Too Vulnerable for Microfinance? Risk and Vulnerability as Determinants of Microfinance Selection in Lima

Abstract:
Despite dramatic microfinance growth, formal credit use by poor households remains low. There is increasing evidence of muted demand, suggesting a link between the risk of projects financed by credit and households' risk management. This paper analyzes these links using panel data on urban microentrepreneurs in Lima, based on a model in which the risk of projects and the ability to manage risk determine if a household seeks microfinance. Controlling for unobservable traits like risk aversion and skill, results suggest that more vulnerable entrepreneurs are significantly less likely to use microfinance than their less vulnerable counterparts.

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In the past 30 years microfinance has become a popular part of poverty reduction agendas of governments, NGOs and multilateral institutions. With the help of significant enthusiasm and support the industry has spread around the world, and recent estimates are that more than 3,500 microfinance institutions collectively serve almost 150 million clients worldwide (Daley-Harris, 2009). Despite dramatic growth, there is an infrequently cited puzzle about microfinance, which is that many institutions face low penetration rates, i.e., a significant number of potential borrowers never seek microfinance loans. For example, in the case of Peru, the country of focus of this analysis, it is estimated that only five per cent of all microentrepreneurs access credit from MFIs (Berger, 2003)[1]. While this could be entirely a supply side phenomenon, with poor borrowers quantity rationed by lenders, the high dropout rates experienced by many microfinance institutions coupled with recent evidence that many entrepreneurs deemed creditworthy by lenders have no interest in microloans suggest that muted demand also plays a role (CGAP, 2000; Johnston and Morduch, 2008, Banerjee et. al 2010).

Recognizing the income risk and vulnerability that many poor households face, much of the nascent research on the demand for formal credit has focused on the interplay between the risk profiles of projects financed by the credit and households' ability to manage that risk. This work builds on the large body of theoretical and empirical literature that argues that vulnerability - defined as the inability to smooth consumption across negative shocks - leads households to underinvest in profitable but risky projects (Dercon and Christiaensen, 2011; Fletschner et al., 2010; Fafchamps, 2003; Eswaran & Kotwal, 1990; Morduch 1995). Given that credit use frequently is linked to project choice, the extension to credit markets is natural. For example, Boucher and Guirkinger (2007) present a theoretical model in which borrowers face a choice between less expensive formal loans that require collateral and more expensive informal loans that do not, but involve more monitoring by the lender. They find that some borrowers with sufficient wealth to meet collateral

requirements forgo formal loans due to the added risk of posting collateral. Using data on rural households in Peru, Boucher, Guirkinger and Trivelli(2010) find evidence that this type of risk rationing can explain a portion of low formal credit use. Finally, using a field experiment with farmers in Malawi, Giné and Yang (2009) test if a lack of insurance can explain the low uptake of credit provided for high yielding but more risky crops.

This paper similarly explores the relationship between project risk, vulnerability and formal credit use, but unlike previous work it does so within an urban context, focusing on non-agricultural activities and microfinance as the predominant source of formal credit. The extension to urban households is important given the increasing recognition of the size of the microenterprise sector in generating employment and income in the developing world and new questions about whether or not access to credit is sufficient for these firms to grow. Meanwhile, the extension to microfinance is important because many microfinance institutions have minimal or non-existent collateral requirements, which means that the risk of losing collateral cannot be a dominant explanation for low uptake. In lieu of collateral requirements, we focus on size as another difference between formal and informal loans: as shown in Table 2, microfinance loans are three to six times larger than loans from informal sources, including suppliers. If there are production non-convexities - and recent literature has not been able to rule them out at higher levels of capital - larger projects may have higher returns (McKenzie and Woodruff 2006). However, they also may have more risk, particularly if they take the form of bulky inventory which has a higher probability of being stolen or remaining unsold. These risks are particularly salient for entrepreneurs operating in urban environments and may provide an important, additional explanation for why borrowers who qualify for microfinance loans eschew them.

The paper starts with a theoretical model of project choice and microfinance use. The model assumes that microentrepreneurs can finance low yield/low risk enterprises with internal

funds or informal loans but require a larger microfinance loan to finance high yield/high risk enterprises. It also assumes that given the need to fund the enterprise, entrepreneurs hit with a negative shock must rely on non-microfinance sources, such as informal loans, to smooth consumption. The model predicts that even after controlling for skill and wealth, more vulnerable entrepreneurs reject the high yield activity with microfinance for the safer option.

The theoretical predictions are then tested using panel data on microentrepreneurs in Lima, Peru. Given the short nature of the panel, which limits the ability to measure vulnerability based on households' response to shocks, indirect measures based on entrepreneurs' links to informal networks, a principal source of consumption credit, are employed. Selection is addressed through a random effects panel probit model, controlling for several observable, individual and enterprise level characteristics and unobservable, time-invariant characteristics, such as risk aversion and skill. Several robustness checks are undertaken to ensure that the vulnerability measures capture access to social networks rather than alternative factors that impact microfinance participation, in particular the possibility that the measures proxy for the supply of credit or idiosyncratic income shocks. Overall I find corroboration of the theoretical results. More vulnerable entrepreneurs are significantly less likely to have a microfinance loan than their less vulnerable counterparts.

The paper proceeds as follows. Section two develops the theoretical model. Section three describes the data. Section four empirically estimates the determinants of microfinance participation. Section five contains robustness checks. Section six concludes.

2. Theoretical Model

2.1 Setup

Consider a two period model in which risk-averse entrepreneurs make decisions to maximize expected lifetime utility. Entrepreneurs begin period one with an exogenous skill endowment that

can be either high (T_H) or low (T_L). They also begin with an endowment of liquid wealth, such as household durables or cash, drawn from a uniform distribution over the range $[\underline{W}, \overline{W}]$. All values earn zero interest.

Entrepreneurs choose between two projects; a risky enterprise (*RE*) and a safe enterprise (*SE*). Both require a fixed, working capital investment to operate. Liquid wealth and informal loans from moneylenders, family and friends are sufficient to cover the investment for the safe enterprise, but insufficient to cover the investment for the risky enterprise[2]. Only a formal lender, in this case a microfinance institution, can provide a loan sufficiently large to make the risky enterprise investment. Thus to choose the risky enterprise entrepreneurs must take out a microfinance loan. The microfinance institution, on the other hand, cannot view skill and therefore lends the same amount (MF) and charges the same interest rate (b) to all borrowers who meet the collateral requirement of $\underline{W}$. Since all entrepreneurs qualify for loans, this shifts the focus purely to demand.

Enterprise returns are realized at the end of period one. Safe enterprise returns are constant across skill and state realizations. Risky enterprise returns are uncertain and depend on the state of nature, which can be either good (G) or bad (B). The probability of a good state is p_H for a high skill entrepreneur and p_L for a low skill entrepreneur, where $p_H > p_L$. The risky enterprise has a higher return than the safe enterprise in a good state but a lower return in a bad state ($R_{RE}^G < R_{SE} < R_{RE}^B$). The expected return of the risky enterprise, however, is greater than that for the safe enterprise for both skill types.

After gross returns are realized entrepreneurs decide about loan repayment. The microfinance institution offers no repayment flexibility and if a borrower fails to repay she is barred from any future loans. This assumption is based on standard practice in the microfinance industry, which is to adhere to strict repayment schedules and harsh default penalties (see Section 3). The absence of

flexibility means that if a borrower defaults the risky enterprise must be abandoned in the second period. The microfinance institution also seizes wealth placed as collateral. Risky enterprise returns net of loan repayment are positive in a good state and zero in a bad state:

$$\begin{aligned} &= R_{RE}^{G} - (1+b)MF > 0 \quad \text{w/probability} = p_T \\ &= R_{RE}^{B} - (1+b)MF = 0 \quad \text{w/probability} = (1-p_T) \end{aligned} \tag{1}$$

At the beginning of the second period entrepreneurs again choose projects. Second period income is certain for both enterprises, and second period risky enterprise income equals expected first period income. For borrowers that default or choose the safe project, second period income equals R_{SE}. For borrowers that do not default second period income equals $E(R_{RE}^{T}) - (1+b)MF > R_{SE}$. Entrepreneurs therefore have an incentive to continue the risky enterprise if a bad state is realized, as it leads to higher second period income[3]. Finally, an entrepreneur cannot take out a microfinance loan in the second period if she did not do so in the first period.

2.2 Vulnerability and Consumption Credit

Up until this point entrepreneurs have no source of consumption credit because diversion of microfinance loan funds to consumption leaves insufficient working capital to operate the enterprise and zero income. Without consumption credit the entrepreneur must use liquid wealth if a bad state is realized. While this is realistic, it yields the unsatisfactory conclusion that the ability to smooth consumption depends only on wealth. In reality it also depends on access to credit, which may be uncorrelated with wealth. To explore this dimension, assume no correlation between access to consumption credit and wealth. Consumption credit is defined as:

$$\gamma(E(R_{RE}^{T}) - (1+b)MF), \text{ where } \gamma \in [0,1] \tag{2}$$

Gamma comes from informal sources and carries no interest; it dictates the portion of certain second period income an entrepreneur can borrow in the first period.[4] Higher γ values imply less vulnerability, while lower γ values imply more vulnerability.

2.3 Entrepreneur's Decisions

Entrepreneurs choose consumption to maximize expected lifetime utility: $EU = Eu(c_1) + Eu(c_2)$. Atemporal utility is increasing and strictly concave and the degree of time preference equals one. By comparing ex-post utility one finds that for all levels of skill, wealth and vulnerability, lifetime utility from the safe enterprise is higher than that from the risky enterprise if a bad state is realized, but lower if a good state is realized. Entrepreneurs know this when choosing projects in the first period.

To discern borrower's decisions, compare expected lifetime utility under both options for non-vulnerable entrepreneurs. For these entrepreneurs gamma is sufficiently high such that the borrowing constraint does not bind. Expected lifetime utility under the risky enterprise is:

$$p_T[2u(0.5(E(R_{RE}^T) + R_{RE}^G - 2(1+b)MF + W)] + (1-p_T)[2u(0.5(E(R_{RE}^T) - (1+b)MF + W)] \quad (3)$$

Entrepreneurs are indifferent between the safe and risky enterprise when expected utility is the same. The probability of a good state, $p_T = \hat{p}_T$, that solves indifference:

$$\hat{p}_T = \frac{u(R_{SE} + 0.5W) - u(0.5(E(R_{RE}^T) - (1+b)MF + W))}{u(0.5(E(R_{RE}^T) + R_{\mathrm{Re}}^G - 2(1+b)MF + W)) - u(0.5(E(R_{RE}^T) - (1+b)MF + W))} \quad (4)$$

$$\Rightarrow \hat{p}_T = \frac{u(safe) - u(risky_{bad})}{u(risky_{good}) - u(risky_{bad})}$$

The value of $\hat{p}_T$ depends on the degree of curvature in the utility function, but for any strictly concave function $\hat{p}_T \in (0,1)$. While it is not necessary to solve for an explicit value, it is necessary to

assume that $p_T > \hat{p}_T$. If this is not true we cannot generate predictions about microfinance selection as all entrepreneurs prefer the safe enterprise and no microfinance.

This leads to analyzing vulnerable entrepreneurs, for whom gamma is low enough such that the borrowing constraint binds. Lifetime expected utility under the risky option is:

$$\begin{aligned} & p_T[2u(0.5(E(R_{RE}^T) + R_{RE}^G - 2(1+b)MF + W)] \\ & + (1-p_T)[u(\gamma E(R_{RE}^T) - (1+b)MF + W) + u((1-\gamma)E(R_{RE}^T) - (1+b)MF] \end{aligned} \tag{5}$$

It is possible to solve for the level of vulnerability, $\gamma = \hat{\gamma}$, at which a vulnerable entrepreneur is indifferent between the safe and risky enterprise, hence $\hat{\gamma}$ solves:

$$\begin{aligned} & (1-p_T)[u(\hat{\gamma}(E(R_{RE}^T) - (1+b)MF) + W) + u((1-\hat{\gamma})(E(R_{RE}^T) - (1+b)MF)) = \\ & 2u(R_{SE} + 0.5W) - p_T[2u(0.5(E(R_{RE}^T) + R_{\mathrm{Re}}^G - 2(1+b)MF + W))] \end{aligned} \tag{6}$$

To show that vulnerability negatively impacts microfinance selection it is sufficient to show that $\hat{\gamma}$ exists and lies between zero and one. This is straightforward given the assumptions about p_T and the differences between safe and risky income. This produces the key result of the model: vulnerability negatively impacts the probability that an entrepreneur selects microfinance.

Equation six also has implications for the relationship between vulnerability, skill and wealth. For skill, since the probability of a good state is greater for high skill entrepreneurs, the threshold level of vulnerability is lower for these entrepreneurs ($\hat{\gamma}_{T=H} < \hat{\gamma}_{T=L}$). This is the second result of the model: vulnerability weighs less heavily in the microfinance selection decision for high skill entrepreneurs.

Total differentiation of equation six illustrates how threshold vulnerability changes in wealth.

$$\frac{d\hat{\gamma}}{dW} = \frac{p_T u'(c_{RE,G}) + (1-p_T)u'(c_{RE,B}^1) + u'(c_{SE})}{(1-p_T)(E(R_{RE}^T) - (1+b)MF)[u'(c_{RE,B}^1) - u'(c_{RE,B}^2)]} \tag{7}$$

Given concave utility the sign of equation seven is negative. This is the third key result of the model: vulnerability matters less for high wealth entrepreneurs than for low wealth entrepreneurs.

In sum the model predicts: 1) If vulnerability is sufficiently high entrepreneurs do not choose microfinance loans; 2) Vulnerability weighs less heavily in microfinance selection as entrepreneurial skill increases; and 3) Vulnerability weighs less heavily in microfinance selection as wealth increases. The remainder of the paper examines the empirical evidence for these conclusions.

3. Description of the Data

3.A The Sample

The data come from an evaluation conducted by USAID's AIMS Project of Accion Comunitaria del Peru (ACP, which became MiBanco in 1998), a large microfinance institution with operations in Lima, Peru. Data on clients of ACP and a comparison group were collected in August of 1997 and 1999, producing a panel data set that contains 520 urban entrepreneurs. The client group is comprised of randomly selected borrowers from three neighborhoods covered by ACP, while the comparison group is comprised of randomly selected microentrepreneurs in these neighborhoods with similar characteristics as their microfinance counterparts. To ensure that the comparison group meets the qualifications for ACP loans the sample was limited to households that did not have microfinance credit from any source and an enterprise with at least six months of operating history (an ACP requirement). In theory the comparison group would be able to obtain a loan from ACP, as they meet the requirements and researchers involved with data collection believe most would be approved for a loan if they applied. However, since this group was not screened by the lender we cannot be sure how many actually would be accepted for a loan. Unobserved borrower quality, therefore, will be a consideration.

Summary statistics of the sample are provided in Table 1. Two points are worth noting. First, unlike many microfinance institutions, ACP does not lend exclusively to women. During the survey the percentage of female borrowers is around 60 per cent, as reflected in the sample. Second, the transition rates in microfinance status across both periods are non-trivial. Twenty eight per cent of entrepreneurs with microfinance in 1997 cease to have any formal credit by 1999, while 30 per cent of those without microfinance in 1997 become microfinance borrowers by 1999. This indicates that microfinance is by no means an absorbing state, raising further questions about which entrepreneurs seek out and maintain microfinance over time.

Table 1 about here

3.B. Credit

At the time of the survey the principal product offered by ACP is a working capital loan with loan lengths ranging from six weeks to six months. The average loan size is 1,021 soles (approximately $384) and loans are paid back on a bi-weekly or monthly basis. Loans are granted either to a group or to an individual, the requirement for the latter being home ownership or a guarantor with home ownership. Loans can be taken out by only one household member and for only one microenterprise (Dunn and Arbuckle, 2001). While loan use is not monitored, the short maturity lengths combined with frequent repayment generally mean microfinance loans primarily are directed to short-term business needs. For example, when asked about loan use, one respondent replied:

> 'I don't know what we bought (with the last loan), but it has always been inventory, you know? Because you can't spend it on your house or you can't take it and go spend it on furniture… You have to make the money produce, because they are going to charge interest too, you know?' (Dunn and Arbuckle, 2001, page 102)

Other credit sources include formal lenders such as commercial banks, credit cooperatives, and construction banks, and informal lenders, such as suppliers, friends, family, moneylenders, and ROSCAS. The last column of Table 2 compares median loan sizes across lenders, highlighting that one of microfinance's advantages is the ability to provide larger loans. Median loan sizes for ACP

far surpass those from all other sources except other formal lenders. In interviews ACP clients cite larger loan size as an advantage of borrowing from the institution, while dropouts mention the difficulty in cobbling together the same quantity of funds from other sources as a cost of leaving.

Table 2 about here

The size advantage can explain the appeal of ACP loans despite less attractive repayment terms and interest rates which are not necessarily lower. ACP has strict repayment terms, similar to most microfinance institutions. If a borrower is delinquent she is charged a daily fee, and if she defaults she is barred forever from future loans. This compares to terms that are more flexible for loans from suppliers, moneylenders, family and friends (Banerjee and Duflo 2007). The lack of leniency is standard practice in the microfinance industry and is one way in which institutions mitigate adverse selection and moral hazard problems (Armendariz and Morduch 2010). Unlike informal lenders, microfinance institutions do not benefit from close relationships with borrowers, making it more costly to verify borrower types, decisions and outcomes. Strict repayment terms are a cost effective way to overcome these information gaps.

In the case of interest rates, ACP charges unsubsidized and market determined interest rates. At the time of the survey nominal, annual rates were close to 50 per cent, which translates into real rates of approximately 42 per cent in 1997 and 48 per cent in 1999. These rates are comparable to those charged by other microlenders, lower than those charged by moneylenders, pawnshops, and suppliers, and higher than those charged by family, friends and ROSCAs (Dunn and Arbuckle 2001).

3.3 Microfinance and Project Choice

As a result of larger loans microfinance can finance projects which other credit sources cannot. The theoretical model assumes that projects with larger working capital requirements have higher returns and risk than those with lower requirements. This assumption is based on client interviews, which

indicate that high yield projects often translate into bulky inventory items that have higher risk. For example:

> 'When Pepa was receiving loans… she would use them primarily to invest in high margin clothing for sale. She saw the loans as a separate credit for her mobile clothing business, and used them only for her (other home based retail business during peak sales seasons)…. Credit helped Pepa invest in clothing, which while requiring larger investments, provided higher returns.' (Dunn and Arbuckle, 2001, page 102)

Pepa is later forced to dropout of ACP due to her husband's payment delinquency. After losing access to microfinance loans she must abandon her high quality clothing business due to an inability to procure the same quantity of funds from other sources. Another ACP client comments:

> "(With loans you can buy) other things that take longer to move, but which leave you with more profit." (Dunn and Arbuckle, 2001, page 126)

The quotes illustrate why microfinance borrowers might be limited to entrepreneurs with sufficient support to cover loan payments and consumption if an adverse shock, such as robbery, occurs.

3.D. Measuring Vulnerability

In this paper vulnerability is defined as the inability to smooth consumption across adverse shocks to income. Empirically, vulnerability is challenging to measure and a standard strategy is to use ex post values derived from the response of consumption to unexpected changes in income (Deaton, 1997). This strategy, though, is plagued with problems in a short panel such as the ACP data (Kamanou and Morduch 2002). The first concern is the limited number of observed states of the world. Households facing the same shock distribution will have different short-term draws, and only a limited portion will face the test of trying to smooth consumption. The second concern is the inability to distinguish temporary and permanent income changes. As a result we do not know if declines in consumption are a sign of vulnerability or a rational response to lower lifetime income. Given these challenges I employ indirect measures of vulnerability that attempt gauge access to funds that can be used to smooth consumption.

Table 3 about here?

As shown in Table 3, the primary way in which households manage negative shocks is through savings and borrowing from family and friends. It is important to use vulnerability measures that are not correlated with microfinance status, and thus instead of using savings or assets we focus on measures of informal networks. These are the main source of consumption credit for households in the sample. Family and friends are cited as the second most used source of credit overall (Table 2), and are the most cited source for credit to manage negative shocks. For example, of households that report borrowing to manage negative shocks in 1997, 70 per cent borrowed from family and friends, while only 7 per cent borrowed from moneylenders, 2 per cent from ROSCAs, and 11 per cent from formal lenders, including microfinance institutions. Interestingly, the incidence of borrowing from family and friends is not significantly lower for those with microfinance, implying this type of informal credit fills an important need[5].

In the absence of information on the quantity and quality of social contacts, three variables that likely are highly correlated with informal networks but not to microfinance participation are used. The first is marital status, as measured by a dummy variable that equals one if an entrepreneur has a spouse or partner. A spouse or partner may affect a borrower's ability to repay loans if they provide loan repayment assistance (Van Tassel 2004) and if they confer access to a wider network of family and friends who can provide funds in times of need. The second variable is tenure in Lima, measured as the percentage of a respondent's life spent in Lima[6]. Longer tenure means the entrepreneur has had greater opportunity to develop informal networks. The third variable is whether or not the household has given gifts/ remittances to other households in the past year. If gift giving is reciprocal this may proxy for the ability to call on others in times of need. Summary statistics are provided in Table 1 above.

There may be concerns that the vulnerability measures capture other observable characteristics that affect microfinance selection. First, marital status may capture the effect of

having another working adult in the household. This may impact microfinance selection if it leads to more diversified household income or an enhanced ability to manage negative shocks by adjusting work hours. To control for this the number of economically active household members is included. Second, time in Lima may capture entrepreneurial experience rather than access to informal networks; education and entrepreneurial experience, as measured by the longest tenure, in years, of the household's microenterprises, controls for this. Third, remittances may capture wealth, as wealthier households may be sought after to help others in need. Dummy variables if the household has legal title to its home, has running water within their home, and has a telephone are used to controls for this. These measures are preferable to assets because they largely depend on neighborhood location and are less likely to be correlated with microfinance status. For example, home ownership, which is high in the sample, principally is a product of a massive titling program that began in 1992 and was implemented somewhat randomly across neighborhoods (see Field 2007 for a detailed description). Similarly, water and telephone service likely are uncorrelated with microfinance status, as the nature of microfinance loans make it highly unlikely that they are used to make capital intensive home improvements.

4. Empirical Model of Microfinance Selection

The theory section outlines a model in which project choice and microfinance selection are jointly determined. Empirically it is not possible to estimate this joint decision due to the absence of information on the risk and return characteristics of entrepreneurial projects[7]. Therefore the focus is on the microfinance decision alone in the empirical analysis.

4.A. Estimation Strategy

Following Wooldridge (2002) and Greene (2008), the binary microfinance participation decision for entrepreneurs can be modeled as follows:

$$y_{it} = 1(x_{it}'\beta + c_i + u_{it} > 0) \quad (8)$$

This is an indicator function that equals one if entrepreneur *i* has a microfinance loan in period *t,* and zero otherwise. *Xit* are observable characteristics of the entrepreneur and their enterprise. The unobservable component is separated into two parts. The first part, c_i, is a random intercept that controls for unobservable, time-invariant characteristics. These include factors that are constant and influence microfinance participation in all periods, such as entrepreneurial skill and risk aversion. These factors not only impact whether or not an entrepreneur seeks out microfinance credit but, to the extent the lender can discern them, they also impact the chances they are granted one.

The second unobservable component, u_{it} is an independent and normally distributed error. The variance of u_{it} is normalized to be 1, such that the correlation in the aggregate error terms across time periods is: $corr[c_i + u_{it}, c_i + u_{is}] = \rho = \frac{\sigma_c^2}{\sigma_c^2 + 1}$, where ρ is the portion of total variance that comes from unobserved, individual heterogeneity.

In order to estimate the model we need to make an assumption about the distribution of c_i [8]. The standard random effects probit model assumes it follows a normal distribution. This assumption is strong, as it means that c_i and x_{it} are independent and thus, after controlling for c_i, x_{it} is exogenous. This model will yield biased estimates if, in fact, x_{it} and c_i are correlated. This is a very real possibility in the present context, as the same unobserved qualities that make some entrepreneurs more likely to seek out microfinance loans also might make them more or less active participants in social networks. It is possible to relax this strict exogeneity by assuming that c_i is correlated with some combination of observable characteristics x_{it}. Specifically, it is possible to assume that c_i takes the form: $c_i = \psi + \bar{x}_i\xi + a_i$, where $\bar{x}_i$ are the average values of the covariates.

This form assumes that a_i is independent of both x_{it} and u_{it} and normally distributed. Therefore by splitting the unobserved individual effect into a_i (the portion that is uncorrelated with x_{it}) and $\psi + \bar{x}_i\xi$ (the portion correlated with x_{it}) we can more confidently estimate a model that accounts for observed and unobserved characteristics. Inserting the new specification for c_i into equation eight yields the correlated random effects probit model:

$$y_{it} = 1(x_{it}'\beta + \psi + \bar{x}_i\xi + a_i + u_{it} > 0). \quad (9)$$

4.B. Covariates

Observable factors that impact microfinance participation include gender, education, experience, experience squared, the number of economically active household members, household wealth as measured by home ownership, running water within the home, and telephone service, industry dummies, marital status, time in Lima, and the giving of gifts. Variables which are constant across both periods are not included in $\bar{x}_i$

A year 1997 dummy variable is included to account for aggregate shocks that may change the general behavior of microentrepreneurs between 1997 and 1999. Accounting for aggregate shocks is important because in 1998 the Peruvian economy entered into recession and only began to emerge at the end of 1999, after the second panel period. The contraction likely affected microentrepreneurs in the sample, decreasing profitability and reducing the use of microfinance loans. These average effects are captured by the time dummy (the potential for differential impacts is considered in the robustness analysis).

The model assumes that after accounting for unobserved, individual heterogeneity the controls are exogenous. This assumption would be violated if there were reverse causality; that is, if having microfinance caused any of the characteristics. There are reasons to think that this is not the case. For marital status and time in Lima, given that we control for unobserved characteristics that might

increase the propensity that an individual is married and moves to a large city, it is unlikely that these characteristics are independently determined by microfinance status. The story with gift giving is more complicated, however, as microfinance can increase enterprise prosperity and the generosity of those with loans. For this reason, some specifications control for firm size, measured by the total number of employees, and formal status, measured by a dummy variable that equals one if any enterprises operated by the household is formal[9]. Increased firm prosperity likely will manifest itself in growth, which might be captured by more employees or formalization (these measures are preferable to assets as they are less likely to be correlated with microfinance status).

4.C. Empirical results

The correlated random effects probit models are estimated using maximum likelihood, with results from a pooled probit model, which does not account for unobserved, individual heterogeneity, and from a standard, random effects probit for comparison. The comparisons show the extent to which correlated, unobserved heterogeneity explains microfinance participation. Table 4 reports the coefficients and Table 5reports selected marginal effects. For accurate comparison the coefficients and standard errors from the random effects models are rescaled to account for different normalizations of the error variance (Arulampalam 1999).

Tables 4 & 5 about here

First, the results show that unobserved, individual heterogeneity is important in explaining microfinance participation. The estimated values for ρ range from 0.60 to 0.62 and the null of a zero value can be rejected at the 1 per cent level in all cases. The confidence intervals suggest that unobserved heterogeneity accounts for approximately fifty to seventy per cent of the total variance. This result confirms the importance of unobserved characteristics, such as skill and risk aversion, in determining microfinance participation.

Second, the results show that after controlling for time-invariant, unobserved heterogeneity few observable characteristics are strong predictors of microfinance participation. This list includes several variables that, ex ante, seemed likely to play a role in determining microfinance status. For example, female and more educated entrepreneurs are not significantly more likely to be microfinance participants. Wealthier entrepreneurs, defined as those which own their homes and have a telephone, are more likely to be participants, but the significance of these variables disappears in the correlated random effects model. The same is true for characteristics likely linked with success, such as business duration, formal status and total employees. All three variables are positively associated with microfinance participation, which is to be expected if more successful firms are those that seek out microloans, but cease to be significant in the correlated random effects model. For some variables, such as home ownership, the change in the size and significance of the coefficients could be due to the short panel period combined with low transition rates. In these cases the differenced variables do not differ much from the original. However, the change also may imply that these variables are correlated with unobserved characteristics. This suggests that not appropriately accounting for unobserved characteristics may overstate the importance of these factors in determining microfinance participation[10].

Third, marital status emerges as the single, largest predictor of microfinance status. The coefficient on marital status is positive and significant in all of the estimations and the size of the estimate effect is large. As shown in Table 5, entrepreneurs with spouses or partners are estimated to be 14-16 per cent more likely to have microfinance than their unmarried counterparts. Meanwhile, time in Lima and remittances are positive, but insignificant in all of the estimations. The coefficient on remittances, in particular, is sensitive to the model specification, as the size and sign changes across the three models. Given the low level of gift giving in the sample, (average gifts

constitute less than one per cent of yearly household income) it could be the case that reciprocal gift exchange is a weaker measure of informal networks than in other settings.

Overall the results favor of the theory that vulnerable entrepreneurs are less likely to seek microfinance loans. In particular marital status emerges as the strongest predictor of microfinance status. Since the model accounts for potential confounding factors, such as observables like the number of working age adults, and unobservables, like risk aversion and skill, marital status captures something other than these factors that determines microfinance participation. While this factor could be access to informal networks and vulnerability, it also could be something else. The next section attempts to control for additional factors to further isolate the vulnerability channel.

5. Robustness Checks

5.A. The Supply of Microfinance Loans

One concern regarding the vulnerability measures is that they are used by loan officers to assess creditworthiness and thus may capture the supply of microfinance credit rather than demand. For example, married entrepreneurs or those with longer time in Lima may be deemed more creditworthy and thus are more likely to be granted a loan or accepted into a lending group. While the survey documentation does not detail the information used by ACP loan officers, the fact that the screening process includes a home visit makes it possible that vulnerability measures are used to assess creditworthiness.

Two robustness checks attempt to separate the vulnerability channel from the credit supply channel. First, a measure of income for everyone in the household except the microfinance borrower is introduced. This is based on the assumption that if vulnerability measures affect a borrower's credit score, they likely do so through perceptions about the ability of the household, rather than just the individual, to repay the loan. These perceptions may be based on the number of

economically active members of the household, which is already included as a control, and on the income of other household members. Including non-respondent income in the model might reveal the extent to which the vulnerability measures are capturing credit supply.

Second, the microfinance borrower sample is limited to entrepreneurs that had an individual loan with a guarantor as of the first survey round (as opposed to a group loan or an individual loan with no guarantor). The presence of a guarantor reduces the need for the lender to gauge the ability of a borrower to call on social networks if they face repayment difficulties. The vulnerability measures therefore should play less of a role in determining credit supply for this group.

Estimates from the model which includes other household income are shown in columns one and two of Table 6, while estimates from the model which limits borrowers to those with guarantors are shown in columns three and four. Overall the results are robust to these controls, as the coefficients on marital status and time in Lima remain positive and marital status remains significant. This shows that marital status remains an important predictor of microfinance status even among borrowers for whom it should play a smaller role in the credit approval process. While the results do not eliminate the possibility that the vulnerability measures partially capture the supply of credit, they do suggest that supply is not the dominant channel through which these measures impact microfinance participation.

Table 6 about here

5.B. Alternative Vulnerability Measure

Another concern is that the vulnerability measures are indirect and weakly capture the ability of households to smooth consumption across negative income shocks. More direct measures can be used for two sub-samples of entrepreneurs. The first is comprised of entrepreneurs that report being hit with a negative shock and list expenditure reduction as one method of managing the shock. The second is comprised of entrepreneurs that register a decline in both income and non-durable

consumption per capita. Neither measure is ideal, as we do not know the extent to which shocks or income declines represent temporary or permanent changes. Despite this limitation I re-estimate microfinance participation among the sub-samples using the consumption response variables in lieu of the vulnerability measures[11].

Results are shown in Table 6. Column five shows the results for a reduction in non-durable consumption per capita. This model is estimated using a simple probit on year 1997. Columns six and seven show the results for expenditure reduction as a coping mechanism. The results show that expenditure reduction is not associated with a change in microfinance participation, as the coefficient is positive but insignificant in all cases. In general, however, it is difficult to draw strong conclusions from these results. The short nature the panel and the fact that only half of the sample reports being hit with a shock limit the ability to estimate the importance of expenditure reduction precisely or compare it to the other vulnerability measures. This highlights the challenge of identifying vulnerable households and the need to control for other factors to isolate the social network channel.

5.C. Differential Impact of the Economic Downturn

A related concern is that the recession which took place during the two panel periods had differential impacts on entrepreneurs depending on their level of vulnerability. If entrepreneurs who were married, lived longer in Lima or gave remittances were less affected by the crisis, these variables may capture different exposure to shocks rather than access to social networks and vulnerability. In distinguishing the two effects it is important to emphasize that this paper defines vulnerability as the inability to smooth consumption across adverse income shocks rather than exposure to the shocks themselves.

To test for differential impacts of the recession I examine the types of shocks households report, constructing a dummy variable that equals one if a household reports suffering a job loss or

reduction in income between 1997 and 1999,[12] and test if the results are robust to differential recession impacts by re-estimating microfinance participation with the income shock dummy. Results are shown in columns eight and nine of Table 6. Overall, controlling for income shocks has a limited effect on the vulnerability measures. To the extent that the income shock variable captures the differential impact of the recession, this suggests that the vulnerability measures do not simply capture the economic crisis.

A test of the theoretical predictions that vulnerability's role in selection declines in wealth and skill is conducted using two sets of interaction terms for the vulnerability measures with measures of wealth and skill. The results, available on request, lend some support for the relationship with wealth: marital status and time in Lima play less of a role in determining microfinance status for entrepreneurs that own their home or a telephone..

6. Conclusion

This paper argues that vulnerability is a determinant of entrepreneurs' decision to seek microfinance loans and one explanation for low microfinance participation rates. In a theoretical model vulnerability is found to drive some entrepreneurs to reject high yield/high risk enterprises and microfinance. This prediction is tested using panel data on microentrepreneurs in Lima, Peru, and the vulnerability measures are significantly associated with microfinance participation. In particular, marital status is found to be the strongest predictor of microfinance participation, and this conclusion is robust to controls for several alternative channels through which this variable might impact microfinance selection. It is important to recognize, however, that the strength of these conclusions is limited by the data. The data used in this paper come from one of the few panel data sets on urban microentrepreneurs, but they are imperfect due to the short panel and the limited information on social networks. While the results suggest that informal networks are the most likely channel through which marital status operates, the possibility of other channels remains. More

expansive data sets, once they become available, may yield further insight into the links between vulnerability, project choice and microfinance.

The results have implications for microfinance institutions and general efforts to expand credit access. Despite enthusiasm surrounding these efforts, credit expansion has not proved a magic solution to poverty. Given the credit constraints many poor household face and the likely link between these constraints and poverty, it is curious that credit programs have had less of an impact than anticipated. There is increasing recognition that vulnerability may be one important explanation for this phenomenon, and practitioners and researchers are devoting more time to exploring the inter-linkages between credit and insurance markets. From a policy perspective this suggests that efforts to improve risk management strategies should play a larger role in poverty reduction policies. Specifically, promotion of credit that can better be used for consumption smoothing (longer maturity lengths combined with longer or more flexible repayment periods) and microinsurance should be more thoroughly integrated into credit expansion programs.

[1] Although this estimate, along with others, overstates the extent of underpenetration by classifying all microentrepreneurs as potential clients, the client base is sufficiently low to indicate a substantial number of households remain untouched by microfinance.

[2] This assumption is based on comments by several ACP entrepreneurs, who cite bulky inventory, such as clothing or appliances, as the high return/high risk projects under consideration. These projects require a fixed investment that many entrepreneurs cannot finance without external funds.

[3]I assume that return realizations are such that the difference between net income of the risky and safe enterprise is greater than the difference between loan repayment and the value of seized collateral. This generates a no-default equilibrium. Second period risky income is sufficiently greater than safe income such that defaulting is always suboptimal.

[4] It is not uncommon to observe zero interest rates on loans from family, friends and ROSCAs (Dunn and Arbuckle, 2001).

[5]While borrowers may have turned to ACP to cope with a negative shock, the data suggest that the extent to which this happens is limited. In 1997 only 29 per cent of microfinance borrowers hit with a shock list borrowing from any source as a coping mechanism, and only 11.6 per cent of these cite the source as formal. This suggests that reliance on ACP to manage negative shocks is low.

[6] I use percentage of life in Lima as opposed to age for two reasons. First, age alone may not pick up the extent of informal networks. For example, a 35 year old entrepreneur who has lived in Lima her entire life likely will have larger informal networks than a 50 year old who moved to Lima five years ago. Percentage of life in Lima better captures entrenchment in the community. Second, since experience- as measured by enterprise duration in years- is included in the model, including age likely will introduce problems of multicollinearity.

[7] The short panel makes it difficult to estimate the average enterprise returns and their variance.

[8] A fixed effects model, which does not require this assumption, leads to inconsistent estimates in the context of a non-linear, binary model

[9] The employee variable includes full and part time workers, as well as remunerated and unremunerated workers. Therefore it likely captures increased labor needs stemming from firm growth.

[10] When I do not difference home ownership, telephone and water service, the first two variables remain significant. The other conclusions hold, however, suggesting that correlation with unobserved characteristics is a concern.

[11] To check the robustness of the indirect vulnerability measures I regress the consumption response measures on the indirect measures and other household characteristics. These results, available upon request, show a weak correlation between the indirect vulnerability measures and consumption declines in the face of shocks. The coefficient on remittances is negative in five out of six regressions while the coefficient on time in Lima is negative in four out of six regressions. The coefficient on marital status, however, is negative in only two out of six regressions. Furthermore, almost none of the coefficients are significant. Given that the sample is limited to approximately 270 entrepreneurs and to only two panel periods, I view this test as fairly weak. In particular more panel periods would be necessary for a more robust analysis of direct vulnerability measures.

[12] Estimation of the incidence of income shocks (available upon request) finds that none of the vulnerability measures are associated with a lower incidence of income shocks.

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Table 1: Summary Statistics

1997 Values	Total	Microfinance Status in 1997		P-value (t-test)
		Have	Don't Have	
Household Characteristics				
Woman	60.8%	62.3%	58.7%	0.409
Percentage time in Lima	68.1%	71.0%	64.0%	0.002***
	(25.8%)	(24.4%)	(27.2%)	
Remittances given	21.7%	24.1%	18.5%	0.134
Married	79.7%	84.2%	73.2%	0.002***
Age	41.7	42.6	40.4	0.024**
	(10.9)	(9.9)	(12.1)	
Education:				
Less than Primary	1.5%	1.6%	1.4%	0.834
Primary	30.7%	28.2%	34.3%	0.147
Secondary	48.2%	49.5%	46.5%	0.498
Tertiary	19.5%	20.6%	17.8%	0.427
Working Members of HH	2.33	2.44	2.15	0.008***
	(1.20)	(1.23)	(1.14)	
Income per capita (US$)	1,738	2,013	1,344	0.000***
	(1,759)	(2,057)	(1,100)	
Own Home	80.9%	87.2%	71.8%	0.000***
Has running water in home	84.2%	86.2%	81.2%	0.125
Has telephone service in home	42.5%	51.5%	29.6%	0.000***
Enterprise Characteristics				
Formality	73.5%	77.1%	68.4%	0.027**
Maximum Duration	8.09	8.75	7.15	0.014**
	(7.27)	(7.31)	(7.12)	
Have Enterprise in Category				
Manufacturing	14.0%	14.9%	12.7%	0.625
Construction/Auto Repair	9.5%	8.6%	10.4%	0.498
Retail and Wholesale	80.0%	78.5%	82.1%	0.317
Hospitality	9.5%	11.6%	6.6%	0.058*
Transport	10.5%	14.6%	4.7%	0.003***
Services	6.4%	6.3%	6.6%	0.887
Total employees, all enterprises	1.87	2.09	1.57	0.002***
	(1.88)	(1.95)	(1.75)	
Yearly Enterprise Income (US$)	4986.7	5840.7	3763.8	0.000***
	(4894.6)	(5352.4)	(3845.9)	
Net Enterprise Assets (US$)	2,811	3,651	1,618	0.000***
	(5,009)	(5,966)	(2,798)	
Observations (N)	514	302	212	

**Difference in means significant at the 10% level; **significant at the 5% level; ***significant at the 1% level*

Nuevo Sol values converted to USD using the September 1997 exchange rate (2.656).

Table 2: Types of Credit, 1997

	Microfinance Status in 1997		P-value	Median Amount
	Have	Don't Have	(t-test)	Outstanding (US$)
Have a loan from:				
Informal Sources				
Family/Friend	9.8%	10.8%	0.734	193.9
Moneylenders	2.6%	4.6%	0.253	75.3
Pawnshop	0.7%	0.5%	0.751	82.8
Suppliers	47.3%	45.4%	0.674	67.7
ROSCAs	4.2%	4.1%	0.982	75.3
Formal Sources				
Companies/Credit Unions	2.3%	1.5%	0.581	269.2
Banks	5.7%	2.1%	0.055*	828.3
EDPYMEs	1.5%	0.0%	0.085*	169.5
Cooperatives	0.4%	0.5%	0.826	414.1
Government	0.4%	1.5%	0.185	120.5
Construction Banks	7.6%	3.1%	0.041*	903.6
ACP				489.5
Relative Size of Last ACP Loan				
	Median	Hypothetical Median		
ACP Loan/Yearly Enterprise Income	11.6%	18.2%		
ACP Loan/Enterprise Assets	35.3%	87.8%		
Observations	264	194		

*Difference in means significant at the 10% level; ** Difference in means significant at the 5% level
Nuevo sol values converted to USD using the September 1997 exchange rate (2.656)
Total observations are smaller because 60 entrepreneurs do not respond to the debt questions.
EDPYME stands for Entidades de Desarrollo para la Pequena y Microempresas, MFIs that are regulated financial institutions, unlike most NGOs that are unregulated.

Hypothetical median value calculated as the ratio of the median value of the last ACP loan for borrowers taken as a percentage of non-borrowers' income and assets.

Table 3: Shocks and Shock Management

Shock Incidence	Total	Microfinance Status in 1997		P-value (t-test)
		Have	Don't Have	
1997				
Hit by Shock in past two years	34.9%	39.3%	28.6%	0.011**
Most Severe Shock				
Robbery	41.4%	44.2%	36.1%	0.298
Illness	32.8%	35.0%	32.8%	0.768
Death of Family member	9.8%	9.2%	9.8%	0.885
Loss or Reduction in Income	3.9%	2.5%	3.9%	0.183
1999				
Hit by Shock in past two years	37.4%	38.3%	36.1%	0.610
Most Severe Shock				
Robbery	33.3%	33.0%	33.8%	0.917
Illness	28.2%	26.1%	31.2%	0.445
Death of Family member	9.9%	7.8%	3.0%	0.243
Loss or Reduction in Income	9.9%	11.3%	7.8%	0.427
Managing Negative Shocks				
1997				
Use Savings	35.4%	35.9%	34.4%	0.852
Borrow	24.3%	28.3%	16.4%	0.0775*
Reduce expenditures	19.3%	19.2%	19.7%	0.936
Of those who borrow, Source:				
Family and friends	71.4%	74.4%	61.5%	0.377
Moneylenders	7.1%	7.0%	7.7%	0.932
Suppliers/Work	3.6%	2.3%	7.7%	0.370
ROSCAs	1.7%	0.0%	7.7%	0.068*
Formal lenders	10.7%	11.6%	7.7%	0.694

*Difference in means significant at the 10% level; **Difference significant at the 5% level; ***Difference significant at the 1% level

Table 4: Probit Estimates of Microfinance Status

Probit Model	Pooled	Random Effects		Pooled	Random Effects	
		Standard	Correlated		Standard	Correlated
	(1)	(2)	(3)	(4)	(5)	(6)
Married	0.405***	0.382***	0.373*	0.395***	0.370***	0.344*
	(0.105)	(0.113)	(0.204)	(0.106)	(0.114)	(0.205)
Percentage of life lived in Lima	0.164	0.213	0.138	0.163	0.206	0.144
	(0.177)	(0.204)	(0.210)	(0.178)	(0.205)	(0.211)
Remittances given	0.157	0.09	-0.048	0.137	0.075	-0.053
	(0.102)	(0.095)	(0.117)	(0.103)	(0.095)	(0.118)
Woman	0.0486	-0.023	-0.002	0.0924	0.013	0.027
	(0.0927)	(0.099)	(0.103)	(0.0953)	(0.101)	(0.105)
Secondary education	0.127	0.14	0.302	0.111	0.125	0.305
	(0.0994)	(0.106)	(0.196)	(0.0999)	(0.106)	(0.197)
Tertiary education	0.0195	0.007	0.115	-0.0369	-0.043	0.094
	(0.130)	(0.138)	(0.264)	(0.132)	(0.139)	(0.264)
Owns home	0.316***	0.300**	0.11	0.295***	0.278**	0.098
	(0.111)	(0.117)	(0.197)	(0.112)	(0.118)	(0.198)
Has water in home	0.0298	0.015	-0.05	-0.00227	-0.012	-0.06
	(0.121)	(0.123)	(0.194)	(0.122)	(0.124)	(0.194)
Has telephone	0.376***	0.335***	0.206	0.326***	0.297***	0.199
	(0.0907)	(0.094)	(0.146)	(0.0927)	(0.095)	(0.147)
Firm duration	0.0493***	0.033**	-0.0135	0.0443***	0.030*	-0.014
	(0.0158)	(0.016)	(0.023)	(0.0159)	(0.016)	(0.023)
At least one enterprise formal				0.169*	0.145	0.155
				(0.0997)	(0.098)	(0.137)
Number employees				0.0606**	0.056**	0.046
				(0.0274)	(0.027)	(0.038)
Total Observations	971	971	971	969	969	969
Number of individuals		518	518		518	518
Rho		0.603	0.616		0.606	0.619
		(0.058)	(0.057)		(0.058)	(0.057)
Log-likelihood value	-619.39	-585.34	-574.67	-613.3	-579.12	-568.74

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Coefficients and standard errors from random effects models adjusted to account for different error normalizations

Other covariates include working adults, duration squared, industry dummies, and a 1997 time dummy

For correlated, random effects model averages used for all variables except gender and time in Lima

Table 5: Marginal effects

Probit Model	Pooled	Random Effects		Pooled	Random Effects	
		Standard	Correlated		Standard	Correlated
Marginal Effects	(1)	(2)	(3)	(4)	(5)	(6)
Married	0.161	0.150	0.146	0.156	0.145	0.135
Percentage of life lived in Lima	0.0646	0.082	0.053	0.0642	0.080	0.056
Remittances/income	0.0612	0.035	-0.019	0.0535	0.029	-0.020
Woman	0.0192	-0.009	-0.001	0.0365	0.005	0.011
Secondary education	0.0502	0.054	0.116	0.0436	0.049	0.117
Tertiary education	0.00767	0.003	0.044	-0.0146	-0.017	0.036
Owns home	0.125	0.118	0.043	0.117	0.109	0.038
Has water in home	0.0118	0.006	-0.019	-0.001	-0.005	-0.023
Has telephone	0.147	0.127	0.079	0.127	0.113	0.076
Firm duration	0.0194	0.013	-0.005	0.0175	0.012	-0.005
At least one enterprise formal				0.0670	0.057	0.060
Number employees				0.0239	0.022	0.018
Total Observations	971	971	971	969	969	969
Number of individuals		518	518		518	518

For continuous variables marginal effects taken at the mean

Marginal effects for random effects model adjusted to account for different error normalizations

Table 6: Robustness Checks

Model	Other Household Income		Loan with Guarantor		Reduce Expenditure			Income Shocks	
Random Effects Probit	Standard	Correlated	Standard	Correlated	Standard	Standard	Correlated	Standard	Correlated
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Married	0.373***	0.353*	0.521***	0.725**				0.382**	0.375*
	(0.114)	(0.205)	(0.178)	(0.346)				(0.114)	(0.204)
Percentage of life in Lima	0.225	0.146	0.000	-0.057				0.211	0.133
	(0.205)	(0.210)	(0.287)	(0.298)				(0.204)	(0.210)
Remittances given	0.088	-0.0467	-0.159	-0.279				0.089	-0.052
	(0.095)	(0.117)	(0.143)	(0.180)				(0.095)	(0.118)
Other household income	0.0003*	0.0002*							
	(0.000)	(0.000)							
Non-durable consumption per capita declines									
Reduced expenditure to manage negative shock					0.0230	0.055	0.084		
					(0.161)	(0.146)	(0.149)		
Hit with income shock								0.006	-0.027
								(0.124)	(0.126)
Total Observations	971	971	548	548	279	561	561	970	970
Number of individuals	518	518	290	290	279	294	294	518	518
Rho	0.601	0.616	0.593	0.625		0.555	0.58	0.602	0.615
	(0.058)	(0.057)	(0.088)	(0.086)		(0.081)	(0.078)	(0.058)	(0.057)
Log-likelihood value	-583.43	-572.48	-288.73	-279.39	-173.94	-343.45	-331.26	-585.25	-574.42

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Coefficients and standard errors from random effects models adjusted for different error normalizations

Other covariates include gender education, working adults in the household, duration, duration squared, industry dummies, home ownership, water, telephone, and, except for column 5 a 1997 time dummy

For correlated, random effects model averages used for all variables except gender, time in Lima, and expenditure reduction