Store Credit as Informal Insurance in Rural Yemen

Sikandra Kurdi

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Abstract

The ability of households in rural Yemen to buy staple food items on credit with flexible repayment and no interest charges can be modeled as an interlinked transaction where store owners offer an implicit insurance product to loyal customers. This informal insurance system plays a significant role in the food security of vulnerable households. It also explains the finding that a randomized anti-poverty intervention in Yemen decreased prices for staple foods while increasing both incomes and demand.

1 Introduction

In various developing country contexts, local shops allow customers to buy consumption goods on credit. If storekeepers take into consideration the economic situation of their customers when deciding how generous to be with the provision of credit, this implicit contract with the shopkeeper takes on an insurance function for customers. I model an implicit contract between the store and the customer in which future access to credit is conditional on income as well as past repayments of debt. When the demand for insurance falls due to higher expected income in the future, the store must drop its prices to keep the implicit contract attractive.

I use this model to explain my primary empirical finding, which is that in randomly assigned treatment villages, incomes and demand for staple goods increased, but there was a large and significant negative effect on local prices. In particular, the negative price effect occurred in treatment villages with few stores. This is predicted by the model of credit as insurance, since stores that are

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faced with less competition can offer a more state-dependent insurance contract without worrying that customers with high incomes will default on the contract.

A supplementary data set from the same context supports the main findings, by showing that shopkeepers self-reported behavior is consistent with a model where credit has an insurance function, and confirming that there is temporal pattern of prices falling during the program and then rising after the program.

1.1 Previous Literature

Theoretically, this paper fits into the literature on informal arrangements that provide insurance functions for risk-averse households in contexts missing a formal market for insurance and interlinked transactions more generally. Notably, the insurance function of informal store credit for buying staple goods in Yemen is similar to the insurance function found in Udry's analysis of informal inter-household credit in Northern Nigeria. In contrast to models of mutual insurance with limited commitment as in Ligon, Thomas, and Worrall (2002) however, there is an important asymmetry where the store is risk neutral leading to a contract that needs to be sustained only from the point of view of keeping the customer from defaulting.

The existence of any kind of mutual insurance system should attenuate the effect of a positive income shock, with the gains spread through the system instead of focused on specific individuals. This is a policy relevant question in measuring the targeting effectiveness of social programs. This type of spillover via transfers and credit markets was examined in Progresa by Angelucci and De Giorgi (2009). They find substantial spillovers (11% of program transfers) to non-eligible households via inter-households transfers and borrowing. In the model presented below where mutual insurance is provided through store credit, the observed decline in local prices is a spillover effect that provides modest immediate measurable benefits to non-participants in the LIWP program.

This insurance-based prediction is in contrast to the ordinary intuition about the effect of cash transfers on local prices. Cunho, De Giorgi, and Jayachandran in an upcoming paper discuss the equilibrium effects of cash versus in-kind transfers on local prices and show that cash transfers caused higher prices in villages in Mexico.

2 Characteristics of Store Credit in Yemen

Selling on credit is an important feature of the market for staple goods in rural Yemen. Shopkeepers in the small villages in our sample reported overwhelmingly that they know their customers individually and are willing to sell on credit to customers they trust. On the other hand, larger local markets also exist in which this type of store credit is not observed.

Due to an Islamic prohibition, all loans apparently have zero interest rates. Over 99% of households in the Household Budget Survey responded that there

was no interest charged on loans from shopkeepers; during our own data collection, local consultants suggested that it was not worth including this question in the shopkeeper survey, as there is such as strong stigma against even the suggestion of charging interest on debt. [1] Yet store credit remains widely accessible.

Most households in our sample population report taking credit from shopkeepers and at the national level, debt owed to storekeepers represents a major share of total credit owed by households in Yemen. Debts to storekeepers and traders represented 28% of the number of debts and 21% of value of all debts reported in the Household Budget Survey. In our sample, 73% of households with any debt reported that at least part of that debt was owed to a shopkeeper, while shopkeepers reported average current debt among randomly selected active customers of 15,677 riyal ($74). This is slightly less than the cost of a monthly bundle of staple commodities sufficient for an average sized household. Notably, this debt is not repaid in full at the end of the month. 10,909 riyal ($51) of the current debt of an average household represents "fixed debt" - debt that was accumulated in the past and has remained on the ledger for for multiple months. In addition, shopkeepers reported that 18% of all of their customers were no longer allowed to actively receive credit, due to long delays in repayment. Shopkeepers referred to these customers as carrying "bad debt" to the average magnitude of 25,147 riyal ($118). Over the past 15 years, Yemen has experienced average inflation of 10%, so even in the short-term non-interest bearing loans represent a substantial loss for the creditor. Clearly, the provision of store credit at zero-interest rate is a major expense for store keepers, and deserves to be analyzed as part of their business model.

Agricultural productivity in Yemen in low and accounts for only a small share of the rural economy. Farm sales accounted for less than 20% of the income of rural households in the 2005-2006 National Household Budget Survey Household Budget Survey, while and more than 90% of wheat, the staple food grain, is imported. Other so income shocks faced by households are unlikely to be highly correlated. Rural incomes informal day labor or remittances, with migrants often crossing the border to work in Saudi Arabia for short periods until they are expelled, meaning that

3 Model

In local interviews, storekeepers and customers described an understanding of mutually understood maximum debt balance. If the running debt balance reaches the maximum level without repayment, the debt is denoted as "bad debt" and no further credit is allowed until some debt is repaid. This maximum

[1] Microfinance organizations and formal bank loans used for purchasing capital assets do charge interest for credit, however these loan contracts are often structured to accord with religious requirements by making interest indirectly present in the structure of a rent-to-buy contract. For consumption loans, this type of loan contract is not possible, and it can be assumed that consumption smoothing using interest based loans is excluded from the household choice set.

debt level is specific to individual consumers. The model proposed here is based on the idea that the store keeper offers the customer an individualized implicit contract specifying a maximum debt balance they are allowed to carry based on their reputation with the storekeeper, where the customer invests in this reputation by making his purchases at the store and repaying outstanding debts in a timely manner. A good reputation results in a higher maximum debt balance, which the customer can use to fund purchases during periods of low income. The model also allows for variation in the degree to which a state-dependent insurance component is part of the implicit contract. This insurance component takes the form of allowing customers to buy more on credit than their maximum debt balance would otherwise allow if they have low income during the period, and conversely requiring more debt repayment than would otherwise be expected to maintain their reputation if they have high income.

Consider a two-period model in which the customers decides in the current period how much to invest in his reputation via repaying outstanding debt and purchasing goods at the store, and realizes the consequences of this decision in the second period. There is a single consumption good and customers can choose between purchasing this good at an anonymous market, or at a store where their first period behavior effects their purchasing ability in the second period. Customers draw income in each period from a common distribution with the support y_L to y_H. Customer income draws are independent. The customer makes the choice about where to purchase after seeing his income realization in the first period, but while his second period income realization is unknown. All customers have identical CARA utility functions $u = -e^{-\gamma c}$ in each period, and total utility is $U = u(c_1) + u(c_2)$.

First, we should establish the outside option for customers who buy at the low price at market with no implicit contract with their local store. If the customer saves independently, consumption will be:

$$\begin{aligned} c_{1,nc} &= y_1 - s \\ c_{2,nc} &= y_2 + rs \end{aligned} \tag{1}$$

Maximizing the sum of the two period utilities with respect to s, his optimal choice of savings in the first period is:

$$s^*_{nc} = \frac{y_1}{2} + \frac{1}{2\gamma} ln(r\chi) \tag{2}$$

Where $\chi = \frac{u(y_H)-u(y_L)}{\gamma(y_H-y_L)} = -E[u(y_2)]$, and represents the negative of expected utility of income in period 2. As the expected utility in period 2 increases, the optimal amount of savings decreases. Expected utility for the two periods is:

$$EU(s^*_{nc}) = u((1 - \frac{1}{1+r})y_1)(r\chi)^{\frac{1}{1+r}} + u(\frac{ry_1}{1+r})\chi(r\chi)^{\frac{-r}{1+r}} \tag{3}$$

Now, consider a contract offered by a local store in which a markup of m percent is charged on purchases at the store in the current period, and the customer has the option to increase or decrease their outstanding debt at the store by amount p. The store rewards repayment and purchases such that the debt limit is increased by $\frac{\alpha}{m}p$ to reward repayment and $\frac{\alpha}{m}(1-\frac{1}{m})(x_1)$ to reward first period purchases at the markup m. In the second period, the customer consumes all the debt limit. The parameter α can be thought of as impatience-the higher α, the more that the storekeeper penalizes reputation more for unpaid debt, while the parameter β describes the degree of insurance.

$$\begin{aligned} c_{1,ic} &= \frac{1}{m}(y_1 - p) + \frac{\beta}{m}(\overline{y} - y_1) \\ c_{2,ic} &= y_2 + \frac{\alpha}{m}(1 - \frac{1}{m})(y_1 - p) + \frac{\alpha}{m}p + \frac{\beta}{m}(\overline{y} - y_2) \end{aligned} \tag{4}$$

The purchase rewards term $(1-\frac{1}{m})(y_1-s-p)$ is important because otherwise customers will not buy at the store unless buying on credit and customer who buys more has higher interest rate than customer who buys less. This allows for customers to have built up reputation with the store even before buying on credit for the first time. By keeping the ratio of rewards for purchasing at markup to rewards for repaying debt keeping at exactly 1, the storekeeper avoids extending credit greater than the amount that customer has already paid except to the extent that the contract includes an insurance component.

If β is equal to zero, the contract above can be seen simply as a savings contract, where the implicit interest rate is $\frac{\alpha}{m}$. In this way, the model clarifies that some store credit and repayment patterns can be generated simply by considering investment in reputation with a store as a type of savings technology.

Consider the nested version of the model in which there is no insurance component, (referred to with subscripts as sc for the savings only contract) :

$$\begin{aligned} c_{1,sc} &= \frac{1}{m}(y_1 - p) \\ c_{2,sc} &= y_2 + \frac{\alpha}{m}p + \frac{\alpha}{m}(1 - \frac{1}{m})(y_1 - p) \end{aligned} \tag{5}$$

If $r = \frac{\alpha}{m}$, then the expected utility of repaying debt at the optimal level is the same as the expected utility of savings in the absence of any contract.

$$EU(p^*_{sc}) = ((\frac{\alpha}{m}\chi)^{\frac{1}{1+\frac{\alpha}{m}}} + \chi(\frac{\alpha}{m}\chi)^{\frac{-\frac{\alpha}{m}}{1+\frac{\alpha}{m}}})u((\frac{\frac{\alpha}{m}}{1+\frac{\alpha}{m}})y_1) \tag{6}$$

Letting β be greater than zero gives more access to credit for customers with below average incomes, and less access to credit for customers with above average incomes. At the optimal level of debt repayment, expected utility is:

$$EU(p^*_{ic}) = u(\frac{\frac{\alpha}{m} - \frac{\beta\alpha}{m^2}}{1+\frac{\alpha}{m}}y_1 + \frac{\beta}{m}\overline{y})\widetilde{\chi}^{\frac{1}{1+\frac{\alpha}{m}}}\frac{\alpha}{m}^{\frac{1}{1+\frac{\alpha}{m}}} + u(\frac{\frac{\alpha}{m} - \frac{\alpha\beta}{m^2}}{1+\frac{\alpha}{m}}y_1 + \frac{\beta}{m}\overline{y})\widetilde{\chi}^{\frac{1}{1+\frac{\alpha}{m}}}\frac{\alpha}{m}^{\frac{-\frac{\alpha}{m}}{1+\frac{\alpha}{m}}} \tag{7}$$

Where $\widetilde{\chi} = \frac{u(y_H(1-\frac{\beta}{m}))-u(y_L(1-\frac{\beta}{m}))}{\gamma(y_H-y_L)} = -E[u(y_2(1-\frac{\beta}{m})]$. Since customers are risk averse, while the value of y_1 is still unknown, the insurance contract is preferred by all customers over a savings only contract with the same implicit interest rate.

$$\begin{gathered} -\chi \leq -\widetilde{\chi} \\ u((\frac{\frac{\alpha}{m}y_1}{1+\frac{\alpha}{m}})\overline{y})((\frac{\alpha}{m}\chi)^{\frac{1}{1+\frac{\alpha}{m}}} + \chi(\frac{\alpha}{m}\chi)^{\frac{-\frac{\alpha}{m}}{1+\frac{\alpha}{m}}}) \leq u(\frac{\frac{\alpha}{m}+\frac{\beta}{m}}{1+\frac{\alpha}{m}}\overline{y})((\frac{\alpha}{m}\widetilde{\chi})^{\frac{1}{1+\frac{\alpha}{m}}} + \widetilde{\chi}(\frac{\alpha}{m}\widetilde{\chi})^{\frac{-\frac{\alpha}{m}}{1+\frac{\alpha}{m}}}) \\ E[U(p^*_{sc})|y_1 = \overline{y}] \leq E[U(p^*_{ic})|y_1 = \overline{y}] \end{gathered} \tag{8}$$

However, once y_1 is revealed, expected utility with the insurance contract is not necessarily greater than expected utility from savings. For example, if $y_1 = y_H$, expected utility is higher with savings strategy for any positive value of β. The implicit contract with the storekeeper, therefore, is vulnerable to strategic default in which customers with high income avoid or delay repayments on their debts or purchases at the store until some time in the future when their income is low again.

For the store to offer actuarialy fair insurance as implied in the contract, customers with high incomes must be willing to refrain from defaulting after their income for the period is revealed. This can be expressed as an incentive compatibility constraint requiring that at the high end of the expected distribution of incomes, the expected utility of remaining in the contract higher than that of switching to buy at the market minus a penalty enacted by the store of Z. This penalty may include a combination of blocking access to credit in the future for some number of periods and social sanctions. The effectiveness of the penalty is diluted by the number of local shops in the area, since the customer cares less about being cut off from one source of credit or social contact if there are other potential credit sources to access. For this reason, all else being equal, as the number of stores increases, the supportable level of insurance(β) decreases. So we expect to see implicit contracts with a stronger insurance component in areas with few stores.

$$\begin{aligned} EU(p^*_{ic}|y_1 = y_H) &\geq EU(s_{nc}|y_1 = y_H) - \frac{Z}{n} \\ u(\frac{\frac{\alpha}{m}+\frac{\beta}{m}}{1+\frac{\alpha}{m}}\overline{y})((\frac{\alpha}{m}\widetilde{\chi})^{\frac{1}{1+\frac{\alpha}{m}}} + \widetilde{\chi}(\frac{\alpha}{m}\widetilde{\chi})^{\frac{-\frac{\alpha}{m}}{1+\frac{\alpha}{m}}}) &\geq EU(s_{nc}|y_1 = y_H) - \frac{Z}{n} \end{aligned} \tag{9}$$

3.1 Testable Implications

The use of store credit is clearly observed in Yemen, and the model presented above possible explanation for the implicit contract between customers and store owners that supports the repayment of this credit.

An alternative explanation would be to see credit as purely serving a convenience function to reduce the transactions costs of carrying cash at every visit to the store. Instead of an endogenous credit limit serving as an incentive for repayment, there is some external mechanism for enforcing repayment at random times. This implies that the expected value of observed level of credit at any time would be directly related to the level of consumption. Therefore an increase in income increases consumption and therefore average debt levels and negative shocks to available income decrease average debt levels. Aggregate increases in income have the expected positive effect on prices due to increased demand.

The second model allows for investment in reputation, but without any conditionality of credit availability on the customer's situation. There is no predicted effect of a temporary aggregate income shock on prices beyond the normal effect of increased demand and average prices are lower in areas with greater competition. With this savings only contract, increases in current income (y_1) lead to an increase in debt repayment (p) in the first period. Conversely, repayment decreases with increases in the future period expected income.

The third model is the credit as savings and insurance contract, in which there is both investment in reputation and credit availability is conditional on customer income. In common with the second model, we expect customer behavior to follow a buffer-stock savings strategy, with repayment increasing with current income and decreasing with expected future income. However, because the incentive to buy from the store at all varies with current income, an increase to future income shock is predicted to cause a decline in prices as the store adjusts the markup to correct the implicit price of insurance for an environment of reduced demand. The degree to which this occurs depends on the degree to which there is an insurance function for credit (value of β). Because the expectation of repeated interactions is necessary to sustain a high level of β, the prediction is to see a drop in price in areas with few stores.

Because the savings only contract returns transfers to every customer in the second period, there is no change in store profits or incentive to change the level of markup as a result of expected increases in second period income (ω). Note that the fact that any transfers to or from the store are eventually returned follows from the defintion of a savings only contract, since any other contract would implicitly be transfering resources between customers, based on their choice of repayment in each period, which means it acts as an implicit insurance contract.[2]

The test to take to the data, therefore, is twofold. First, this paper rejects a pure convenience function for store credit in Yemen, by showing that store

[2] Or theoretically this could take the form of an anti-insurance risk-increasing contract, but in a world of risk-averse customers there is no demand for such a contract.

debt acts as a negative savings account with positive shocks causing increases in repayment and negative shocks causing decreases in repayment. Secondly, it shows that in the areas where dynamic incentives are most likely to occur, the effect of a positive income shock on prices is consistent with the existence of an informal insurance contract allowing risk-sharing across the population of customers.

4 Data

The data used come from two surveys related to a workfare program in Yemen. LIWP (Labor Intensive Works Program) is a cash-for-work employment program run by the Yemen Social Fund for Development. LIWP provides short term work opportunities in poor communities in the construction of labor intensive community infrastructure projects such as repairing roads and constructing rainwater harvesting systems. In treated villages, approximately 74% of households have a member participate in the program, and participants receive an average payment of approximately $450 for two months of work. In the absence of the intervention, average monthly income per household in the target villages was about $160. The first data source is a household survey conducted as part of an impact evaluation of the LIWP intervention. In 2010, half of a set of eligible commu- nities were assigned to receive treatment in the second wave of the program, with the remainder deferred until the third wave. This randomized assignment provides exogenous variation in household income. Baseline household and com- munity surveys were collected prior to the start of the interventions in May 2010, and the expost data were collected during or after the program had ended in October/ November 2011. The intervening months fell in a period of major economic and political crisis in Yemen, with rising prices for staple goods and petrol and and reduced opportunities for casual labor that was the main form of employment in the targeted villages. The second data source is a survey of shopkeepers in villages with LIWP in- terventions collected in August 2013. Shopkeepers were asked speciffically about debt levels and publicly known shocks experienced by 5 randomly selected LIWP participants and 5 non-participants from among their customers. While the po- litical situation had stabilized, there has been only limited economic recovery since 2011.

5 Results

5.1 Store Credit is Used to Smooth Consumption Over Time

This section of the paper presents evidence that debt repayment varies directly with current income levels, rejecting the most restrictive model of store credit and showing that store credit acts as a store of value that allows customers to smooth consumption over time. We identify this relationship using both the

randomly assigned income shock caused by LIWP treatment and using publicly known shocks reported by the storekeeper.

5.1.1 Using LIWP Income Shock in Randomized Control Trial

The LIWP intervention was a positive shock to incomes by providing relatively highly paid work in a context with widespread underemployment. While incomes were poorly measured in the household survey, our impact evaluation of the intervention suggested that average wage income per household increased by about 3800-4800 riyals per month ($18-23) or about an 11-13% increase over baseline income. We estimate the impact of this positive income shock on debt repayment in a differences in differences framework using the estimating equation $Debt_{it} = Expost_t + LIWP_t\beta + FE_i + \epsilon_{it}$, where $LIWP_t$ is the average treatment effect of the intervention (ITT) and $Expost_t$ is the time trend. In general, due to the economic and political crisis that occured between baseline and expost data collection, the time trend is negative for all economic indicators.

The household survey asked respondents whether they had been in debt during the past 12 months, and if so, to whom the debt was owed, the total amount of the debt, and how much was repaid. Because multiple responses could be given to the question of whom the debt is owed to, the entire debt amount recorded in the survey is not necessarily debt owed to storekeepers, however consistent with the evidence above that store debt is the most quantitavely important form of debt in Yemen, 71% of households who were in debt at baseline reported that they were indebted to local store owners.

The results in Tables 3 and **??** show that the LIWP intervention did not significantly influence the probability that a household had been in debt during the year, or in debt to a storekeeper specfically. Nor did it increase the average amount of borrowed as would be expected in a purely convenience model of store credit. If anything, the amount borrowed actually decreased, although the coefficient is not statistically significant. However, the LIWP program intervention did significantly increase the amount of debt paid off in the past year. In Table 3, I estimate the effect of the LIWP intervention on debt repayment using all households in communities with 5 or fewer stores, but am left with missing observations for households that had no debt during the year to repay. In Table **??**, I limit the analysis to households that were indebted at baseline, which mostly elimates the potential selection bias of not including non-indebted households. The corresponding estimates for the impact of LIWP on debt repayment is an increase of 20,843 riyal ($98), or about 20% of the average amount borrowed across all households, or 15,170 riyal ($71) 12% of the average amount borrowed when limiting the sample to control for selection bias. In other words, one third to one half of the estimated increase in annual incomes due to the LIWP intervention was devoted to increasing debt repayment.

These empirical findings in the LIWP data are supported by self-reported behavior. When asked directly in the household survey how they spent income from the program, 44% of respondents indicated that they used project income for debt repayment. Also, in focus group discussions, both participants and

shopkeepers mentioned increased debt repayment as a notable result of the LIWP intervention.

5.1.2 Using Time Series Variation in LIWP Income

The data in the shopkeeper survey provides a supplementary opportunity to test for the impact of fluctuations of income on debt repayment. By matching the storekeeper records on credit and debt repayment with LIWP payment records, we use month to month variation in program income to identify the average share of LIWP income devoted to debt repayment. Month to month fluctuations in income from the project are plausibly exogenous because 1) work opportunities for different jobs fluctuated due over the course of the project completion due to engineering constraints, 2) start dates for projects were impacted by factors such as community decision making speed and consultant schedules that are unrelated to fluctuations in household budgets, and 3) cash paid per month did not necessarily correspond with earnings for the previous month as payrolls were delivered unpredictably and it often happened that households that missed the delivery in one month picked up their cash the following month.

Using the shopkeeper data, we estimate approximately 10% of LIWP income is used for debt reduction. Table 4 shows our preferred specification (columns 2-4). As we only have four months of credit and repayment data, there is relatively little variation in LIWP income between periods for each customer, but there is still an indication of a negative relationship between income and debt level (column 5). Using purely cross-sectional variation is problematic, however, because clearly customers who participate in LIWP differ systematically from non-participants, and households with high LIWP income due to more days worked or more highly skilled work may be larger or better-off than households with low LIWP income. To address these issues, we include only LIWP participants (columns 1-4) and control for the fixed-debt of the household which is an indicator of normal levels of credit and purchasing (columns 2-4).

5.1.3 Publicly Known Idiosyncratic Income Shocks

Finally, the shopkeeper survey data allows us to test whether credit levels reflect idiosyncatic publicly known past shocks experienced by the customer. In the shopkeeper survey, we asked shopkeepers to recall negative shocks experienced by customers during the past year (including illness, deaths in family, loss of job, agricultural misfortune, etc.). Our data thus by necessity focuses on those shocks which are public knowledge. The shopkeepers recalled 25% of customers as having experienced at least one shock in the past year, while 7% experienced multiple shocks.

The regression results in table 10 show that having a negative shock in the past year increased the average debt level at the end of Ramadan (just prior to data collection) by approximately 8106 riyal ($38) for non-LIWP participants. Having more than one negative shock in the past year did not increase the average debt level beyond having a single negative shock, indicating combination

of (perhaps) lower expectations about future earnings plus the existence of a debt limit. In specification (2) the coefficient on multiple shocks is negative, and while the standard error is large, at the maximum it suggests that true coefficient could be slightly positive, and far less than the impact on debt level of the first shock. We ignore participants (in specification (3) the coefficient is still positive, but smaller in magnitude and not significant), because as will be shown below, the LIWP program income significantly affected their use of credit.

Although the panel structure of our data is limited, we can look at two months (Rajab and Shaaban) for which we have data from shopkeepers about both debt levels and negative shocks experienced by households within that month, allowing us to control for household fixed effects. This allows us to control for cross-sectional variation in household average income and consumption levels. Again, we find that for non-participants, the experience of a negative shock led to higher debt levels at the end of the month.

That negative shocks increase debt up to a certain point (after which "savings" are exhausted) is supported by direct questions to the shopkeepers in our survey about how whether they were asked whether the customer had asked for help in dealing with the shock and if so, how the shopkeeper had responded. (These questions were asked at the conclusion of the survey and separate from recall questions about shocks). In our dataset 67% of customers who experienced job loss or illness in family asked for help from shopkeeper (69% of customers who experienced single shock, 54% of customers who experienced multiple shocks). See table (14).

Storekeepers reported that 22% of their customers had bad debt, of which 36% cleared their debt during the year, showing that there is a strong incentive for customers to clear bad debt rather than writing it off.

Storeowners also reported that they are highly informed about customers' incomes and ability to repay. 94% of shopkeepers in villages with LIWP interventions in the shopkeeper survey reported that they were aware of which of their customers were participating in LIWP, and on checking with LIWP registration information, they were correct 91% of the time. 65% of shopkeepers claimed to know about labor incomes of their customers and 84% knew about transfers from the Social Welfare Fund.

5.2 Store Credit is Used to Share Risk Across Customers

This section of the paper presents qualitative and indirect evidence consistent with the third model, in which there is an implicit insurance constract where access to credit is conditional on the customers income situation in any given period.

5.2.1 More Competitive Markets are Correlated with Less Reported Use of Credit as Insurance

As discussed above, this type of insurance contract is only sustainable if there are relatively few stores, and because the markup includes the cost of insurance, an aggregate income shock should lead stores to drop prices to prevent customers from defaulting.

While the model above assumed a single local shop, the number of shops per village in our sample ranges from zero to 9, with a mean of approximately 4 [double check this]. In a community with a single shop, reputational incentives are strongest because customers must return to the shop to request credit in the future with high probability. As the number of shops increases, however, it becomes possible for a customer to default on one shop, but still hope to get credit at another shop, meaning that the equilibrium value of α (measure of the degree of insurance role) is lower in markets with more stores.

We can look for some correlations between self-reported behavior in the LIWP data set. During the baseline data collection, 66% of households in the LIWP sample reported that they had trouble providing food during the past year. Of these, 61% (39% of all households), listed buying on credit from local shops as a coping strategy for responding to food insecurity. Table 5 shows that customers in villages with more stores are less likely to report using shop credit as a coping strategy for food insecurity and more likely to have borrowed from sources other than a storekeeper. This is consistent with a story in which because of the lack of expected repeated interactions, insurance cannot be easily bundled with consumption, so it the insurance role of store credit is substituted by mutual insurance.

From informal interviews with LIWP participants in Al Hodeidah city and surrounding areas as well as in more isolated villages, while both sets of participants used shop credit, the use of shop credit as insurance was only reported in isolated villages. In isolated villages, shopkeepers were reported to be "patient" about repayment if they knew that the customer was experiencing a negative shock, while shopkeepers in urban areas demanded debt repayment within at most two months.

Table 6 shows how the presence or absence of store credit as insurance affects the debt repayment reaction to shocks. Since customers benefit from an insurance role of credit to the extent that they are allowed to delay repayment, the degree to which the economic crisis allowed more delays or greater accumulation of debt is a proxy for the insurance function of the store credit. We see in the first column (All control) that repayment rates were significantly higher in communities with more stores. In the second and third columns, we see that in communities with more than 2 stores, the share of debt repaid increased as a result of the crisis, while in communities with fewer than 2 stores, there was no trend towards greater debt repayment in expost except for communities with the LIWP intervention.

In the shopkeeper dataset, our sample is limited to areas with 4 or fewer stores, but we do find a signficant correlation between the probability of cus-

tomers having bad debt (as reported by shopkeepers) and the the number of stores in the community. (Table 7)

5.2.2 Aggregate Income Shock Leads to Lower Prices is Non-Competitive Markets

From the model, we see that an aggregate income shock leads to lower prices to the extent that there is a threat of customers defaulting from the implicit insurance contract. As shown in the preceding section, markets with fewer stores are predicted to have more of an insurance role for credit, so the model predicts that a negative price effect of aggregate positive income shocks will occur in those markets. Another intuitive way to see this is that in monopolistic markets, consumption is bundled with insurance because there is sufficient expectation in repeated interactions to diminish moral hazard, while in competitive markets, credit is still offered, but only as a source of savings rather than as an insurance product.

While prices rose throughout Yemen, the increase was significantly lower in communities treated by the LIWP program. Data on prices are taken from from the household survey which had an average of 12 respondents per community. Households were asked for the price of a 50kg sack of flour in the village.

Table 1 shows the effect of the LIWP program on the price of wheat. Identification comes from the randomized assignment to LIWP treatment and double differences to control for any differences in baseline levels. The estimating equation is $d_{it} = Expost_t + LIWP_t\beta + FE_i + \epsilon_{it}$. The sample is split by number of stores per community, to focus specifically on the price effect in isolated, rural markets. The coefficient on LIWP treatment is the program treatment effect, while the coefficient on Expost is the time trend. As can be seen, there was a dramatic increase in prices of about 1800 riyal between baseline and expost, and in LIWP villages with fewer than 5 stores, a relative decline of 400-500 riyal. The average price of a sack of wheat at baseline was 4241 riyal (approximately \$20), so this represents was a 42% increase in prices in all villages, which was reduced to about 32% in villages with LIWP programs.

We can also show that the effect on prices is temporary, with a drop during the program followed by an increase after the program. This is consistent with our model in which prices drop to prevent short term default. While program timing was not random within the set of treated villages, heterogeneity in the program dates emerged based on factors such as how long it took for the community to agree the construction project, and the technical details of the project itself, which are plausibly exogenous to the price of staple goods in the village. Table 14 shows that prices fell during the LIWP program followed by increase after the program.

5.2.3 Excluding Alternative Explanations for the Relative Price Drop

We should exclude some other potential explanations about the reason that the relative drop in prices in treated villages might occur. Table 16 shows the

same regressions as table 1, but excluding villages with LIWP programs where there was improvements to roads, to verify that the negative price effect was not driven by a decrease in transport costs.

Wheat flour, eaten in bread and dumplings, is the staple calorie source in Yemen, so the price of flour is an important indicator for food security. It is also primarily imported, so price variations are determined by international markets plus retail markups. It is also not an inferior good: shopkeepers reported that demand increased and there is corroborating evidence in the nutrition module of the survey to the effect that consumption of wheat increased by approximately 10%. Nor were there economies of scale: only 7 out of 69 shopkeepers surveyed received any quantity discounts from their wholesalers and for these shopkeepers the discount received did not change compared to prior to the LIWP intervention.

Another potential concern with understanding the system of informal credit as an insurance transaction is that storekeepers might engage in price discrimination, charging higher prices to customers that pay late in order to indirectly charge interest. According to informal conversations with shopkeepers, price discrimination is not an open practice as it would probably be understood to violate Islamic prohibition on selling basic commodities for different prices where there is no difference in quality. Discounts may be given quietly to customers who do not take credit, but in contexts where almost all customers take credit there is not price discrimination based on the amount of debt or lateness in repaying. We can test this in the household survey data. The variation in prices reported within each community is generally within 1000 riyals. Within community variation in reported prices reported may result from prices being reported from different shops or with reference to purchases at different times. No evidence of correlation between relative price and income levels of the customers. As seen in table 15, there is no evidence that household that customers that take store credit report systematically higher prices than other households in the same community at baseline. In each of the specifications, the sign on the coefficient is negative, implying that if anything the households that take credit pay lower prices. The significance of the negative results is driven by a small number of outlier observations with extremely high debts, indicating either a data entry, and when they are removed, the coefficient is not statistically significant. [Fix table to reflect dropping outliers] The magnitudes however are very small and not economically meaningful, with the estimated difference between household that have and don't have store debt of only 9 riyals ($0.04) on a 5000 riyal sack of flour .

We also check whether the differences seen in pricing between communities with more stores and communities with few stores is a function of market of structure of simply isolation and higher transport costs to the village by looking for the same negative effect on prices but using distance or cost of travel to the nearest market as explanatory variables. The regressions in table 17 show that the interaction of LIWP treatment and number of stores is significant in explaining the negative price effect, while cost and distance are not. In columns (1) and (2) the coefficients on distance to market and distance interacted with

LIWP are not significant. In columns (3) and (4) the coefficent on cost to market is significant and positive (i.e. where the transport cost to market is higher, prices are higher), but the coefficient on the interaction with LIWP is non-significant and positive, rather than negative as would be expected if the negative price effect in communities with few stores was being driven by higher transport costs. By contrast in columns (5) and (6) we see that communities with more stores have lower prices generally, but the interaction with LIWP is significant and positive, indicating lower prices in areas with fewer stores as seen earlier.

6 Conclusion

Using our estimated ratio of income to debt repayment of 10%-14% (estimates from shopkeeper survey and LIWP data respectively) of the on average transfer of $500 and an estimated decline in prices of 10%, we can make a rough calculation of the spillover benefits of the LIWP income transfers. Assuming that all villagers buy one basket of goods each month, the average transfer of $500 which went to 70% of the village would lead to additional total repayment per customer of $35-$49 for the storekeeper, and $8 per month each month or $48per household.

Our finding that the effect on debt repayment can mitigate or reverse the expected increase in prices due to an infusion on cash in shallow markets is important for understanding the general equilibrium effects of social programs. On the one hand, customers benefit from the insurance function as seen in their ability to accumulate large amounts of debt during the crisis in villages with few stores. On the other hand, a large share of their income went to repaying this debt, and protecting shopkeepers from defaults, which is only partially redistributed among customers via a decrease in price levels.

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Tables

Table 1

Table 1: Negative Price Effect

	Price of 50kg sack of flour in village			
	All	$stores < 2$	$2 <= stores < 5$	$stores > 5$
LIWP Treatment	-130.7	-414.9**	85.2	472.0
	(118.7)	(159.8)	(174.3)	(290.7)
Expost	1762.5***	1947.4***	1606.6***	1534.5***
	(84.3)	(122.5)	(113.5)	(238.6)
Fixed effects	Comm	Comm	Comm	Comm
Observations	1475	609	462	252
Mean Dep. Var.	5328.7	5279.3	5278.8	5375.2

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Program treatment effect on the price of wheat. In the first column households in all communities in the sample are included, while subsequent columns restrict the sample to households in communities to those with the indicated number of grocery stores per village. From LIWP RCT dataset.

Table 2: LIWP Impact on Household Debt Paid Off

	In Debt	Debt Amount	Paid Off	Assets Sold
LIP Program	0.0302	-61143.2	20843.0**	-5636.7
	(0.0455)	(63372.6)	(8437.5)	(10334.6)
Expost	0.0436	79164.5	3162.0	16827.7*
	(0.0354)	(61592.4)	(5885.9)	(9328.4)
HH FE	Yes	Yes	Yes	Yes
Observations	1339	1338	1017	1331

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Regression results for LIWP impact on total debt amount of debt repaid, and value of assets sold in past 12 months in control and treatment villages before and after the intervention. Only communities with fewer than 5 stores are included to focus on village-type markets. In Debt: was the household in debt during the 12 months. In Debt to Storekeeper: household was in debt in past 12 months and storekeeper listed as a creditor. Amount of Debt: amount of debt during the past 12 months, with zero for households that were not in debt. Amount of debt paid off: for households that reported having been in debt during past 12 months, how much was paid off. Standard errors are clustered at community level.

Table 3: LIWP Impact on Debt Repayment

	In Debt to Store	Debt Amount	Amount Paid	Amount Paid
LIWP Treatment	0.04	-61143.23	20843.00**	15170.35**
	(0.06)	(62786.22)	(8357.44)	(7241.41)
Expost	-0.03	79164.53	3161.97	2870.52
	(0.04)	(61022.55)	(5830.10)	(4685.90)
Fixed effects	HH	HH	HH	HH
Observations	1338	1336	828	962
Mean Dep. Var.	0.65	118439.54	26621.95	23818.84

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Regression results for LIWP impact on total debt amount of debt repaid, and value of assets sold in past 12 months in control and treatment villages before and after the intervention. Only communities with fewer than 5 stores are included to focus on village-type markets. In Debt to Storekeeper: household was in debt in past 12 months and storekeeper listed as a creditor. Amount of Debt: amount of debt during the past 12 months, with zero for households that were not in debt. Amount of debt paid off: for households that reported having been in debt during past 12 months, how much was paid off. Final column is restricted to households that reported being in debt in past 12 months at baseline. Very few households that were in debt at baseline were not also in debt at expost, mostly elimating the selection issue in measuring the impact on amount of debt repaid. Standard errors are clustered at community level.

Table 4: LIWP Impact on Debt Repayment

	Net Debt Repaid	Net Debt Repaid
Any LIWP Income Prev. Month	1772.2	
	(1.30)	
LIWP Income Prev. Month		0.0899***
		(2.71)
month==Shaaban	1334.7	1452.7
	(1.59)	(1.50)
month==Ramadan	-1332.7	-5770.0***
	(-1.32)	(-3.26)
month==Shawwal	-3856.9**	-5591.3***
	(-2.64)	(-3.26)
Fixed Effects	Customer	Customer
Observations	2671	365
Mean Dep. Var.	-10418.2	-11248.6

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Standard errors clustered at village level

Table 5: Self-Reported Use of Credit as Insurance

	Use Credit as Coping Strategy		Borrowed from Other Source	
	(1)	(2)	(3)	(4)
At Least 5 Stores	-0.12		0.09	
	(0.08)		(0.07)	
2 to 4 Stores	-0.04		0.02	
	(0.08)		(0.06)	
Number of Stores		-0.023*		0.017
		(0.099)		(0.015)
Mean Dep. Var	0.698	0.698	0.540	0.540
Observations	390	390	774	774

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Share of customers that reported using shop credit as a coping strategy for food insecurity and share of customers with non-store debt by type of market

Table 6: Effect of Shock on Debt Repayment

	Percent Repaid		
	All control	$n \geq 2$	$n < 2$
At Least 5 Stores	0.08*		
	(0.04)		
2 to 4 Stores	0.08**		
	(0.04)		
Expost	0.06	0.07	-0.01
	(0.04)	(0.04)	(0.05)
LIWP treatment		-0.02	0.13**
		(0.05)	(0.06)
Mean Dep. Var.	0.21	0.24	0.20

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The economic crisis effect on debt repayment in competitive vs. monopolistic markets. (n refers to average number of stores in project villages)

Table 7: Correlation of Market Structure and Bad Debt

	Share Transactions Credit	Share Bad	Share Bad Clear
Number stores	-0.06**	0.06*	0.02
	(0.03)	(0.03)	(0.13)
N	69	69	56
Mean Dep. Var.	.503	.182	0.363

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Correlation Between Share of Customers Taking Credit and Price of Consumption Basket

	Price of Basket	Markup vs. Hodeidah
Share of Customers that Buy on Credit	2055.18**	0.09**
	(979.53)	(0.04)
N	647	648
Mean Dep. Var.	14277	0 .0168

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Correlation Between Share of Customers Taking Credit and Price of Consumption Basket.

Table 9: Correlation Between Food Insecurity and Debt Repayment

	Percent of Debt Repaid in Expost Survey			
	Control	Treatment	Control	Treatment
Food Insecure	-0.084***	-0.045*	-0.102***	-0.059**
	(0.024)	(0.026)	(0.025)	(0.027)
Food Shortage			0.056***	0.046**
			(0.021)	(0.021)
Observations	393	429	393	429

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Food shortage here means that household responded that had trouble providing food during past 12 months, food insecure means that adults or children skipped some meals due to food shortage. Data from LIWP RCT survey.

Table 10: Cumulative Effect of Shocks on Debt Repayment

	Debt Level			
	Non-Participants		Participants	
Negative Shock in Past Year	8106.79*	10636.41*	1933.47	3742.11
	(4430.47)	(6089.77)	(3448.58)	(4331.82)
Multiple Negative Shocks in Past Year		-7299.73		-4756.53
		(6275.39)		(3475.69)
Observations	266	266	393	393

Random effects, standard errors clustered at the store level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Effect of shocks during past year on debt level of customer at the beginning of Ramadan (25% of customers had single shock, 7% had multiple shocks). Data from shopkeeper survey.

Table 11: Effect of Single Shock on Debt Repayment

	Current Debt Level		Monthly Debt Level	
	Non-Participants	Participants	Non-Participants	Participants
Negative Shock in Past Year	8106.79*	1933.47		
	(4430.47)	(3448.58)		
Shock in Past Month			7147.07**	-2191.16
			(2810.97)	(2838.00)
Month FE			Yes	Yes
Observations	266	393	542	774

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Effect of shock during the month on debt level at the end of Rajab and Shaaban. Data from shopkeeper survey.

Table 12: Shopkeeper Reported Responsiveness to Customer Income

Shopkeeper's response:	Single Shock	Multiple Shocks	Total
Increased credit	22	1	23
Delayed repayment	44	23	67
Gave charity	9	7	16
Other	3	2	5

Table 13: Negative Price Effect in Shopkeeper Data

	Basket Markup	Flour Markup
During LIWP	-0.04**	-0.08***
	(0.01)	(0.02)
After LIWP	0.07***	0.15***
	(0.02)	(0.02)
N	648	696
Mean Dep. Var.	0.02	0.06
Fixed effects	Project	Project

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14: Monthly prices in village shops relative to start date of LIWP intervention. Dry basket excludes oil due to concerns about measurement error related to variation in container size.

	Price of 50kg sack of flour	
	HHs with Store Debt	All HHs
Store Debt (10,000s)	-0.15	
	(0.12)	
Any Store Debt		-19.31
		(42.27)
Community FE	Yes	Yes
Observations	322	626

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15: Lack of price discrimination seen via regression of relative price level to household debt status (baseline only). Debt is measures in thousands of riyals and price in riyals.

Table 16: Negative Price Effect - Excluding Road Projects

	Price of 50kg sack of flour			
	All	$stores < 2$	$2 <= stores < 5$	$stores > 5$
LIWP treatment	-34.7	-591.1***	30.2	507.2**
	(160.0)	(170.2)	(169.4)	(234.2)
Expost	1809.7***	1927.6***	1605.0***	1538.1***
	(83.5)	(109.1)	(108.3)	(176.6)
Observations	1378	656	447	275

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Program treatment effect on the price of wheat, excluding villages in which the LIWP project involved road repair or construction.

Table 17: Market Structure Drives Negative Price Effect

	Price of 50kg sack of flour		
	(1)	(2)	(3)
LIWP Treatment	-326.4**	-288.5**	-514.6***
	(152.1)	(129.2)	(193.0)
Expost	1788.0***	1787.0***	1789.7***
	(90.1)	(95.0)	(89.7)
Distance * LIWP	0.7		
	(0.7)		
Cost * LIWP		0.2***	
		(0.1)	
Num. Stores * LIWP			128.2*
			(69.5)
Community FE	Yes	Yes	Yes
Observations	1150	1064	1159

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Comparison of distance to market, cost of travel to market, and number of stores as explanatory variables for the negative price effect of LIWP intervention in communities with few stores

7 Appendix: Proof of Equation 8

$$E[U(p^*_{ic})|y_1 = \overline{y}] > E[U(p^*_{ic})|y_1 = \overline{y}] \tag{10}$$

Recall:

$$E[U(p^*_{ic})|y_1 = \overline{y}] = u(\frac{\frac{\alpha}{m} + \frac{\beta}{m}}{1 + \frac{\alpha}{m}}\overline{y})((\frac{\alpha}{m}\widetilde{\chi})^{\frac{1}{1+\frac{\alpha}{m}}} + \widetilde{\chi}(\frac{\alpha}{m}\widetilde{\chi})^{\frac{-\frac{\alpha}{m}}{1+\frac{\alpha}{m}}}) \tag{11}$$

$$E[U(p^*_{sc})|y_1 = \overline{y}] = u((\frac{\frac{\alpha}{m}y_1}{1 + \frac{\alpha}{m}})\overline{y})((\frac{\alpha}{m}\chi)^{\frac{1}{1+\frac{\alpha}{m}}} + \chi(\frac{\alpha}{m}\chi)^{\frac{-\frac{\alpha}{m}}{1+\frac{\alpha}{m}}}) \tag{12}$$

We can show that insurance contract is preferable at least at $\frac{\alpha}{m} = 1$.
Proof:

$$2u((\frac{1}{2} + \frac{\beta}{2m})\overline{y})\widetilde{\chi}^{\frac{1}{2}} > 2u(\frac{1}{2}\overline{y})\chi^{\frac{1}{2}} \tag{13}$$

$$2u((\frac{1}{2} + \frac{\beta}{m})\overline{y})(\frac{u(y_H(1-\frac{\beta}{m})) - u(y_L(1-\frac{\beta}{m}))}{\gamma(y_H(1-\frac{\beta}{m}) - y_L(1-\frac{\beta}{m}))})^{\frac{1}{2}} > 2u(\frac{1}{2}\overline{y})(\frac{u(y_H) - u(y_L)}{\gamma(y_H - y_L)})^{\frac{1}{2}} \tag{14}$$

Both sides are negative and $u((\frac{1}{2} + \frac{\beta}{m})\overline{y}) > u(\frac{1}{2}\overline{y})$, so want to show that $\widetilde{\chi}^{\frac{1}{2}} \leq \chi^{\frac{1}{2}}$.

For $\frac{\beta}{m} = 0$,(minimum value), $\widetilde{\chi}^{\frac{1}{2}} = \chi^{\frac{1}{2}}$.

As $\frac{\beta}{m}$ increases, $\widetilde{\chi}^{\frac{1}{2}}$ decreases (denominator increases and numerator decreases):

$$\frac{d}{d(\frac{\beta}{m})}\left(-e^{-\gamma((1-\frac{\beta}{m})y_H)} + e^{-\gamma((1-\frac{\beta}{m})y_L)}\right) = -(y_H\gamma)e^{-\gamma((1-\frac{\beta}{m})y_H)} + y_L\gamma e^{-\gamma((1-\frac{\beta}{m})y_L)} \tag{15}$$

So can conclude that $\widetilde{\chi}^{\frac{1}{2}} \leq \chi^{\frac{1}{2}}$

So:

$2u(\frac{1}{2}\overline{y})(\frac{\chi}{\widetilde{\chi}})^{\frac{1}{2}} \leq 2u(\frac{1}{2}\overline{y}) \leq 2u((\frac{1}{2} + \frac{\beta}{m}\overline{y})$