i}}\}$.

Similarly, from equation 4, we have:

$$u'(x_{1i}) = \delta u'(x_{2i}) \left(\frac{\partial x_{2i}}{\partial c_{2i}} \right) (1+r) = 0 \tag{17}$$

Positive income shock will lead to smaller $u'(x_{2i})$, and larger $(1 - \frac{\partial z_{2i}}{\partial c_{2i}})$ $(= \frac{\partial x_{2i}}{\partial c_{2i}})$. The left-hand side of equation 17 will increase when the positive shock leads to a much larger $(1 - \frac{\partial z_{2i}}{\partial c_{2i}})$. Similar conclusion can be achieved for x good: $\frac{\partial x_{1i}}{\partial \theta_{1i}} < 0$ when c_{2i} is small.

Following the same logic, a poor enough peer can also increase his temptation consumption when encountering negative income shock. Here I want to show the intuition that a poor peers' negative shock can lead to an increase in household's own temptation consumption if holding all other peers' shock constant. Suppose that there is a household $j' \in \{$ poor & i's peer group $\}$, who encounters negative income shock (smaller $\theta_{1j'}$). Household j' will increase temptation consumption (i.e. $\frac{\partial z_{1j'}}{\partial \theta_{1j'}} < 0$) because the second effect $(1 - \frac{\partial z_{2j'}}{\partial c_{2j'}})$ dominates the first $(u'(x_{2j'}))$ on the right-hand side of equation 17. An increase in $z_{1j'}$ responding to a smaller $\theta_{1j'}$ will lead to an increase in the peers' average temptation consumption $(\overline{z_{1-ig}})$ because $j' \in \{$ i's peer group $\}$. Based on prediction 1, an increase in peers' average temptation consumption will result in an increase in individual's own temptation consumption. Similar logic applies if more than one poor peers encounter negative shock event.

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Table 1: Predictions from Social Norm and Risk-sharing Model

	Specification	Social Norm	Risk-sharing
1: Own and peer	$temp_{it} = \alpha_0 + \alpha_1 temp_{G_{it}} + controls + \epsilon_{it}$	$\alpha_1 > 0$	$\alpha_1 > 0$
2: Extra Control	$temp_{ivt} = \gamma_0 + \gamma_1 temp_{G_ivt} + \gamma_2 cons_{G_ivt} + controls + \varepsilon_{ivt}$	$\gamma_1 > 0$	$\gamma_1 = 0$, $\gamma_2 > 0$
3: Non-temp vs temp	$temp_{ivt} = \gamma_0 + \gamma_{temp} temp_{G_ivt} + controls + \varepsilon_{ivt}$ $nontemp_{ivt} = \gamma_0 + \gamma_{nontemp} nontemp_{G_ivt} + controls + \varepsilon_{ivt}$	$\gamma_{temp} > \gamma_{nontemp}$	$\gamma_{temp} = \gamma_{nontemp}$
4: Observability	$alcoholTOTAL_{ivt} = \gamma_0 + \gamma_{temp_H} alcoholHOME_{G_ivt} + controls + \varepsilon_{ivt}$ $alcoholTOTAL_{ivt} = \gamma_0 + \gamma_{temp_O} alcoholOUT_{G_ivt} + controls + \varepsilon_{ivt}$	$\gamma_{temp_O} > \gamma_{temp_H}$	$\gamma_{temp_O} = \gamma_{nontemp_H}$
5: Shock event	$temp_{ivt} = \beta_0 + \beta_{temp1} healthshock_{G_ivt} + \beta_{temp2} healthshock_{ivt} +$ $controls + \epsilon_{ivt}$ $nontemp_{ivt} = b_0 + b_{nontemp1} healthshock_{G_ivt} + b_{nontemp2} healthshock_{ivt}$ $+controls + \epsilon_{ivt}$	$\beta_{temp1} > 0$, $\beta_{temp2} > 0$ $b_{nontemp2} > 0$	$\beta_{temp1} < 0$, $\beta_{temp2} = 0$; $b_{nontemp1} < 0$ $b_{nontemp2} = 0$

Table 2: Summary Statistics

	mean	sd	min	max	N
Temptation consumption	94	211.9145	0	7433	26928
Non temptation consumption	1,393	3482.114	37	287815	26928
Total consumption	1,487	3528.544	37	287815	26928
Alcohol consumption at home	31	158.2397	0	6687	26928
Alcohol consumption outside	12	51.46327	0	1680	26928
Sickness	6.36	15.52159	0	686	26928
Temptation spending among total consumption	0.068	0.081228	0	0.7208	26928
Household per-capita monthly income	2,872	11765.49	-301900	430397	26928
Household Size	4.37	1.9368	1	15	26928

Note: All the consumption figures are per capita monthly spending in Thai Baht (1 US dollar=40 Thai Baht in 2000)

Figure 3: Histogram of Proportional Spending on Temptation Goods

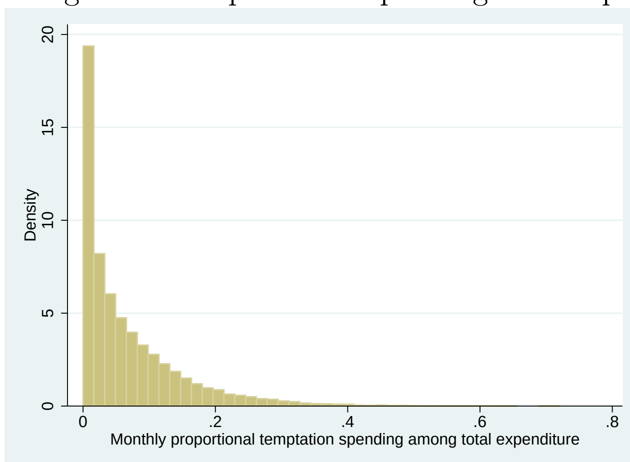

Table 3: Correlation of Social Network

Income	0.1470***
Household size	0.1342***
Percentage of ag income (differed by year)	0.5286***
Percentage of ag income (average throughout years)	0.3802***
Days of health shock	0.0207***

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

Table 4: Consumption Relationship between Own and Peer

	temp	non-temp	temp	non-temp	temp	non-temp
	OLS		IV		IV	
	(1)	(2)	(3)	(4)	(5)	(6)
Peer's temptation consumption	0.0439**		1.516*		1.636*	
	(0.0158)		(0.784)		(0.883)	
	[0.005]***		[0.0000]***		[0,0000]***	
Peer's non-temptation consumption		0.0190		1.153		-34.24*
		(0.0128)		(0.812)		(20.23)
		[0.1178]		[0.0599]*		[0.1238]
Peer's consumption					-0.0148	33.94*
					(0.0138)	(20.03)
					[0.2635]	[0.0918]*
Household size	-10.86***	-136.2**	-10.63***	-140.8**	-10.57***	-128.5**
	(3.031)	(47.53)	(3.276)	(61.27)	(3.211)	(53.10)
	[0.002]***	[0.004]***	[0.004]***	[0.012]**	[0.004]	[0.016]
Village-year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Seasonal fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,928	26,928	24,353	24,353	24,353	24,353
F-stat of 1st Stage			7.206	2.874	6.423	1.520
CI of IV coefficient using CLR			[.4682, 5.9437]		[.4980, 7.5359]	

Robust standard errors clustered at the village level in parenthesis; p value using wild cluster bootstrap reported underneath the robust standard errors

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

All dependent variables are the level of household's per capita monthly consumption. Peer's consumption is calculated as the average level of per capita consumption excluding own household's consumption. Peer's consumption is instrumented using lagged consumption of individual i's friends of friends who are not directly linked with i. Conditional Likelihood Ratio (CLR) Test is developed by Moreira (2002). Similar to Anderson-Rubin (AR) test, CLR test gives robust confidence set under weak instrument. Yet, CLR test outperform AR test in power simulations (Andrews et al 2006).

Table 5: Alcohol Consumption at Home and Outside

	Dependent Variable: Household's alcohol consumption							
	Total				At home		Total	
	OLS	OLS	IV	IV	IV	IV	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Peer's alcohol consumption at home	0.00239		3.098		2.406		3.602	
	(0.00747)		(4.524)		(3.570)		(5.978)	
	[0.7342]		[0.5039]		[0.5108]		[0.5558]	
Peer's alcohol consumption outside		0.193**		4.316***		2.169*		4.317***
		(0.0839)		(1.472)		(1.223)		(1.474)
		[0.0394]**		[0.0103]**		[0.0963]*		[0.0103]**
Peer's total consumption							-0.0293	-0.000110
							(0.0553)	(0.000561)
							[0.6048]	[0.8470]
Household size	-6.166***	-6.197***	-4.738	-8.797***	-2.807	-5.431**	-4.334	-8.798***
	(1.924)	(1.932)	(5.201)	(3.049)	(3.775)	(2.421)	(6.071)	(3.049)
	[0.0281]**	[0.0268]**	[0.3766]	[0.0113]**	[0.4687]	[0.0403]**	[0.4862]	[0.0039]***
Village-year fixed effect		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Seasonal fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,928	26,928	24,353	24,353	24,353	24,353	24,353	24,353
F-stat of 1st Stage			2.345	21.52	2.345	21.52	2.064	21.47

Robust standard errors clustered at the village level in parenthesis; p value using wild cluster bootstrap reported underneath the robust standard errors

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

Peer's consumption is calculated as the average level of per capita monthly consumption excluding own household's consumption. Peer's consumption is instrumented using lagged consumption of individual i's friends of friends who are not directly linked with i.

Table 6: Shock on Consumption Pattern with Income Interaction

	temp OLS (1)	non-temp OLS (2)	temp IV (3)	non-temp IV (4)	temp IV (5)	non-temp IV (6)
Poor peer's total days of health shock	0.0272	0.155	1.223***	-7.188	1.172***	-7.088
	(0.0505)	(0.330)	(0.347)	(10.19)	(0.313)	(10.00)
	[0.5980]	[0.6451]	[0.0062]***	[0.4729]	[0.0025]***	[0.4787]
Individual's days of health shock	-0.117	5.030	-0.175	5.388	-0.182	5.401
	(0.230)	(3.291)	(0.238)	(3.292)	(0.237)	(3.302)
	[0.6187]	[0.14725]	[0.3446]	[0.1715]	[0.3321]	[0.1717]
Poverty	-83.78***	-1,204***	-85.09***	-1,196***	-83.17***	-1,200***
	(11.07)	(90.62)	(10.61)	(85.59)	(10.53)	(88.42)
	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***
Poverty*individual's health shock	0.0572	-6.208*	0.0925	-6.425**	0.0946	-6.429**
	(0.228)	(3.169)	(0.246)	(3.071)	(0.244)	(3.070)
	[0.8050]	[0.0689]*	[0.5934]	[0.0955]*	[0.6227]	[0.0955]*
Household size	-6.593*	-78.73	-6.298**	-80.54*	-6.412**	-80.32*
	(3.130)	(45.56)	(3.165)	(43.44)	(3.115)	(43.60)
	[0.0524]	[0.1045]	[0.0665]	[0.0171]	[0.0632]*	[0.0173]**
Village-year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Seasonal fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Additional control for # of poor peers					Yes	Yes
Observations	28,008	28,008	28,008	28,008	28,008	28,008
F-stat of 1st Stage			114.8	114.8	125.7	125.7

Robust standard errors clustered at the village level in parenthesis; p value using wild cluster bootstrap reported underneath the robust standard errors

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

Peer's consumption is calculated as the average level of per capita monthly consumption excluding own household's consumption. Peer's health shock is instrumented using contemporaneous shock information of individual i's friends of friends who are not directly linked with i.

10 Appendix

Table A-1: Risk-sharing at the Village

	Household's consumption per capita	
	level	first difference
Net income per capita	0.0300***	
	(0.00340)	
Net income per capita (first difference)		0.0237
		(0.0230)
Observations	3,804	3,170
R-squared	0.095	0.033

Standard errors in parenthesis

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

All dependent variables are at the level of household's per capita yearly consumption.

People within the same village are categorized as in the same social network.

Table A-2: Consumption Relationship between Own and Peer (Different Time Frame)

	temp	non-temp	temp	non-temp
	IV t-2 instrument on t-1			
	(1)	(2)	(3)	(4)
Peer's temptation consumption at $t-1$	1.154*		1.264	
	(0.695)		(0.822)	
Peer's non-temptation consumption at $t-1$		1.146		-45.52
		(0.726)		(30.70)
Peer's consumption at $t-1$			-0.0121	45.10
			(0.0127)	(30.38)
Household size	-12.37***	-146.3**	-12.40***	-186.1**
	(4.003)	(60.25)	(4.041)	(66.29)
Village-year fixed effect	Yes	Yes	Yes	Yes
Seasonal fixed effect	Yes	Yes	Yes	Yes
Household fixed effect	Yes	Yes	Yes	Yes
Observations	24,010	24,010	24,010	24,010
F-stat of 1st Stage	7.549	3.350	6.598	1.026

Robust standard errors clustered at the village level in parenthesis

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

All dependent variables are at the level of household's per capita monthly consumption. Peer's consumption is calculated as the average level of per capita monthly consumption excluding own household's consumption. In columns (1) to (4), peer's t-1 consumption is instrumented using 2-period lagged consumption of individual i's friends of friends who are not directly linked with i.

Table A-3: Alcohol Consumption at Home and Outside (Different Time Frame)

	Dependent Variable: Household's alcohol consumption					
	Total		At home		Total	
	IV					
	$t-2$ instrument on $t-1$					
	(1)	(2)	(3)	(4)	(5)	(6)
Peer's alcohol consumption at home at $t-1$	1.263		0.339		1.563	
	(1.955)		(1.005)		(2.850)	
Peer's alcohol consumption outside at $t-1$		4.684**		2.262		4.698**
		(2.054)		(1.628)		(2.063)
Peer's total consumption at $t-1$					-7.513**	-8.378***
					(3.187)	(3.235)
Household size	-7.483**	-8.378***	-4.694**	-5.244**	-7.484**	-8.377***
	(2.990)	(3.234)	(2.236)	(2.565)	(2.971)	(3.236)
Village-year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Seasonal fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	24,010	24,010	24,010	24,010	24,010	24,010
F-stat of 1st Stage	0.530	19.57	0.530	19.57	0.365	19.50

Robust standard errors clustered at the village level in parenthesis

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

Peer's consumption is calculated as the average level of per capita monthly consumption excluding own household's consumption. Peer's t-1 consumption is instrumented using 2-period lagged consumption of individual i's friends of friends who are not directly linked with i.

Table A-4: Consumption Relationship between Own and Peer (Sub-sample)

	temp OLS (1)	non-temp OLS (2)	temp IV (3)	non-temp IV (4)	temp IV (5)	non-temp IV (6)
Peer's temptation consumption	0.0117		1.339**		1.356**	
	(0.0177)		(0.639)		(0.644)	
Peer's non-temptation consumption		-0.0120***		-1.082		-55.65
		(0.00247)		(1.244)		(51.32)
Peer's consumption					-0.00487	55.44
					(0.00477)	(51.16)
Household size	-11.35**	-111.3	-7.904	-42.40	-7.798	-37.67
	(4.078)	(78.22)	(4.885)	(96.05)	(4.806)	(184.0)
	(3.031)	(47.53)	(3.276)	(61.27)	(3.211)	(53.10)
Village-year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Seasonal fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,304	11,304	8,946	8,946	8,946	8,946
F-stat of 1st Stage			10.36	3.007	10.21	1.040

Robust standard errors clustered at the village level in parenthesis

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

All dependent variables are at the level of household's per capita monthly consumption. Peer's consumption is calculated as the average level of per capita monthly consumption excluding own household's consumption. Peer's consumption is instrumented using lagged consumption of individual i's friends of friends who are not directly linked with i

Table A-5: Alcohol Consumption at Home and Outside (Sub-sample)

	Dependent Variable: Household's alcohol consumption							
	Total				At home		Total	
	OLS	OLS	IV	IV	IV	IV	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Peer's alcohol consumption at home	0.00364		2.297***		1.889***		2.332***	
	(0.0138)		(0.799)		(0.665)		(0.830)	
Peer's alcohol consumption outside		-0.0155		3.187***		1.178**		3.163***
		(0.0409)		(0.677)		(0.505)		(0.685)
Peer's total consumption							-0.00809	0.000513***
							(0.00787)	(0.000178)
Household size	-7.060***	-7.077***	-7.740***	-3.822	-5.985**	-3.875	-7.599***	-3.850
	(2.299)	(2.314)	(2.636)	(2.988)	(2.575)	(2.837)	(2.450)	(2.992)
Village-year fixed effect		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Seasonal fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,304	11,304	8,946	8,946	8,946	8,946	8,946	8,946
F-stat of 1st Stage			1.745	36.79	1.745	36.79	1.720	37.19

Robust standard errors clustered at the village level in parenthesis

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

Peer's consumption is calculated as the average level of per capita monthly consumption excluding own household's consumption. Peer's consumption is instrumented using lagged consumption of individual i's friends of friends who are not directly linked with i.

Table A-6: Shock on Consumption Pattern with Income Interaction (Sub-sample)

	temp	non-temp	temp	non-temp
	OLS		IV	
	(1)	(2)	(3)	(4)
Log peer's days of health shock	-3.961	-21.58	104.3	-568.2
	(2.787)	(31.89)	(123.9)	(545.0)
Log individual's helth shock	4.431	180.9	10.52	224.7*
	(6.059)	(107.1)	(10.06)	(131.6)
Log net income	3.485***	24.08	4.005***	12.87
	(0.975)	(17.27)	(1.549)	(20.26)
log (Income)*log (individual's helth shock)	-0.529	-24.70	-1.052	-31.09
	(0.654)	(15.49)	(1.004)	(18.95)
Household size	-14.13**	-117.8	-11.47	-67.42
	(5.936)	(123.4)	(7.435)	(131.5)
Village-year fixed effect	Yes	Yes	Yes	Yes
Seasonal fixed effect	Yes	Yes	Yes	Yes
Household fixed effect	Yes	Yes	Yes	Yes
Observations	7,284	7,284	5,654	5,654
F-stat of 1st Stage			24.75	24.75

Robust standard errors clustered at the village level in parenthesis

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

Peer's consumption is calculated as the average level of per capita monthly consumption excluding own household's consumption. Peer's health shock is instrumented using lagged consumption of individual i's friends of friends who are not directly linked with i.

Table A-7: Temptation Consumption excluding Alcohol Consumption

Dependent variable: household's temptation consumption excluding alcohol consumption		
	(1)	(2)
Peer's temptation consumption (except alcohol)	1.635*	1.652
	(0.992)	(1.009)
	[0.41916]	[0.37924]
Peer's total consumption		-0.00154
		-0.00113
		[0.19162]
Household size	-4.128**	-4.124**
	(1.638)	(1.657)
	[0.01597]**	[0.02794]**
Village-year fixed effect	Yes	Yes
Seasonal fixed effect	Yes	Yes
Household fixed effect	Yes	Yes
Observations	24,353	24,353
F-stat of 1st Stage	28.54	27.97

Robust standard errors clustered at the village level in parenthesis; p value using wild cluster bootstrap reported underneath the robust standard errors

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

All dependent variables are at the level of household's per capita monthly consumption. Peer's consumption is calculated as the average level of per capita monthly consumption excluding own household's consumption. Peer's consumption is instrumented using lagged consumption of individual i's friends of friends who are not directly linked with i. The social network is defined using people's financial, gift-giving, and labor-sharing relations.

Table A-8: Peers' Temptation on Saving

Dependent variable: Whether household opens a saving account in the given month	
Peer's temptation consumption	-0.00224
	(0.00197)
Household size	0.0135*
	(0.00724)
Village-year fixed effect	Yes
Seasonal fixed effect	Yes
Household fixed effect	Yes
Observations	24,346
F-stat of 1st Stage	6.84
CI of IV coefficient using CLR	[-.0093, -.0009]

Robust standard errors clustered at the village level in parenthesis

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

Saving captures whether any household member has opened saving account in the past month. Peer's consumption is calculated as the average level of per capita monthly consumption excluding own household's consumption. Peer's consumption is instrumented using lagged consumption of individual i's friends of friends who are not directly linked with i. The social network is defined using people's financial, gift-giving, and labor-sharing relations. Conditional Likelihood Ratio (CLR) Test is developed by Moreira (2002). Similar to Anderson-Rubin (AR) test, CLR test gives robust confidence set under weak instrument. Yet, CLR test outperform AR test in power simulations (Andrews et al 2006).