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Precautionary Saving under Liquidity Constraints: Evidence from Rural Pakistan*

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Abstract

This paper investigates precautionary saving under liquidity constraints in Pakistan using household panel data. In particular, while we estimates Kimball's (1990) prudence parameter, we deviate from Dynan's (1993) framework by explicitly considering liquidity constraints, as in Zeldes (1989). By doing so, we attempt to differentiate the standard precautionary saving caused by uncertainty from the one due to liquidity constraints. Furthermore, endogenous liquidity constraints are considered to resolve issues of selection biases. In this study, we document substantial evidence of the presence of precautionary saving in Pakistan. More specifically, the estimated prudence is significantly higher for liquidity-constrained households as compared with unconstrained ones. The results support the emerging view that facilitating saving may often be more important than finding better ways of lending to the poor.

JEL Classification: E210, O120

Key Words: Precautionary Saving; Prudence; Liquidity Constraints; Switching Regression

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1 Introduction

People in developing countries, especially the poor, face a wide variety of income shocks. The existing studies address the effectiveness of self, mutual, or market insurances against income shocks such as precautionary saving, credit market transactions, labor market participation, and mutual transfers [Besley (1995); Dercon ed. (2005); Fafchamps (2003); Kochar (1999); Morduch (1995); Rosenzweig (2001); Townsend (1994); and Udry (1994)].[1]

The purpose of our study is to empirically examine the relationship between liquidity constraints and precautionary saving using the household panel data from rural Pakistan. In order to achieve this, Kimball's (1990, henceforth Kimball) concept of prudence is estimated primarily based on the framework studied by Dynan (1993, henceforth Dynan). This study differs from previous work in that it integrates Dynan's approach with Zeldes' (1989, henceforth Zeldes) liquidity constraint model, which is extended by endogenous liquidity constraints. We document substantial evidence with regard to the existence of precautionary saving in Pakistan. Furthermore, the findings suggest that the levels of estimated prudence appear to be associated with the levels of wealth: While poor, liquidity-constrained households behave prudently, rich, un-constrained ones do not exhibit precautionary saving motives. The findings could have significant implications on the role of precautionary saving in developing countries.[2]

In particular, this paper attempts to contribute to the research on this sub-

[1]When facing a negative income shock, a household can utilize credit market transactions to smooth consumption by reallocating future resources for present use [Eswaran and Kotwal (1989); Besley (1995)]. Yet, there is a plenty of evidence that poor households have only limited access to the credit market and are therefore constrained from borrowing [Morduch (1990), Pender (1996)]. Since households are aware that liquidity constraints are binding, they will attempt to insure themselves by accumulating precautionary saving. Then, in the event of unexpected negative shocks, the households utilize their own financial and physical assets that have been previously accumulated [Deaton (1991)].

[2]The importance of precautionary saving in general has been well documented. For an example on aggregate consumption, see Gourinchas and Parker (2001). For a survey based on micro data, see Browning and Lusardi (1996).

ject in three ways. First, multiple risk-coping strategies are considered. Most of the existing studies on risk and household behavior in developing countries have not permitted the simultaneous employment of different risk-coping strategies by households [Rosenzweig (2001)]. It would be merely misleading to consider any single method of risk-coping in isolation [Alderman and Paxson (1992, p.2)]. This paper aims to particularly bridge this gap in the existing literature by considering both the precautionary saving and liquidity constraints within an integrated framework.[3]

Second, this paper investigates the empirical relationship between precautionary saving and liquidity constraints. Based on numerical studies, Zeldes (1984) showed that liquidity constraints could induce precautionary saving even under the quadratic utility function. Carroll and Kimball (2001) also developed a rigorous theory and a numerical analysis to explain the relationship between precautionary saving and liquidity constraints.[4] However, there has been little consensus with regard to studies on this empirical relationship. In order to bridge this gap in the literature, we estimate Kimball's prudence parameter for precautionary saving, based primarily on the consumption Euler equation approach suggested by Dynan, and integrate it with Zeldes' liquidity constraint model.[5] Furthermore, we follow Jappelli (1990); Jappelli, Pischeke, and Souleles (1998); and Garcia, Lusardi, and Ng (1997) in order to consider endogenous liquidity constraints for resolving issues of sample selection biases.

This type of empirical research is particularly important in the context of de-

[3]This type of study is also of practical importance since changes in the costs and benefits of one coping strategy affect the manner in which other strategies are used, and thus, these interactions among different strategies may be important for a policy design. For example, Cox and Jimenez (1990) have shown that public transfers crowded out altruistically-motivated private transfers, mitigating the net effectiveness of public interventions.

[4]See Samwick (2003) and Xu (1995) for other theoretical treatments.

[5]There exist a large number of discussions on the usefulness of the consumption Euler estimation approach. See Attanasio and Low (2004), Carroll (2001), and Ludvigson and Paxon (2001) for examples. In particular, Ludvigson and Paxon (2001) argued that Dynan's specification was likely to produce a downward bias in the estimated prudence parameters.

veloping countries. Poor households in developing countries are known to hold significant amounts of precautionary saving in a wide variety of forms such as stored grain, cash holdings, jewelry, and livestock [Alderman (1996); Fafchamps, Udry, and Czukas(1998); Park (2005); Rosenzweig and Wolpin (1993); and Townsend (1995)]. Park (2005) argued that grain stocks were the most important form of precautionary saving in developing countries despite their negative returns. This is a strange situation wherein many impoverished people save their precious resources, which later generate negative returns. This seemingly awkward practice may be due to the lack of access to credit and/or reliable saving opportunities.

Finally, this paper provides another reason for small estimates of the prudence parameter in the U.S., based on the Dynan specification.[6] While existing studies such as Chen and Zhou (2003) for China, Hori and Shimizutani (2005) for Japan, Ludvigson and Paxon (2001) for the U.S., and Merrigan and Mornandin (1996) for the U.K. provided several possible reasons, our study considers a repeatedly investigated factor–the liquidity constraint. Some unique information on liquidity constraints obtained from the Pakistan panel data set permits a more precise empirical analysis of precautionary saving and liquidity constraints as compared with that of the previous studies. In other words, estimating the prudence parameter based on the Dynan specification without taking into account liquidity constraints may lead to an omitted variable bias if a large portion of the sample is liquidity-constrained.

In summary, this study documents strong evidence in support of the existence of precautionary saving under liquidity constraints in Pakistan, characterized by the sizable estimated prudence parameters. However, if the liquidity constraint variables are not controlled, the estimated prudence gets signifi-

[6] Dynan estimated the prudence parameters to be in the range of 0.02 and 0.3 and argued that these values were *too low to be consistent with the widely accepted beliefs about risk aversion.*

cantly lowered, suggesting a possible omitted variable bias in Dynan's specification. Moreover, prudence is substantially higher in the case of the liquidity-constrained rather than unconstrained households. The results are robust even when the endogeneity bias with regard to liquidity constraints is carefully eliminated. The precautionary saving motives are found to be stronger when households have limited access to credit markets, suggesting that the levels of estimated prudence may be associated with levels of wealth. In other words, the rich, having credit market access, display few precautionary saving motives. This is consistent with the findings of Alderman (1996) who estimated saving functions directly using the same data as ours; he found that the wealthiest households saved their entire transitory income. Thus, the standard life cycle permanent income hypothesis holds.

The reminder of this paper is structured as follows. The next section presents an integrated model of precautionary saving and liquidity constraints. Section 3 describes the Pakistan household panel data set and illustrates the estimation results. The final section summarizes our findings and discusses policy implications.

2 The Model

2.1 Precautionary Saving and Liquidity Constraints

Following Dynan and Kimball, we quantify households' precautionary saving motives by estimating the coefficient of relative prudence $\rho = -\frac{U'''Ci,t}{U''}$, where C is the consumption level.[7] Moreover, we extend Dynan's specification by explicitly considering possible liquidity constraints. Let A, y, and Z represent household assets at the beginning of the period, exogenously given income,

[7]The non-negative third derivative of the utility function indicates that the marginal utility is convex and when a consumer faces increases in uncertainty, the expected consumption growth rises. Thus, the household increases saving and decreases consumption.

and the credit ceiling, respectively. Following Zeldes, the liquidity constraints $A+y-C+Z \geq 0$ are introduced into the household problem, and, accordingly, we derive the following consumption Euler equation:

$$U'(C_t) = (\frac{1+r}{1+\delta})E_t[U'(C_{t+1})] + \lambda_t, \tag{1}$$

where r is the interest rate, δ is the subjective discount rate, and E_t is the conditional expectation operator. The last term on the right hand side, λ, is the Lagrange multiplier associated with the liquidity constraint equation.

In Equation (1), the shadow value of the constraint λ_t for the un-constrained households is zero, and the standard consumption Euler equation holds. However, with regard to the constrained households, the shadow cost of the liquidity constraint is positive, i.e., $\lambda_t > 0$ and the household decreases its current consumption. With a non-zero shadow cost of the liquidity constraint, this study applies a second-order Taylor approximation of $E_t[U'(C_{i,t+1})]$ around the point C_t to obtain the following modified Euler equation:

$$E_t[\frac{C_{i,t+1} - C_{i,t}}{C_{i,t}}] = \frac{1}{\sigma}(\frac{r-\delta}{1+r}) + \frac{\rho}{2}E_t[(\frac{C_{i,t+1} - C_{i,t}}{C_{i,t}})^2] + \tilde{\lambda}_{i,t}, \tag{2}$$

where σ is the coefficient of relative risk aversion, $-\frac{U''C_{i,t}}{U'}$, ρ is the the coefficient of relative prudence, $-\frac{U'''C_{i,t}}{U''}$, and $\tilde{\lambda_t}$ is $-\frac{\lambda_t}{C_{i,t}U''}$.

In order to derive an estimable model based on Equation (2), we follow Merrigan and Normandin (1996) and replace the expected consumption growth term with the observed consumption growth as well as the rational expectation error terms:

$$\frac{C_{i,t+1} - C_{i,t}}{C_{i,t}} = \beta_0 + \beta_1(\frac{C_{i,t+1} - C_{i,t}}{C_{i,t}})^2 + \tilde{\lambda}_{i,t} + \eta_{i,t+1}, \tag{3}$$

where $\beta_0 = \frac{1}{\sigma}(\frac{r-\delta}{1+r})$ and $\beta_1 = \frac{\rho}{2}$. In Equation (3), β_1 captures a half of the coefficient of relative prudence under liquidity constraints. Equation (3) is our econometric model to be estimated. In Equation (3), the error term η_i has a mean of zero, but it might be correlated with $(\frac{C_{i,t+1}-C_{i,t}}{C_{i,t}})^2$. Thus, this study employs the instrumental variable (IV) regressions to estimate the model. Moreover, it is unlikely that the error term η is independent and identically distributed for the following three reasons: there might exist measurement errors, changes in tastes may not be independent and identically distributed, and expectations errors may differ across families. Hence, we control for heterogeneity and aggregate shocks by including age dummies and district dummies in the estimated equation.[8]

The manner in which the Lagrange multiplier term for liquidity constraints should be treated is a remaining issue. The conventional empirical approach such as Zeldes (1989) employs the divided sample into two groups based on income and asset information: those likely to be liquidity-constrained ($\tilde{\lambda}_{i,t} \geq 0$) and those not likely to be liquidity-constrained ($\tilde{\lambda}_{i,t} = 0$).[9] It is straightforward to show that the Lagrange multiplier $\tilde{\lambda}$ is a negative function of the household's income $Y_{i,t}$. Therefore, we follow Zeldes and use the household income as a proxy for the shadow value of the liquidity constraint by assuming that $\tilde{\lambda}_{i,t} = \beta_2 Y_{i,t}$, where $\beta_2 < 0$ for constrained households and zero for un-constrained households.

Among other things, the data set used in our study contains a unique piece of information regarding liquidity constrained households, which will help us clearly identify the constrained and the un-constrained groups. We then estimate the model with different prudence and income coefficients, i.e., β_1 and β_2, for these two groups of households.

[8] The data set contains data from four mutually-distant districts. We assume that each district has different aggregate shocks, such as weather shocks.

[9] See Zeldes for details.

2.2 Endogenous Liquidity Constraints

The above exogenous sample split approach assumes that the liquidity constraint is exogenously given. However, the Euler equation (2) indicates that the liquidity constraint is endogenously determined; thus we also consider endogeneity of liquidity constraints following Garcia, et al. (1997). According to them, the availability of credit may depend not only on economic variables but also on socio-economic values due to collateral requirements and standard information-economics reasons. Thus, they argued that it would be better to use multiple factors while determining the liquidity-constrained groups.

Assume that C^* and C represent the optimal consumption in the absence of a liquidity constraint and the actually chosen consumption level, respectively. $C^* = C$ if the liquidity constraint is not binding, while $C^* > C$ if the liquidity constraint is binding. We can then define the gap, H, between C^* and C^*:

$$H_{i,t} = C^*_{i,t} - C_{i,t}. \tag{4}$$

Following Hayashi (1985) and Jappelli (1990), this study assumes that the conditional expectation of desired consumption C^* can be approximated by a quadratic function of observable cross-sectional variables such as the current income, wealth, age of the household head, and household size. Assuming that the credit ceiling Z can also be a function of the same variables, we can represent H by a reduced form function:

$$H_{i,t} = W_{i,t}\beta_W + \upsilon_{i,t}, \tag{5}$$

where β_W is the column vector of the coefficients of different variables used to determine liquidity constraints.

In order to estimate augmented Euler Equation (3), this study combines it with the endogenous liquidity constraint *a la* Japelli (1990). If superscripts u and c denote the unconstrained and constrained groups, respectively, the estimable Euler equation (3) can be rewritten as follows:

$$\frac{C_{i,t+1}-C_{i,t}}{C_{i,t}} = \beta_0 + \beta_1^c \delta_{i,t} (\frac{C_{i,t+1}-C_{i,t}}{C_{i,t}})^2 + \beta_1^u (1-\delta_{i,t})(\frac{C_{i,t+1}-C_{i,t}}{C_{i,t}})^2 + \beta_1^c \delta_{i,t} Y_{i,t} + \beta_2^u (1-\delta_{i,t}) Y_{i,t} + \eta_{i,t+1}, \quad (6)$$

$$\delta_{i,t} = \begin{cases} 1 & \text{if} \;\; H_{i,t} > 0 \\ 0 & \text{if} \;\; H_{i,t} \leq 0, \end{cases}$$

$$H_{i,t} = W_{i,t}\beta_W + \kappa_{i,t}, \quad (7)$$

where δ is a dummy variable for the liquidity-constraint equation, which takes the value of one if the equation is binding, and zero, otherwise.

In order to estimate the system of Equations (6) and (7), this study applies Amemiya (1985)'s Type 5 Tobit model with observed regimes. We assume that errors η_i and κ_i in Equations (6) and (7), respectively, follow a bivariate normal distribution with zero means, a constant covariance $\sigma_{\eta\kappa}$, and constant variances. The Type 5 Tobit model explicitly considers the endogenous sample selection bias arising from endogenous liquidity constraints. This study estimates the Type 5 Tobit model of Equations (6) and (7) using the Heckman's two-step procedure. In the first step, Equation (7) is estimated by a probit model. Then, based on the estimated coefficients from the first step, this study can obtain a consistent estimate of the sample selection correction term in the conditional expectation of the error term of Equation (6). Subsequently, unbiased coefficients in Equation (6) and the corrected variance–covariance matrix can be estimated.[10]

[10] We also tried to consistently estimate the parameters in the Euler and liquidity-constrained equations by maximizing the log-likelihood function. Yet, we failed to achieve a convergence in the likelihood function. Therefore, we employed a two-step estimation pro-

The other issue that we consider here is an endogeneity bias arising from a correlation between the error term η_i and $(\frac{C_{i,t+1}-C_{i,t}}{C_{i,t}})^2$. In order to cope with this issue, this study postulates the following linear equation for the squared consumption growth: $(\frac{C_{i,t+1}-C_{i,t}}{C_{i,t}})^2 = X_{i,t}\beta_X + u_{i,t}$. Assuming that u_i and η_i follow a bivariate normal distribution, we can employ the Smith and Blundell (1986) method to cope with the endogeneity bias by using the following equation instead of Equation (6):

$$\frac{C_{i,t+1}-C_{i,t}}{C_{i,t}} = \beta_0 + \beta_1^c\delta_{i,t}(\frac{C_{i,t+1}-C_{i,t}}{C_{i,t}})^2 + \beta_1^u(1-\delta_{i,t})(\frac{C_{i,t+1}-C_{i,t}}{C_{i,t}})^2 + \beta_1^c\delta_{i,t}Y_{i,t} + \beta_2^u(1-\delta_{i,t})Y_{i,t} + \alpha u_{i,t+1} + \eta_{i,t+1}. \quad (8)$$

When Equation (8) is estimated along with Equation (7), the error term u is replaced with the residual $\hat{u}$ from the following estimated equation: $(\frac{C_{i,t+1}-C_{i,t}}{C_{i,t}})^2 = X_{i,t}\beta_X + u_{i,t}$.

3 Data and Estimation Results

3.1 IFPRI data

This study uses the multi-purpose household panel data pertaining to rural Pakistan obtained through the Pakistan Food Security Management Project of the International Food Policy Research Institute (IFPRI) [Alderman (1996); Alderman and Garcia (1993)]. The IFPRI panel data set was collected by 14 rounds of survey over six years from 1986 (kharif: monsoon wheat season) to 1991 (rabi: winter season).[11] A total of approximately 1000 households were included in the initial survey. The surveys were conducted in three of the less developed

cedure here.

[11] The second author conducted follow-up surveys in 1997 and 1998 and found significant precautionary saving in the form of grain stock.

districts: the Attock district in the Province of Punjab, the Badin district in the Province of Sind, and the North-West Frontier Province (NWFP)'s Dir district. A relatively well-developed and irrigated area, the Faisalabad district in the Province of Punjab, was also included in the survey for the purpose of comparison [Alderman and Garcia (1993)].

The data set contains rich information regarding various economic environments and the decisions of the poor households in the semi-arid tropical areas with regard to income and expenditures as well as education, landownings, and employment. In particular, it contains valuable direct information on credit market accessibility, which allows us to distinguish the liquidity-constrained households from liquidity un-constrained households. During the credit module of the survey, the enumerators questioned the respondents not having loans regarding the primary and secondary reasons for not availing of the different types of formal loans. The answer choices were: (a) Do not need credit, (b) Do not know how to borrow, (c) No easy access, (d) No collateral, (e) Fear of bad debts, (f) Loan application denied, (g) Easier to borrow from informal sources, and (h) Defaults in past loans.[12] The respondents who chose from options (b) - (h) of the above list for at least one type of credit were identified as households most likely to be liquidity-constrained with regard to formal sources. Yet, the remaining respondents were considered to be the un-constrained. The respondents who chose option (g) from the list could possibly be un-constrained because they may obtain sufficient credit from informal sources. We also conducted the same analysis using a weaker constraint indicator variable, identifying as the constrained group those who chose from options (b) — (f) and (h). The results with the weaker constraint variable, which are not shown in this paper, are fully consistent with the results reported in this paper. Indeed, the

[12] Among the choices provided, (e) *Fear of bad debts* can represent the possibility of future binding liquidity constraints.

respondents who chose the option (g) from the list do not necessarily obtain sufficient credit from informal sources. This is the reason why we have decided to pursue the strict liquidity constraint indicator, using responses of (b) — (h) from the list as evidence of liquidity constraints.[13]

On the basis of these responses, we can identify the liquidity-constrained households who were not able to access credit. Since almost none of the existing multi-purpose household panel surveys include direct questions that identify liquidity constraints (Scott, 2000), the IFPRI data set provides us with valuable information directly to separate the effects of liquidity constraints from those of precautionary saving.[14]

Table 1 shows the descriptive statistics of all the 672 households used in this study. Among them, 573 households are identified to be liquidity-constrained and 98 to be un-constrained, indicating that a majority of households of rural Pakistan are liquidity-constrained.[15] Through out the sample, the head of a household is, on average, 44.5 years old and has approximately 2.1 years of schooling. The average income of the households is 29,057 Rupees ($1,674.75 in 1986/87 price) and the average expenditure is 20,616.57 Rupees ($1,188.27 in 1986/87 price).[16] Thus, their average propensity to consume is 0.71. Further, an average household owns 18,304 Rupees ($1,054.98 in 1986/87 price) worth of livestock and approximately 9.47 acres of land.

While the age profiles of the constrained and un-constrained households are similar, the other characteristics of the two groups are remarkably different. The members of the constrained households are, on average, less educated and poorer than those of the un-constrained households. The constrained house-

[13]The results based on the weaker constraints are available upon request from the corresponding author.

[14]However, the credit module with information relevant to this study is included only during the initial year (round six); thus, we utilize data from the first two years only.

[15]This study considers households whose heads are over 16 years and less than 65 years of age.

[16]Pakistan had a fixed exchange rate system in 1986–87. $1.00 = 17.35 Rupees

holds have approximately 1.9 years of schooling, in comparison with the un-constrained households that have slightly more than three years of schooling. More importantly, the average annual income and the average consumption of the constrained households are 25,475 Rupees ($1,468.29) and 19,935 Rupees ($1,148.99), respectively. Thus, their average propensity to consume is 0.78. On the other hand, the un-constrained households have less than 0.5 of an average propensity to consume. It is evident that the average income for the un-constrained households is close to 50,000 Rupees ($2,881.84), which is almost twice the income level of the constrained households. In addition, the un-constrained households own larger areas of land and more livestock than the constrained ones.

In summary, the descriptive statistics confirm the documented stylized fact of poor households in developing countries: More than 85% of the households in the sample are liquidity-constrained. Therefore, empirical investigations on precautionary saving motives based on the Pakistani household data set could shed light on the importance of complementarity and substitutability with respect to precautionary saving and liquidity constraints.

3.2 Estimation Results

Tables 2–6 show the estimation results for the various specifications considered in this study. As discussed in the previous section, it should be noted that the consumption growth is not an exogenous variable. Thus, we choose education variables, occupation dummies, the numbers of earners in the household, and the value of assets as instruments.[17] First, Table 2 presents the summary of the estimation results for four specifications, which are the same as those of Dynan. The first four columns of Table 2 present the results without including district

[17]This study closely follows Dynan with respect to selecting a set of instruments. With respect to asset holdings, we consider livestock and land ownership, where livestock and land data were collected in the middle and the beginning of the first year, respectively.

dummies, and the next four columns display the results with district dummies. There are four districts in the data set and the district dummy variables are able to capture aggregate risks.[18] Since the overall uncertainty could affect the level of prudence, we control for aggregate risks by including district dummies. Also, age dummies are included in all the specifications in order to control for life cycle effects.

The R^2s for the first-stage regressions range from 0.056 to 0.079, implying that the instruments explain only a small portion of the variability of consumption. Yet, this is similar to the previous studies, including the one conducted by Dynan. While we cannot reject the hypothesis that the coefficients of the instruments are equal to zero in the first stage (Table 2), the overall results of the over-identification tests in Tables 2, 3, and 4 assure the validity of these instruments. The exceptions are specifications (1), (2), and (3) in Table 2.

On the other hand, the second-stage estimation results reveal that risk affects consumption growth positively. In the absence of the district dummies, the implied prudence parameters range between 0.104 and 3.562. Among the four different cases, the results from the first IV regressions (1) in Table 2 show that the implied prudence parameter is 1.550, rejecting the hypothesis that the coefficient of relative prudence is zero. It is evident that the implied prudence is substantially greater than the U.S. estimate reported by Dynan for specifications (1) and (2). On the other hand, the estimated prudence parameters in specifications (3) and (4) are similar to Dynan's estimates.

In Table 2, the implied prudence parameters in the specifications with district dummies are greater than the ones without district dummies. The results from the model with district dummies suggest that precautionary saving motives become stronger once aggregate risks are taken into account.

This study continues to investigate the precautionary saving motives by in-

[18] The district dummy variables could also capture the supply aspects of the credit markets.

tegrating the framework presented by Dynan with Zeldes' model of liquidity constraints. Table 3 summarizes the results with income as an additional independent variable for the Lagrange multiplier associated with the liquidity constraint. With respect to the full set of instruments, the estimated prudence parameter is found to be 2.140, which is statistically significant [specification (1)]. More importantly, the coefficient on income is found to be negative and statistically significant. This is consistent with the model of liquidity-constrained households. In Table 3, the overall negative sign of the coefficient on income suggests that the consumption Euler equation does not hold for Pakistani households in general and the shadow value of liquidity constraints is positive. Indeed, it could be a reflection of the fact that more than 85% the households in the sample are liquidity-constrained. Among other things, Table 3 reveals that the specification suggested by Dynan could suffer from omitted variable biases if applied to developing countries, wherein most of the households are liquidity-constrained. When the results of Table 3 are directly compared with those of Table 2, the estimated prudence parameters are found to be uniformly larger except the specification (2).[19]

This study further examines precautionary saving under liquidity constraints by looking at two separate groups of households on the basis of the direct responses that each household provided in the survey. The results from the two split samples provide even stronger evidence for precautionary saving in Pakistan: Table 4 shows that for all four sets of instruments, the estimated prudence parameters for the constrained households are positive and the coefficients on income are negative. These prudence parameters are uniformly larger than the previous estimates in Tables 2 and 3. They are, indeed, all statistically sig-

[19] Theoretically speaking, this omitted variable bias occurs when the consumption growth squared term and the income variable are negatively correlated. This situation is likely to happen when the rich engage in riskier income-generating activities than the poor.

nificant, suggesting a violation of the standard consumption Euler equation.[20] On the other hand, for the un-constrained households, we fail to reject the hypothesis that the estimated prudence parameters and the shadow value of liquidity constraints are all equal to zero. This is consistent with the standard consumption Euler equation.

A comparison between the implied prudence levels of the constrained group using the full set of instruments, i.e., specification (1) in Table 4 and the one using the same set of instrument in Table 3 reveals that the overall prudence level estimated before the two groups were split could underestimate the importance of precautionary saving of the constrained group. The implied prudence levels of the former and latter groups are 2.578 and 2.140, respectively. As we discussed briefly, since a majority of poor households tend to be liquidity-constrained in Pakistan, they appear to behave very prudently.

A question arises with regard to the other implications that these results have. While this study does not have sufficient data to track the entire life-cycle consumption-saving behavior of each household, the pattern that emerges from Tables 1 and 4 indicates that a low level of prudence is associated with a high level of wealth. In other words, prudence decreases with an increase in wealth. These observed differences in the prudence levels of the two groups of households could be evidence of the decreasing relative risk aversion (DRRA) or the decreasing absolute risk aversion (DARA), which is theoretically studied by Kimball.[21] Moreover, our interpretation is consistent with that of Ogaki and Zhang (2001) who found evidence in support of the DRRA utility by using the same IFPRI Pakistan data.

Finally, this study employs the use of switching regressions to investigate

[20]The levels of significance vary depending on instruments.

[21]If the risk premium associated with any risk is a decreasing function of wealth, then preferences exhibit DARA. Furthermore, DARA requires $U''' > 0$, which implies prudence. DRRA is a very close concept and is stronger than DARA. See Kimball for details.

possible sample selection biases arising from endogenous liquidity constraints (Tables 5–6). Table 5 displays the first stage Probit estimation for the purpose of determining liquidity-constrained households. The results presented in Table 5 indicate that a higher income level leads to less binding liquidity constraints. Table 6 presents estimation results for switching regressions, in which we fail to reject the hypothesis that the sample selection correction term is zero for all four specifications. In addition, the Smith and Blundell adjustment term is found to be statistically insignificant.[22] While the estimated sign of prudence is consistent with the theory's prediction, the size of the implied prudence becomes slightly smaller for the constrained households in comparison to the one in Table 4: The estimated prudence is found to be 1.871 for the constrained and 0.942 for the un-constrained households. Lastly, although the coefficients on income are negative for both the constrained and the un-constrained households, they are not statistically significant. The overall results imply that while, in principle, endogenous liquidity constraints are important and could cause biases in the estimated parameters; our specifications in Table 4 may not suffer from the sample selection problem. Our results are consistent with the findings of Garcia, et al. (1997): it is unlikely that households self-select whether they wish to be liquidity-constrained. Thus, potential sample selection problems caused by endogenous liquidity constraints do not appear to be severe.

4 Concluding Remarks

In summary, this study's empirical investigations provide three main results. First, we document strong evidence of the presence of precautionary saving in Pakistan, especially with respect to the liquidity-constrained households, the es-

[22]When the full set of instruments (1) is used, the estimated covariance term is found to be -0.066 and the Smith and Blundell adjustment term is -0.058 for the constrained households. However, both the terms are not statistically significant even at the 10% level of significance.

timated prudence parameters of which fall within the range of 1.7—4.0. On the other hand, financially better-off households appear to have perfect credit market access [Morduch (1995)]. These results, based on the estimated prudence parameters, are rather robust even with various specifications and different sets of instruments. In fact, based on simulations, Ludvision and Paxon (2001) argued that the degree of bias in Dynan's specification varied with wealth, with less wealthy households displaying greater downward bias. Thus, the implied prudence of the constrained households in this study could be even larger than reported. Second, on the basis of the fact that un-constrained households are richer, our results can be used as empirical evidence of DRRA (and DARA) studied by Kimball. Although it is found that the liquidity-constrained households have precautionary saving motives, Table 1 shows that their actual average propensity to save is much smaller than that of the un-constrained households. Thus, it may be difficult for them to accumulate assets over their life cycle. This may be one of the reasons why the constrained households end up owning small assets. Finally, the results of this study suggest that precautionary saving becomes stronger under liquidity constraints. The existing theoretical and numerical studies demonstrate that the possibility of *future* binding constraints makes the household accumulate buffer stock [Samwick (2003); Caroll and Kimball (2001); and Xu (1995)]. In this line of research, the presence of liquidity constraints in the standard life cycle model with uncertainty would increase future income risks. Thus, the liquidity constraints strengthen the precautionary saving motives for households. Our results provide an empirical validity to these claims because this study finds that broadly-defined liquidity constraints cause the households to behave prudently. In other words, the results reveal an empirical complementarity between precautionary saving and liquidity constraints.

The findings reported in this study imply that the liquidity-constrained poor would be willing to hold assets even with low or negative returns because they have a desire to set up a buffer stock. This may appear as perverse behavior at first sight; however, it is indeed a rational response given their environmental constraints. The findings question the commonly-held assumptions among researchers that borrowing constraints are far more serious than savings constraints. The combination of the two would generate more serious welfare consequences on the poor than the liquidity constraints alone. From a practical viewpoint, this study supports the emerging view among microfinance practitioners and policy makers that facilitating saving may often be more important than finding better ways to lend to low-income customers, and particularly to the most impoverished households [Armendáriz de Aghion and Morduch, 2005, p. 172].

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Table 1: Sample Statistics

	All	C	Un-C
Variable	Mean	Mean	Mean
Age[a]	44.53	44.43	44.95
	(11.74)	(11.83)	(11.2)
Years of schooling[a]	2.08	1.91	3.12
	(3.93)	(3.73)	(4.82)
Consumption[b]	20615.67	19935.47	24310.31
(in Rupees in 1986/87)	(10546.74)	(9839.234)	(13196.8)
Income[b]	29057.3	25475.1	49955.45
(in Rupees in 1986/87)	(35201.85)	(21820.9)	(72435.6)
Value of livestock[b]	18304.31	17532.92	22709.82
(in Rupees in 1986/87)	(15014.62)	(14543.33)	(16887.99)
Land[b]	9.47	8.49	15.22
(Acres)	(22.23)	(20.07)	(31.66)
Sample size	672	573	98

Standard deviations are in parentheses. C stands for Constrained households and Un-C for Un-constrained households. a. represents the head and b. represents the households.

Table 2: Basic Specifications

	Without District Dummies				With District Dummies			
Instrumental Variable (IV)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Education[a]	0.541	..	0.590	0.548	0.646	..	0.633	0.655
Occupation[a]	0.801	0.836	..	0.803	0.888	0.883	..	0.891
Earners[a]	0.553	0.592	0.569	..	0.292	0.308	0.298	..
Livestock[a]	0.932	0.922	0.739	0.968	0.932	0.971	0.964	0.765
Land[a]	0.914	0.693	0.815	0.889	0.800	0.845	0.858	0.792
$\mathrm{First-stage}\ R^2$	0.068	0.056	0.055	0.068	0.079	0.068	0.068	0.077
$(\mathrm{Con-Growth})^2$	0.775	1.781	0.232	0.485	0.981	1.909	0.783	0.521
	(0.431)*	(0.687)***	(0.665)	(0.443)	(0.431)**	(0.688)***	(0.595)	(0.455)
Prudence	1.550	3.562	0.464	0.970	1.962	3.818	1.566	1.042
	(0.862)*	(1.374)***	(1.33)	(0.886)	(0.862)**	(1.376)***	(1.190)	(0.910)
Over Id[b]	0.004	0.068	0.012	0.18	0.133	0.535	0.111	0.676

Standard errors are in parentheses. Age dummies (not reported here) are included to control for life cycle effects. a. represents the P-values of F-tests from the first stage estimations and b. represents the over-identification tests based on Sargan pseudo-F tests. *** 1% level; 5% level; 10% level; 15# level

Table 3: Specifications with Liquidity Constraints

IV	(1)	(2)	(3)	(4)
$\mathrm{First-stage\ R^2}$	0.083	0.074	0.071	0.079
$\mathrm{(Con-Growth)^2}$	1.070 (0.428)**	1.651 (0.594)***	0.943 (0.597)#	0.598 (0.456)
Implied Prudence	2.140 (0.865)**	3.302 (1.188)***	1.886 (1.194)#	1.196 (0.912)
Income	-0.945 (0.275)***	-1.074 (0.314)***	-0.916 (0.288)***	-0.839 (0.277)***
Over Id[a]	0.253	0.427	0.912	0.661

Standard errors are in parentheses. IV (1) includes education, occupation, number of earners, and assets. IV (2) includes occupation, number of earners, and assets. IV (3) includes education, number of earners, and assets. IV (4) includes education, occupation, and assets. Age dummies (not reported here) are included to control for the life-cycle effects. a. represents the over-identification tests based on Sargan pseudo-F tests. *** 1% level; ** 5% level; * 10% level; # 15% level

Table 4: Specifications with Liquidity Constraints: Split Samples

IV	(1)		(2)		(3)		(4)	
	C	Un-C	C	Un-C	C	Un-C	C	Un-C
$(\text{Con} - \text{Growth})^2$	1.289	0.250	2.013	2.856	1.239	0.659	0.850	-0.252
	(0.442)***	(1.411)	(0.715)***	(2.372)	(0.671)*	(1.637)	(0.458)*	(1.391)
Implied	2.578	0.501	4.026	5.712	2.478	1.319	1,700	-0.505
Prudence	(0.884)***	(2.823)	(1.431)***	(4.744)	(1.342)*	(3.274)	(0.917)*	(2.782)
Income	-1.106	-0.405	-0.956	-0.945	-1.097	-0.486	-1.026	-0.293
	(0.495)**	(0.447)	(0.616)**	(0.643)#	(0.500)**	(0.473)	(0.484)**	(0.438)
Over Id[a]	0.387		0.787		0.141		0.717	

Standard errors in parentheses. C stands for Constrained households and Un-C for Un-constrained households. IV (1) includes education, occupation, number of earners, and assets. IV (2) includes occupation, number of earners, and assets. IV (3) includes education, number of earners, and assets. IV (4) includes education, occupation, and assets. Age dummies (not reported here) are included to control for life cycle effects. a. represents the over-identification tests based on Sargan pseudo-F tests. *** 1% level; ** 5% level; * 10% level; # 15% level

Table 5: Variables Identifying Constrained Households

First Stage Probit Estimates for Switching Regressions

Variable	Parameter	S.E.
Income	-11.606	4.439***
Income^2	11.026	8.934
Income X Land	-0.036	0.072
Land	0.000^a	0.009
Land^2	-0.000^a	0.000^a
Age	-0.033	0.045
Age^2	0.000^a	0.001
Number of Earners	0.022	0.045
Number of Children	-0.062	0.047
District Dummy 2	1.350	0.243***
District Dummy 3	0.969	0.186***
District Dummy 4	1.698	0.237***
Constant	1.162	0.998

S.E = Standard Error. a. Due to rounding. *** 1% level; ** 5% level; * 10% level; # 15% level

Table 6: Switching Regressions

IV	(1)		(2)		(3)		(4)	
	C	Un-C	C	Un-C	C	Un-C	C	Un-C
$(\text{Con} - \text{Growth})^2$	0.935 (0.415)**	0.471 (0.477)	1.649 (0.620)***	1.199 (0.672)*	0.893 (0.557)#	0.428 (0.587)	0.768 (0.417)*	0.302 (0.478)
Implied Prudence	1.871 (0.830)**	0.942 -0.954	3.298 (1.241)***	2.399 (1.345)*	1.787 (1.115)#	0.857 (1.175)	1.536 (0.834)*	0.605 (0.957)
Income	-0.718 (0.633)	-0.143 (0.508)	-0.650 (0.635)	-0.100 (0.510)	-0.718 (0.634)	-0.143 (0.509)	-0.710 (0.633)	-0.140 (0.508)
Smith & Blundell[a]	-0.058 (0.419)		-0.78 (0.624)		-0.015 (0.559)		0.112 (0.420)	
Sample Selection Correction[b]	-0.066 (0.087)		-0.075 (0.088)		-0.066 (0.087)		-0.065 (0.087)	

Standard errors are in parentheses. C stands for Constrained households and Un-C for Un-constrained households. IV (1) includes education, occupation, number of earners, and assets. IV (2) includes occupation, number of earners, and assets. IV (3) includes education, number of earners, and assets. IV (4) includes education, occupation, and assets. Age dummies (not reported here) are included to control for life cycle effects. a. represents the Smith & Blundell adjustment term and b. represents the sample selection correction term. *** 1% level; ** 5% level; * 10% level; # 15% level