Household Finance in Developing Countries

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Abstract

We use a novel panel data on Indian households to document the household asset portfolio choice along the extensive margin. While households hold high stocks of gold and real estate, a majority of them participate exclusively in financial assets on a regular basis. This dilutes the puzzle on why households in developing countries hold excessive physical assets. We show that a portfolio choice model, a la Grossman and Laroque (1990), where households face an adjustment cost to change their asset holdings, can explain the mismatch observed in the stocks and flows data. Using regional weather shocks as a source of exogenous variation to household incomes, we show that consecutive positive shocks increases household participation in physical assets while a single positive weather shock increases household participation in financial assets, suggesting that households use financial assets as a transitory asset class, thus providing a direct causal evidence for adjustment costs. Furthermore, we show that increasing access to formal financial institutions increases household participation in physical assets by reducing the adjustment costs.

Keywords : Indian Households Finance, Portfolio Choice, Financial vs. Physical Assets

JEL Codes: D14, D15, O16

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1 Introduction

How do households allocate their income across different financial assets? Is it governed by culture or rational choice or both? The Household Committee Report published by RBI (2017) shows that a large portion of household wealth is locked in physical assets (gold and real estate) and significant welfare gains can be achieved if Indian households re-balance their portfolio like their counterparts in developed countries [1]. While these patterns are also observed for households in other EMEs such as China, Bangladesh and Philippines (Badarinza et al. (2018)), it is still a puzzle that households continue to accumulate large stock of physical assets in these countries.

The key issue, however, is that these observations are mostly based on cross-sectional survey data on household asset, measuring only the stock of assets. When it comes to participation rates, the literature has not distinguished between stock and flow reports of households. In fact, using information on the stock data to understand the household asset portfolio choice in the case of developing countries can be misleading, as we demonstrate in this paper.

We revisit the household asset choice problem using information on the flow dimension of assets. We utilize a new database on Indian households called the CMIE Households Consumer Pyramids to look at asset allocation of households over a period of time. We use a balanced panel covering over 100,000 households, observed over a 4 year period. The data therefore provides a large sample of households which can be followed over time to study the flow of their asset allocation. However, this survey only contains information on participation, i.e., on the extensive margin, and not the volume of asset purchased along the intensive margin. This however does not limit our understanding on how households make their asset portfolio choice over the life-cycle.

[1] See RBI Report of the Household Finance Committee, 2017.

Based on the flows data, our major findings are as follows. First, out of those households that invest, more than half choose to save only in financial assets across the entire time horizon of the data. Second, investment in physical assets (gold and real estate) is still high among households but those who invest in physical assets, also invest in financial assets. In fact, the share of households investing in all three asset classes i.e. gold, real estate and financial assets, is the second highest, after the share of those who invest exclusively in financial assets. Third, households investing only in gold or in real estate are very few in number. These observations suggest that although most households that invest in assets hold a higher proportion of their wealth stock in gold and real estate, a majority of such households invest only in financial assets in the short run. This implies that participation in basic financial markets is not a big hurdle, something which emerges from looking only at the survey data on stocks.

In the second part of the paper we try give the mechanism that helps explain the divergent patterns observed in the flows data vis-a-vis the stocks data. For causal identification, we use regional weather shocks as a source of exogenous variation in household incomes, akin to a large body of papers in the development literature (see for instance, Colmer (2016), Dell et al. (2012), Jayachandran (2006) and Kaur (2017)) and identify portfolio choices in response to weather-induced variations in household incomes.[2] The baseline empirical results show that while a single contemporary positive rainfall shock increases the likelihood of household participation in financial assets, consecutive positive rainfall shocks (or the momentum effect) increases the likelihood of household participation in physical assets – primarily real estate – while reducing households' participation likelihood in financial assets. The coefficients are economically large: a single contemporary rainfall shock increases the likelihood of household participation in financial assets by 10

[2] Specifically, the paper uses rainfall shocks at the district-level. The district is the third administrative level in India, after the federal and the state, and is equivalent to the U.S. county.

percent while consecutive positive rainfall shocks increases the likelihood of household participation in real estate by 40 percent.

We also test for the presence of adjustment costs associated with changing the level of physical assets, similar to Grossman and Laroque (1990), who predict that households would become excessively risk-averse in the immediate aftermath of purchasing a lumpy asset. Intuitively, this is explained by the fact that households have limited money left on the table after making a lumpy investment and prefer not to engage in any risky activity in order to finance their consumption and undertake necessary expenditures. We use an empirical strategy similar to Chetty and Szeidel (2006) who observe household asset choices immediately following household home purchases. In this paper, we identify households' response to consecutive positive rainfall shocks, conditional on the household investing in real estate in the previous year. Contrary to our baseline results and consistent with the predictions of Grossman and Laroque (1990), the results show that conditional on households investing in real estate in the prior year, consecutive positive rainfall shocks now have no significant effect on household participation in either physical, or financial assets.

The fact that conditional on investing in real estate in the past year, consecutive positive rainfall shocks have no impact on household participation in any asset class rules out the concerns that the results might be driven due to portfolio re-balancing by households. While we do show evidence of households engaging in active portfolio re-balancing in response to consecutive positive income shocks in the periods following investments in financial assets or gold, this behaviour is absent in the year following investments in real estate. This highlights higher adjustment costs associated with real estate investments.

Finally, we show that these results are in line with a model of household portfolio choice, where households derive utility from consumption and a physical asset. Similar to Grossman and Laroque (1990), our model has a transaction cost associated with changing the level of their physical asset holdings. This model is able to generate and explain the mechanism behind the results shown in the empirical section. Some other papers which deal with inertial behavior of households are Attanasio (2000), Flavin Nakagawa (2003) etc.

For example- two consecutive positive income shocks take the household further away (relative to a single shock) from their optimal level of investment in physical assets and increases the probability of adjustment. At the same time, since households need more cash to purchase the additional units of physical asset, this brings down their contemporaneous investment in basic financial assets.

Furthermore, the model also predicts that a decrease in adjustment costs makes the adjustment easier (more frequent). We empirically evaluate this by testing for households' differential response to consecutive positive income shocks across districts with below/above median level of banking penetration. Higher banking penetration captures financial development of a district and can be associated with low adjustment costs for switching between assets. And we indeed find that households in districts with higher banking penetration show a significantly higher response to two consecutive shocks in terms of increasing their participation in real estate - vis-a-vis financial assets.

Our paper therefore makes three broad contributions to the existing literature on household finance. First, it is related to the literature on international comparison of household asset portfolio choice across countries. Badarinza et al. (2016) document the relative comparison across households in developed countries while Badarinza et al. (2018) document it for developing countries. The main contribution of our paper here is to show that flows and stock data can give very different picture on household level participation in various asset classes. This has been ignored in the literature since participation rates over 3-4 years period, whether calculated from stock or flow data on assets, look similar for developed countries (see Ameriks and Zeldes (2004)). However, this might not be true for developing countries as we show in the case of India, and thus highlight the need for using panel data on household asset choice over an extended period of time.

Second, to the best of our knowledge, this is the first paper to empirically identify the presence of adjustment costs in developing economies and how they affect household portfolio choices. While Chetty and Szeidel (2006) test Grossman and Laroque's (1990) predictions regarding adjustment costs, they do so for households residing in the U.S. and using an instrumental variables approach where the exclusion restriction is possibly violated. Our paper uses a more direct approach: we first establish that only successive weather-induced income shocks increase household participation in real estate. Subsequently we show that successive weather shocks have no effect on household participation in any asset class, conditional on households investing in real estate in the previous year. This gives a direct evidence for inaction in the immediate aftermath of investment in a lumpy asset.

Finally, our paper contributes to the literature studying the role of financial infrastructure on household portfolio choice. The development literature has extensively studied the impact of financial infrastructure and access to finance on household savings and investments with papers such as Burgess and Pande (2004) and Prina (2014) showing that higher financial infrastructure is associated with a faster rate of poverty alleviation and overall improvement in household finances. Our paper on the other hand shows that an additional role of financial infrastructure is to reduce the adjustment costs faced by households for accumulation of physical assets.

The rest of the paper is organized as follows: we first present a model describing the representative household's portfolio choices in Section 2. Section 3 discusses our data and documents the mismatch between household assets based on stocks and flows. Section 4 presents our empirical strategy and documents the key findings of the paper. Section 5 shows that the results are robust to household weights while Section 6 offers concluding thoughts.

2 Model

We build a model of asset portfolio choice where the representative household maximizes a discounted life-time utility and lives for T periods. In every time period, the household faces an income shock Y_t which can take two possible values $\{Y_L, Y_H\}$. Here Y_L corresponds to the low income state and Y_H corresponds to the high income state. The household divides its income every period over consumption and investment.

The household consumes c_t units in every time period t, and can invest in two types of assets – a financial asset a_t which gives a fixed rate of return $(1+r)$, and a physical asset (or a lumpy asset) D_t which gives utility and can be purchased only in discrete units. Additionally, this lumpy asset can be adjusted subject to some haircut $1-\delta$ on the current levels of D_t. Since adjusting the level of a_t is not costly, this drives a wedge between these two types of assets. [3]

The representative household therefore maximizes the following discounted lifetime utility function:

$$\sum_{t=0}^{T} \beta^t F\left(c_t, D_t\right),$$

subject to the following per-period flow budget constraints:

$$c_t + a_t = Y_t + (1+r)\, a_{t-1}, \tag{1}$$

if the household decides to not adjust its existing stock of D_t, or:

$$c_t + a_t + D_t = Y_t + (1+r)\, a_{t-1} + \delta D_{t-1}, \tag{2}$$

[3] Since the goal of the paper is to study portfolio choice in response to income shocks and adjustment cost, we do not introduce a return difference between the two asset classes in our model. In a more general setting, the returns difference can be also introduced but we think it will not alter the testable implications of the model on portfolio re-balancing that we are interested in.

if the households decides to adjust its existing stock of D_t. The parameter $1-\delta \in (0,1)$ is the haircut on the existing stock D_t in case the household readjusts its stock of D_t. The household loses $(1-\delta)$ value of D_t every time it readjusts.

Given the above utility function and constraints, the household's problem can be summarized as follows:

$$\max_{c_t, a_t, D_t} \sum_{t=0}^{T} \beta^t F(c_t, D_t) \tag{3}$$

s.t.,

$$\begin{aligned} c_t + a_t &= Y_t + (1+r)\,a_{t-1}, \text{ under no readjustment of } D, \text{ or} \quad (4)\\ c_t + a_t + D_t &= Y_t + (1+r)\,a_{t-1} + \delta D_{t-1}, \text{ under readjustment of } D, \quad (5) \end{aligned}$$

and

$$\begin{aligned} Y_t &\in \{Y_L, Y_H\} \ \forall t \quad (6)\\ c_t, D_t &> 0, \text{ and } a_t \geqslant 0 \ \forall t. \quad (7)\\ a_t &= 0 \text{ at } t = T, \quad (8) \end{aligned}$$

where β is the discount rate, r is the fixed net rate of return on the asset a and δ is the value of the physical asset that the household gets on liquidation such that $(1-\delta)$ is the hair-cut or loss in value of D on liquidation. The non-negativity constraint (7) assumes that the household cannot consume negative values of c or D, and that a_t is bounded below by 0, which implies that the representative household is also credit-constrained and cannot borrow [4]. The terminal condition (8) implies that at time T, the household will

[4] This condition can be easily relaxed.

not hold any positive a, but can still leave non-zero levels of D [5].

We can rewrite the above discounted-lifetime problem as a two period dynamic programming problem, as follows:

$$v\left(a, D, Y\right) = \max_{c,a\prime,D\prime} \left\{F\left(c_t, D_t\right) + \beta E\left[v\left(a', D', Y'\right)\right]\right\}, \tag{9}$$

subject to (6)–(8). $v(.)$ in eq. (9) is the value function with respect to two endogenous state variables, a and D, and an exogenous state $Y \in \{Y_L, Y_H\}$. Given the non-convexity of the problem, it is not possible to obtain the analytical solution. We therefore use a grid-point approach to solve numerically for the optimal portfolio choice and then simulate our model 1000 times for $T = 30$. For our numerical simulations, we assume:

$$F\left(c, D\right) = \frac{\left[U\left(c, D\right)\right]^{1-\sigma}}{1-\sigma},$$

such that:

$$U\left(c, D\right) = \left\{\mu c^{1/\rho} + \left(1-\mu\right) D^{1/\rho}\right\}^{\rho}.$$

Table 1: Parameter Values for Simulation

β	ρ	μ	σ	r	δ	T
0.95	-0.1	0.8	1.5	0.02	0.7	30

For our numerical simulations, we have chosen parameter values as shown in Table 1. The value of $\beta = 0.95$ is standard in the literature, while $r = 0.02$ is chosen to approximately match the long-term net real returns on risk-free bonds in India. We also choose $\delta = 0.7$ so that the hair-cut on liquidation is

[5] This can be thought as a bequest motives of the household in the model with respect to the lumpy asset D.

fixed at 30% [6]. We then simulate our model for 30 time periods, i.e., $T = 30$.

The numerical simulations of our model give the following predictions:

Prediction 1: The probability that a household liquidates D at any time period t is very low.

Prediction 2: For a single positive income shock, the household increases investments in both a and D.

Prediction 3: After two consecutive positive income shocks, the household increases investments in D and reduces investment in a.

We now move to the empirical section of the paper to test Predictions 2 and 3 using data on household investment flows.

3 Data

This section describes the data used in the paper. We first describe the data on household asset choices and next, the data used to construct weather shocks.

3.1 CMIE Consumer Pyramids Data

The Consumer Pyramids (CP) database is a large panel of Indian households and collected through extensive household surveys conducted by the Centre for Monitoring the Indian Economy (CMIE). It was initiated in 2014 and covers 27 states and 514 districts.[7] Each household is assigned to a survey wave and interviewed thrice every year.[8] The surveys themselves are conducted continuously throughout the year and the data identifies the precise

[6] The parameter values currently chosen are for illustration purpose. In the future version of the paper, we will calibrate them to the data.

[7] Our paper limits the sample to the twenty major states in India, excluding the states of Goa, Jammu and Kashmir, Meghalaya, Tripura, and the union territories of Chandigarh and Puducherry. We also aggregate the districts to 2001 Census district boundaries, leaving us with an aggregate sample across 364 districts.

[8] The survey waves are identified as January-April; June-August and September-December respectively.

month within each wave in which the household is interviewed. Each survey wave covers approximately 135,000 households with 35,000 households being surveyed each month.

The CP surveys cover household investments, borrowing, consumption and income, in addition to household demographics. The investment module enquires about investments made by the household in the past four months along the extensive margin – or participation in asset classes. Thus, our data permits us to observe whether households made any fresh investments in any of the asset classes but does not inform us regarding the magnitude of the investment. The CP surveys enquire households about investments in eight financial instruments, along with gold, real estate and business over the past 4 months. The financial instruments include both risk-free and risky instruments such as fixed deposits, provident funds, life insurance, stocks and mutual funds.[9] As participation in risky assets is almost negligible, we do not consider them as a separate asset category for this paper.[10] As households are surveyed at different periods along the year, we smooth out any seasonal variations by annualizing our data. The primary outcome of interest for household h, residing in district d, in year t is the binary variable $Invest^j$ which equals 1 if the household has made any investment in asset j ($j \in \{Financial, Gold, RealEstate\}$) in year t, and 0 otherwise.

While there is limited attrition in the data, we restrict our sample to the 119,482 households for whom we are able to construct a balanced panel between 2014 and 2017, providing us with 4 observations per household. A potential drawback of the CP data however is that it oversamples urban households, with 60 percent of the responding households being located in urban areas. To verify that this sampling bias do not affect our findings,

[9] Specifically, the eight financial instruments are a) fixed deposits; b) post office savings; c) national savings certificates; d) Kisan Vikas Patra; e) provident fund; f) mutual funds; g) shares and h) life insurance.

[10] Less than 1 percent of the households in the sample participate in risky assets - namely shares and mutual funds. This is a major departure from the existing literature on household finance based in developed economies where a major focus is on how households choose their target share of risky assets and maintain this risky share in response to movements in asset prices.

Table 2 (Appendix 10) reproduces our primary results after weighting them by the sample weights provided in the CP data.[11]

In addition to eliciting households' investment choices in the past 4 months, the CP surveys also ask the respondents whether they have any outstanding investment financial assets, gold or real estate.[12] While this information too is collected along the extensive margin, it is a stock measure which allows us to undertake a comparison between outstanding stocks of household portfolios and annual portfolio choices.

3.2 Rainfall Data

To construct regional weather shocks, we collect monthly district-level rainfall data from the European Centre for Medium-Range Weather Forecasts (ECMWF) for the period 1980-2018. The data is reported at the 0.75*0.75 grid-level and we obtain district-specific precipitation incidence by computing the average across all the points lying within a district's boundaries. To obtain annual rainfall levels for each district-year combination, we calculate the within-district mean precipitation across the 12 months. Using the annual long-run panel of district-level rainfall incidence, we define for each district d and year t, the binary variable, $HighShock_{dt}$, which equals 1 if $Rainfall_{dt} > Rain\bar{f}all_d$. *Rainfall* refers to the annual rainfall incidence in the district while $Rain\bar{f}all_d$ is the long-term median annual rainfall within the district. We will illustrate in the subsequent empirical section how we use *HighShock* to define our exogenous variable of interest.

[11] The weights reflect the inverse of the sampling probability for each household.

[12] The CP enquires households about outstanding investments in each of the 8 financial instruments, which we aggregate to a single measure of outstanding financial assets.

4 Empirical Results

4.1 Flows Data: High Participation in Financial Assets

In this section, we use the CP data to document the household asset choice behaviour on the flows dimension and compare it with the current literature, where asset participation is calculated from stock level data.

We engage in a basic comparison using bar charts. The top panel of Figure 1 depicts the average household participation over 4 years across 8 mutually exclusive asset classes while the bottom panel shows outstanding stocks of assets based on the first survey undertaken for the household in 2014.[13] As household investment patterns in developing economies typically vary across rural and urban areas, we disaggregate our sample by rural and urban households.

From the top panel in Figure 1, our first observation is that the average household is characterized by non-participation in any major asset class within the year – over 60 percent of urban households do not make any fresh investment in financial assets, gold, or real estate during an year, with the figure rising to 70 percent for rural households. For the households which choose to invest, the most likely mode is exclusively financial assets, and this holds true even in rural areas. Thus, while 20 percent of rural households invest only in financial assets in this period, the corresponding figure for urban households is almost 30 percent. The remaining categories are quite negligible.

This is in contrast to the statistics based on the outstanding stock of assets held of households, measured in 2014, when households were first interviewed for the CP database (bottom panel, Figure 1). The majority of households, in both urban and rural areas, have outstanding investments in all three

[13] For the clarity's sake, the eight mutually exclusive categories are: only financial assets; only gold; only real estate; financial assets and gold; gold and real estate; financial assets and real estate; and financial assets, gold and real estate. The eight category is non-investment in any of the above categories.

asset classes: financial, gold and real estate. The second most preferred category is the combination of gold and real estate - this is particularly large for rural households, 35 percent of whom have outstanding investments only in these two classes of physical assets and no outstanding investments in financial assets. The share of households with outstanding investments only in financial assets (and none in gold or real estate) is below 1 percent, even in urban areas.

The summary trends observed in Figure 1 is uniform across the range of household incomes. Figure 2 disaggregates annual per capita household income into 20 bins and plots the average share of households investing in each of the mutually exclusive asset classes between 2014 and 2018, corresponding to each bin. The binned scatter plots show that even within households with the highest per capita income (top 5 percent), almost 50 percent undertake no major investment in either of financial assets, gold or real estate in a year (bottom right panel, Figure 2). This rises to over 80 percent for households in the bottom 5 percent of the per capita income distribution. Similarly, for the households which chooses to invest within a year, the most likely investment class is solely financial assets, and this holds true even for the poorest households (top left panel, Figure 2).

Similarly, Figure 3 shows that the trends in outstanding household stocks across income are consistent with the average trends shown in the bottom panel of Figure 2. The figures are shown as binned scatter plots with the horizontal axis divided into 20 bins of household per capita income in 2014. Figure 3 shows that households in the upper tail of the income distribution are most likely to have outstanding asset stocks in all three asset categories while households in the bottom income decile are most likely to have outstanding asset stocks in only gold and real estate and none in financial assets. Importantly, a negligible share of households have outstanding stocks in only financial assets.

The summary of household investment flows over the 4 year period between 2014 and 2017 along the extensive margin is presented in Table 2. If a household invested in a particular asset class at least once during this period, the investment in that asset class is assigned the value 1. Out of some 174,223 unique households, two-thirds invested in at least one asset during this period. We find that out of all asset classes, the majority of households invested at least once in financial assets. Since there are four asset classes to choose from, households can invest in 4! ways, but they invest only over 8 sets. The key highlights of investment on the extensive margin are:

1. More households invest in financial assets than in any other asset class. A total of 55% households invested only in financial assets during this period. This suggests that financial assets are the most preferred class of asset holdings for most households.

2. Out of the households which bought physical assets, most of them also invested in financial assets. A total of 29% of investor households bought all three assets- gold, real estate and financial assets. This is followed by those who bought gold and financial assets or real estate and financial assets.

3. There are only around 4% households which primarily invested in gold, real estate or both. It implies that on the flows dimension, households are not primarily dependent on physical assets for investment.

4. Less than 1% households invested in all four asset classes. However the share of these households is higher than those who only invested in risky assets. The coverage of the latter is abysmally low across Indian households.

In summary these results suggest that since more than 50% households only invest in financial assets on the extensive margin, they also have a zero investment in gold or real estate on the intensive margin. This implies that solely relying on stock level information to understand household investments might provide an erroneous understanding of the asset portfolio choices of households. Based on Table 2 one can conclude that financial asset class is the first choice of households when it comes to investment, unlike what we find solely by studying the stock data.[14]

4.2 Momentum effect: portfolio choice in response to income shocks

The predictions from our theoretical model showed that the representative household facing transaction costs re-balances his/her portfolio towards lumpy assets only in response to multiple positive income draws. We test this prediction using household data on asset choices from the Consumer Pyramids. To generate exogenous variation in household incomes, we use regional weather shocks – specifically rainfall shocks. This is motivated by the findings of a large body of literature (see for instance Dell et al. 2012) which has established that weather shocks significantly impact both national and household incomes. We exploit the rainfall-induced variations in household income to study household portfolio choices in response to positive rainfall shocks.

To test our model's predictions, we define single and consecutive positive weather shocks to household incomes. Thus, the binary variable $ContempShock_{dt}$ equals 1 if $HighShock_{dt} = 1$ and $HighShock_{dt-1} = 0$, where $HighShock$ is defined as in Section 3.2. Thus, *ContempShock* equals 1 when the rainfall incidence for the current year exceeds the long-run median rainfall incidence in the district, conditional on the rainfall incidence in the previous year being *less* than the median rainfall. We use this variable to identify the impact of a single contemporaneous weather-induced income shock on household portfolio choice.

To identify the impact of multiple positive shocks on household portfolio choices, we construct the binary variable $ConsecShock_{dt} = 1$ if $High_Shock_{dt} = 1$ and $HighShock_{dt-1} = 1$. $ConsecShock_{dt}$ thereby equals 1 if the household has received two consecutive positive weather shocks and we use it to capture

[14] An example of stock survey data used for this exercise is AIDIS published by NSS, India.

the impact of two successive positive shocks on household portfolio choice.[15]

Based on the above formulation of *ConsecShock*, our primary reduced form specification to identify household portfolio choices in response to income shocks is:

$$Pr(Invest^{j}_{idt} = 1) = \alpha_i + \delta_t + \gamma_o + \theta_d t + \beta ConsecShock_{dt} + \gamma X_{idt} + \epsilon_{idt} \quad (10)$$

In (10), the unit of observation is the household i, residing in district d and observed in year t. The outcome of interest is the binary variable *Invest*, which equals 1 if the household made any investments in asset category j in year t; $j \in \{Financial, Gold, RealEstate\}$. α, δ and γ denote household, year and head of household occupation fixed affects while X_{idt} is a vector of household-level time-varying controls.[16] β identifies the causal impact of two consecutive positive rainfall shocks on the change in likelihood of a household participating in asset class j in period t. We estimate (10) using a linear probability model and the standard errors are clustered at the household level.

Table 3 presents the empirical results from estimating this reduced form specification on household portfolio choices. Columns (1)-(4) estimate the impact of a single contemporaneous positive shock while columns (5)-(8) estimate the impact of two consecutive shocks. Table 3 reports that a single contemporaneous shock increases the likelihood of households investing in financial assets (column (2)): computed at the mean of the dependent variable, it reflects that households' likelihood of investing in financial assets increases

[15] As the likelihood of $HighShock_{dt} = 1$ equals 0.5 for any district-year combination, the probability of a household being exposed to *ContempShock* and *ConsecShock* equals 0.25.

[16] The CP data reports the occupation status of each household member using 23 categories. Based on the occupational status of the head of household, we assign households to each of these occupational categories. The household-level covariates control for household size, previous year asset purchases, average age of households, number of females in the household, number of children in the household, average years of education of household members, whether the household has any individual who has completed secondary or higher education.

by 10 percent in response to a single positive rainfall shock. This is accompanied by a decline in households' likelihood of investing in gold and real estate (columns (3) and (4)).[17] The contemporaneous rainfall shock also has limited impact on household savings, as seen from column (1) – while the point estimate is negative, it is extremely small in magnitude.[18]

This pattern of household portfolio choices is however reversed in response to consecutive weather shocks. Column (4) shows that two consecutive positive rainfall shocks have a large positive impact on household savings, increasing it by 10 percent.[19] This result, while confirming that the "first stage" has bite, underlines that multiple positive weather shocks are required to increase household savings. In terms of portfolio choice, two consecutive positive shocks now reduce household participation in financial assets (column (1)) but increase it exclusively in physical assets (columns (5) and (6)): at the mean levels of participation, two consecutive positive rainfall shocks increase households' likelihood of investing in gold by almost 20 percent and in real estate by 40 percent. To verify that the results are not being driven by our choice of household covariates, we reproduce the core results in Table 1 (Appendix 10) using only the fixed effects and district-specific time trends, excluding all the household-specific time-varying covariates.

Overall, the results in Table 3 closely match Predictions 2 and 3 from the model which state that households require multiple positive income draws to participate in lumpy physical assets. Moreover, the fact that households increase their participation in financial assets in response to a single positive rainfall shock but not consecutive rainfall shocks suggests that households switch in and out of financial assets, treating it like a transitory asset class.

[17] It is worth noting that since we only observe household portfolio choices along the extensive margin, we can only detect absolute non-participation of households in an asset class. Thus, if a household reduces its investment in an asset category along the intensive margin, but continues to make some positive investment in that asset category, we still capture it as household participation in that asset category.

[18] The household savings rate is defined as the difference between income and expenditures, scaled by household income.

[19] This is calculated at the mean household savings rate in the sample as 0.029/0.28.

Prior to showing a direct test of adjustment costs as predicted in Grossman and Laroque (1990), we first confirm that the higher participation of households in physical assets in response to two consecutive positive weather shocks is a representative feature across households and not driven by any specific household characteristic. We thus assess household portfolio choices in response to multiple positive rainfall shocks across household location, expenditures and household education. This is motivated by the household finance literature which documents that factors such as financial literacy and household wealth determine household participation in financial assets (see for instance Bianchi 2018; Calvet et al. 2009; Lusardi and Mitchell 2014). In this regard, we test for the presence of heterogeneous effects across households and identify whether the reduction in participation in financial assets in response to consecutive shocks is driven by any particular subset of households.

Unfortunately, as the CP data does not provide any precise measure of financial literacy, we use overall education levels of the household head as a proxy and distinguish households with "high" and "low" education. The households where the head of the household has completed secondary education is deemed to have "high" education and the remaining households have "low" education. As the CP data does not capture the value of household assets but does collect information on household incomes and expenditures, we test for differential effects of the consecutive weather shocks across households with per capita expenditures in excess of median per capita expenditures, as measured in 2014 – the first year in which the households are surveyed.[20] Finally, we disaggregate households by rural or urban location. As rural areas have lower financial infrastructure, we test whether the limited participation in financial assets in response to consecutive weather shocks is concentrated amongst rural households.[21]

[20] We choose expenditures instead of incomes as a proxy for household assets as the existing literature has documented incomes to have a higher level of variance than expenditures.

[21] for instance, bank branches per capita in districts with over 50 percent rural households is 80 branches

We use the following specification to test these differentials:

$$Pr(Invest^j_{idt} = 1) = \alpha_i + \delta_t + \gamma_o + \theta_d t + \beta_1 ConsecShock_{dt} + \beta_2 HHChars^k_i * ConsecShock_{dt} + \gamma X_{idt} + \epsilon_{idt} \quad (11)$$

In (11), *HHChars* is a dummy, for each household characteristic k, discussed above: $k \in \{Rural, HighExp, HighEduc\}$. β_2 estimates the differential impact of the consecutive positive rainfall shocks on households satisfying characteristic k while β_1 estimates the impact of the weather shocks on households which do not satisfy characteristic k. The sum of β_1 and β_2 provides us with the net impact of the consecutive weather shocks on household portfolio choices for households satisfying characteristic k.

The results in Table 5 confirm that across all three characteristics, households increase their participation in physical assets in response to consecutive positive rainfall shocks, while decreasing their participation in financial assets. While there is no differential effect by head of household education (columns (7)-(9)), relative to urban households, rural households (columns (1)-(3)) have a significantly lower likelihood of investing in all three asset classes in response to consecutive rainfall shocks. Nonetheless, their overall likelihood of participating in real estate increases by 30 percent in response to consecutive rainfall shocks.[22]

Finally, while households in the top two expenditure quartiles exhibit a higher likelihood of participating in financial assets (column (4)) in response to consecutive rainfall shocks, the combined effect given by the sum of β_1 and β_2 remains negative, suggesting a lower likelihood of participating in financial assets in response to consecutive positive rainfall shocks. There is also no differential effect of the consecutive shocks on these households' likelihood of

per million persons, relative to 104 branches per million persons, in districts with less than 50 percent of rural households.

[22] This is computed as (0.055-.013)/0.13.

investing in real estate. Thus, the higher (lower) likelihood of participating in physical (financial) assets in response to consecutive rainfall shocks is not driven by potentially wealthy households. Collectively, the results in Table 5 verify that household portfolio choices in response to consecutive positive weather shocks is not determined by any specific household demographic characteristic.

4.3 Inaction effect: household portfolio choices conditional on past investments

Consistent with the model's predictions, Section 4.2 established that households switch into financial assets in response to a single contemporaneous positive income shock, and increase their participation in lumpy assets in response to consecutive positive income shocks. This is indicative of adjustment costs faced by households which can result in periods of inactivity immediately after the accumulation of a lumpy physical asset.

In this section, we directly identify the presence of adjustment costs by testing Grossman and Laroque's (1990) hypothesis that households become risk-averse in the periods immediately succeeding the purchase of a lumpy asset. Chetty and Szeidel (2006) test this theory by comparing household portfolio choices after households purchase a house. For causal identification, they use the date of marriage as an instrument for the timing of home purchase. Our paper adopts a slightly different approach: we identify the behaviour of households in response to an exogenous income shock, conditional on the household having made a lumpy investment – namely invested in real estate – in the past year. The results in Section 4.2 established that consecutive positive shocks increased the likelihood of households to invest in physical assets. We test whether this response is tempered if the household has invested in real estate in the past year.

We use a specification similar to (11) and introduce an interaction term that captures investment in real estate in period $t-1$. The results for this test are shown in Table 5. The columns (1)-(3) show that conditional on investing in real estate in the previous year, consecutive positive weather shocks have no impact on household portfolio choice. The interaction term is negative and statistically significant for both real estate and gold (columns (3) and (2)) while the sum of the coefficients is negative and statistically significant (albeit at the 10 percent level) for gold and real estate. This implies that conditional on investing in real estate in $t-1$, households' participation likelihood in physical assets *decline* in response to consecutive positive rainfall shocks. While the sign on the interaction term for financial assets (column (1)) is positive and statistically significant, the sum of the coefficients is not significant, disallowing us from rejecting the null hypothesis. Collectively, the results in columns (1)-(3) of Table 5 provide empirical evidence in support of the Grossman and Laroque (1990) hypothesis: an exogenous increase in household income does not affect portfolio choice if households have invested in a lumpy asset in the immediate past.

A potential concern regarding the results in Table 5 is that the reported coefficients in columns (1)-(3) of Table 5 are essentially capturing a portfolio diversification and re-balancing effect. If households have a target level of real estate as per the Ss framework, and have attained that level through the investment undertaken in the prior period, it is entirely plausible that they would choose to not invest in real estate in the current period, even when endowed with multiple positive income draws. This however seems an unlikely explanation for two reasons: first, the likelihood of participation declines not just for real estate but all asset classes. Second, as seen from columns (4)-(9), this reduction in participation likelihood across asset classes does not occur when households have invested in financial assets or gold – which are possibly of a lesser magnitude than real estate.

For households investing in these two other classes in the prior year, we on the contrary find evidence for portfolio rebalancing. Thus conditional on investing in financial assets (columns (4)-(6)) in the prior year, households have a higher likelihood of participating in gold and real estate in response to consecutive positive rainfall shocks and a lower likelihood of participating in financial assets. Similarly, conditional on investing in gold (columns (4)-(6)) in the prior year, households have a higher likelihood of participating in financial assets and real estate in response to consecutive positive rainfall shocks and a lower likelihood of participating in gold. These results show that the households in our sample do engage in active portfolio rebalancing. In this regard, a simple rebalancing explanation would have suggested that households would increase their likelihood of participating in gold (and possibly financial assets) in response to consecutive positive shocks, conditional on investing in real estate in the prior year. The fact that our results show a reduction in participation likelihood across all three investment classes indicates that households are unwilling to engage in any major investment after investing in a major lumpy asset, as predicted by Grossman and Laroque (1990).

4.4 Financial infrastructure aids investment in physical assets

The results in Section 4.2 showed that households invest in financial assets in response to a single positive weather shock and physical assets when faced with consecutive positive weather shocks. This is consistent with our model that the presence of adjustment costs generates periods of inaction in household investments in physical assets and we argued that households are using financial assets as a transitory asset class to assist in the process of accumulating physical assets. If this is indeed the case, the presence of financial infrastructure should aid households' ability to invest in financial assets and use the accumulated returns to invest in physical assets when faced with multiple positive income draws. This is both a robustness check as well as prediction borne out of our theory.

We test this hypothesis by identifying the differential impact of consecutive positive rainfall shocks on household portfolio choice across the level of regional financial infrastructure. To measure financial infrastructure, we obtain the number of bank branches in a district from the Basic Statistical Returns (published annually by the RBI) and normalize it by the district's population. To ensure that the rainfall shocks do not affect the number of bank branches through the former's effect on household incomes, we use the number of bank branches in 2011 which is prior to the period considered in our paper.

Using per capita bank branches in 2011, we classify districts into those with "high" and "low" financial infrastructure based on the median per capita bank branches across all districts in 2011. Thus, a district is considered to have "high" ("low") financial infrastructure if the per capita bank branches exceeds (is less than) the median per capita bank branches in 2011. We again use the specification similar to (11) to test for differential effects of consecutive rainfall shocks on household portfolio choices based on the district's financial infrastructure.

The results are shown in Table 6. Column (1) shows that household participation in financial assets increases in response to consecutive rainfall shocks only if households reside in a district with high financial infrastructure. The sum of the coefficients is also significant, suggesting that in districts with high financial infrastructure, consecutive positive rainfall shocks increases housholds' participation in financial assets by 4 percent.[23] However, as seen from column (3), this is not at the expense of physical assets: households residing in districts with high financial infrastructure also have a higher likelihood of investing in real estate in response to consecutive rainfall shocks. The direct effect of consecutive rainfall shocks is half of what we had estimated in Table 3, suggesting that the large impact of consecutive rainfall shocks on household participation in real estate is driven by households residing in districts with high financial infrastructure.

[23] This is computed as (-0.094-.111)/0.45.

One concern about the results in Table 6 is that the bank branches per capita might be a proxy for other factors such as income, due to the high correlation between incomes and bank branches per capita. Thus, the results estimated in columns (1)-(3) of Table 6 may not be reflective of regional financial infrastructure but instead, capturing the different savings choices of richer households. While section 4.2 rule out that richer households invest differently in response to weather shocks, relative to poor households, we explicitly test for the differential portfolio choices of richer households in districts with high financial infrastructure using a triple interaction of consecutive weather shocks, districts with high financial infrastructure and households with high per capita expenditures (measured in 2014).

The results, shown in columns (4) and (6) of Table 6 rule out this case: while the interaction between high financial infrastructure and consecutive rainfall shocks remains positive and significant, the triple interaction is small and statistically insignificant for both financial assets and real estate, suggesting that the higher participation likelihoods in response to multiple positive rainfall shocks in districts with high financial infrastructure is not driven by the high expenditure households.

Collectively, the results in Table 6 provide two major insights: first, that households indeed use financial assets as a transitory asset while accumulating physical assets. If this was not the case, we would have expected consecutive rainfall shocks to not have any differential impacts on households residing in these districts. Thus, the lack of financial infrastructure impedes the usage of financial assets as a transitory asset. Second, the relative lack of financial infrastructure possibly increases the adjustment costs faced by the households for accumulation of physical assets. Seen in this context, expansion of financial infrastructure can actually make it easier for households to accumulate physical assets, contrary to the argument presented in many of the financial literacy papers.

5 Robustness

None of the empirical results estimated in the previous section employ the household weights provided by the Consumer Pyramids. However, as discussed in Section 3.1, the CP surveys oversamples urban households, leading to the potential concern that the empirical results might be reflective of the portfolio choices of urban households and not representative of the sample as a whole. To rule out this concern, we re-estimate our key reduced form results after weighting the coefficients with the household specific weights provided in the CP database. The results from this exercise is shown in Table 2 (Appendix 10) and confirm that weighting the coefficients by the household weights does not change either the economic or statistical significance of the results. This reassures us of the accurance of the results estimated in the empirical section of the paper.

6 Conclusion

This paper uses a novel panel data of Indian households to study household portfolio choices using data on asset flows. The paper documents the mismatch between household asset holdings in terms of stocks, relative to household participation in asset classes as measured using data on asset flows. Subsequently, using regional weather shocks as a source of exogenous variation in household incomes, the paper documents how adjustment costs mediate household portfolio choices in developing countries. The results show that while a single positive rainfall shock increases household participation in financial assets, consecutive positive rainfall shocks increases household participation in physical assets, establishing in the process that households use financial assets as a transitory asset class along the way to accumulating physical assets. Using data on prior household asset purchases, the paper also tests directly for the presence of adjustment costs by documenting the risk averse behaviour of households in the immediate aftermath of investing in a large lumpy asset. The empirical results are consistent with a household model where the representative household derives utility from the consumption of a physical asset and there are transaction costs involved if households choose to change their level of holding of physical assets.

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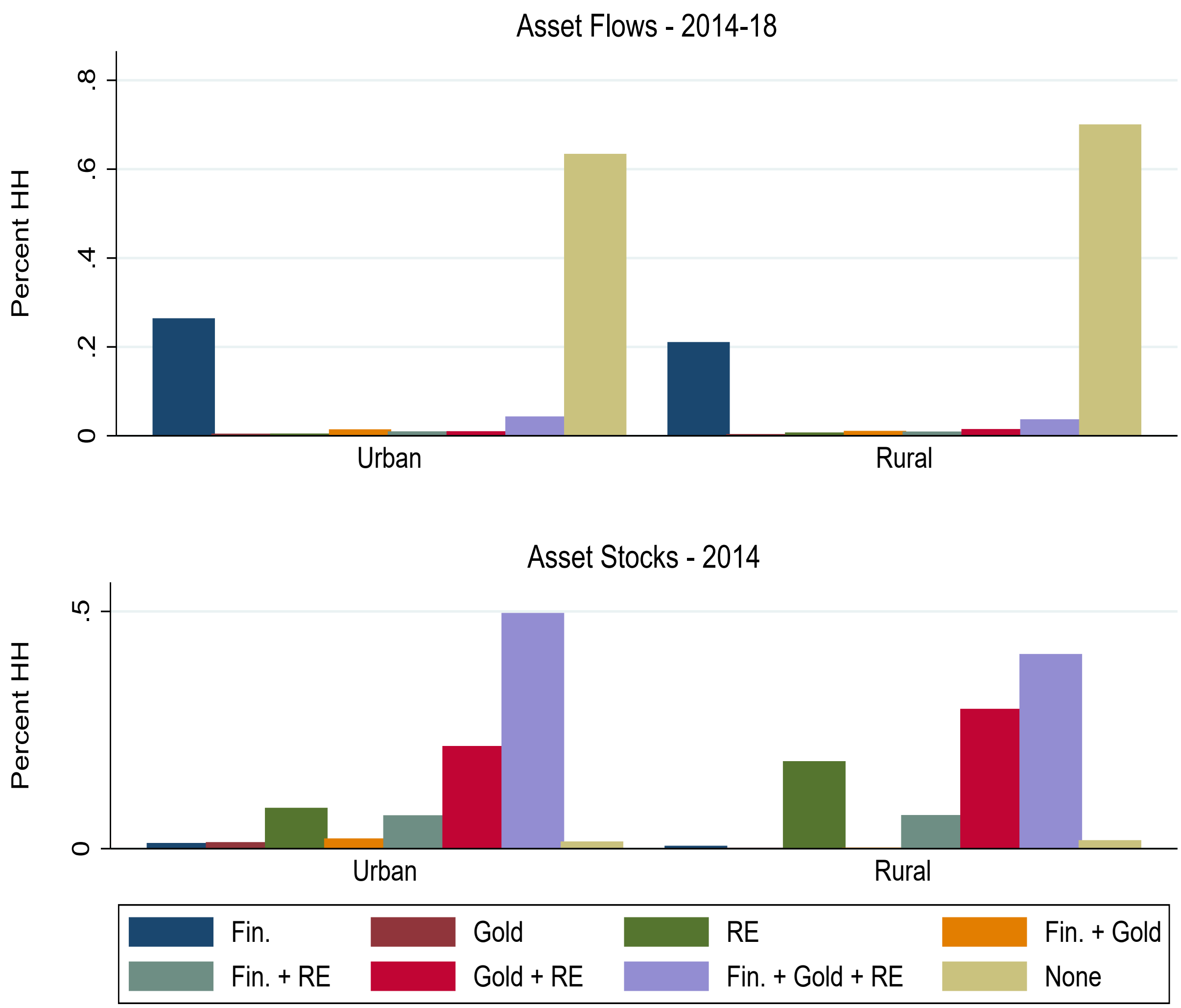
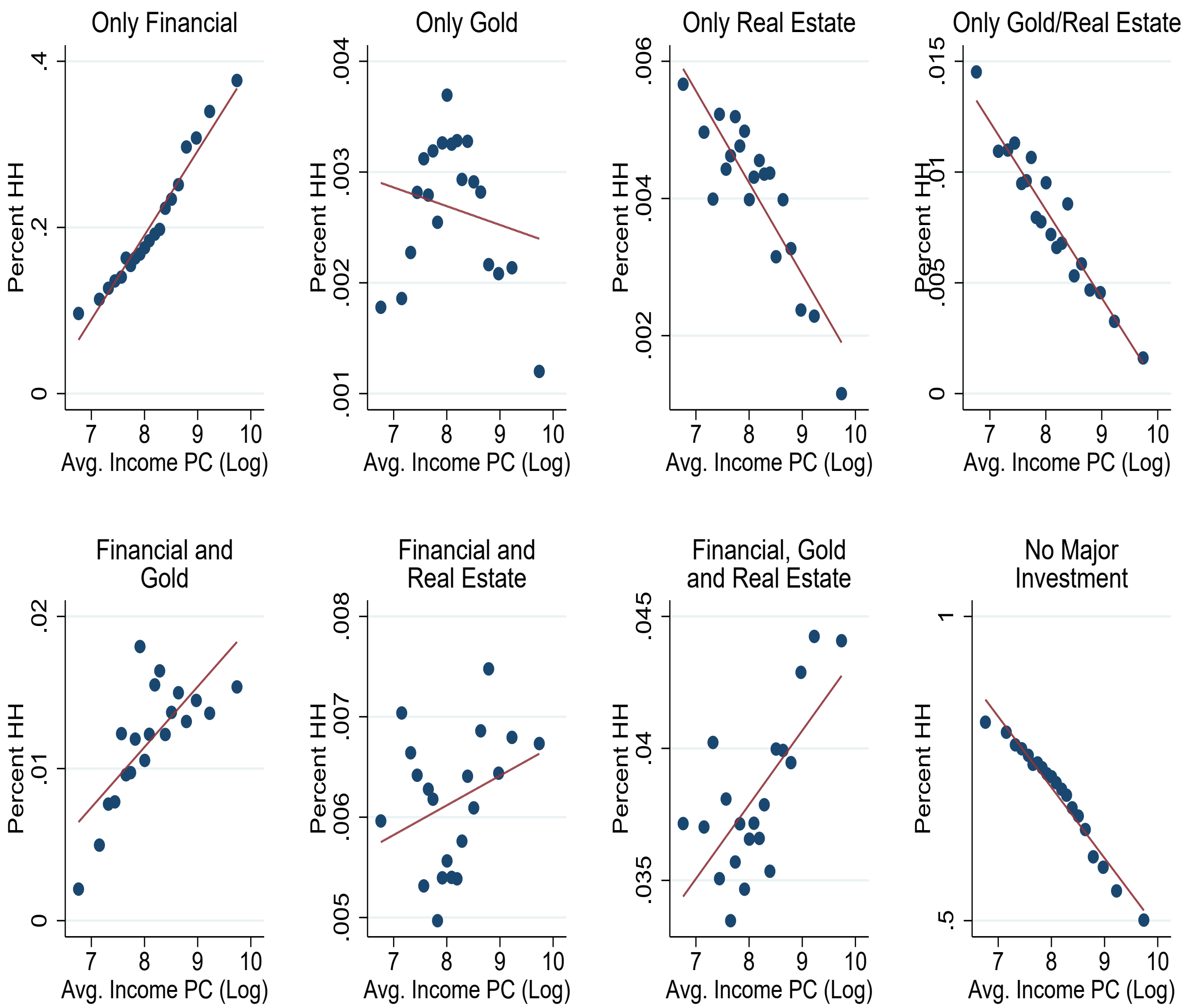
8 Figures

Figure 1: Outstanding Stocks vs Household Participation in Asset Classes: By Rural and Urban Households



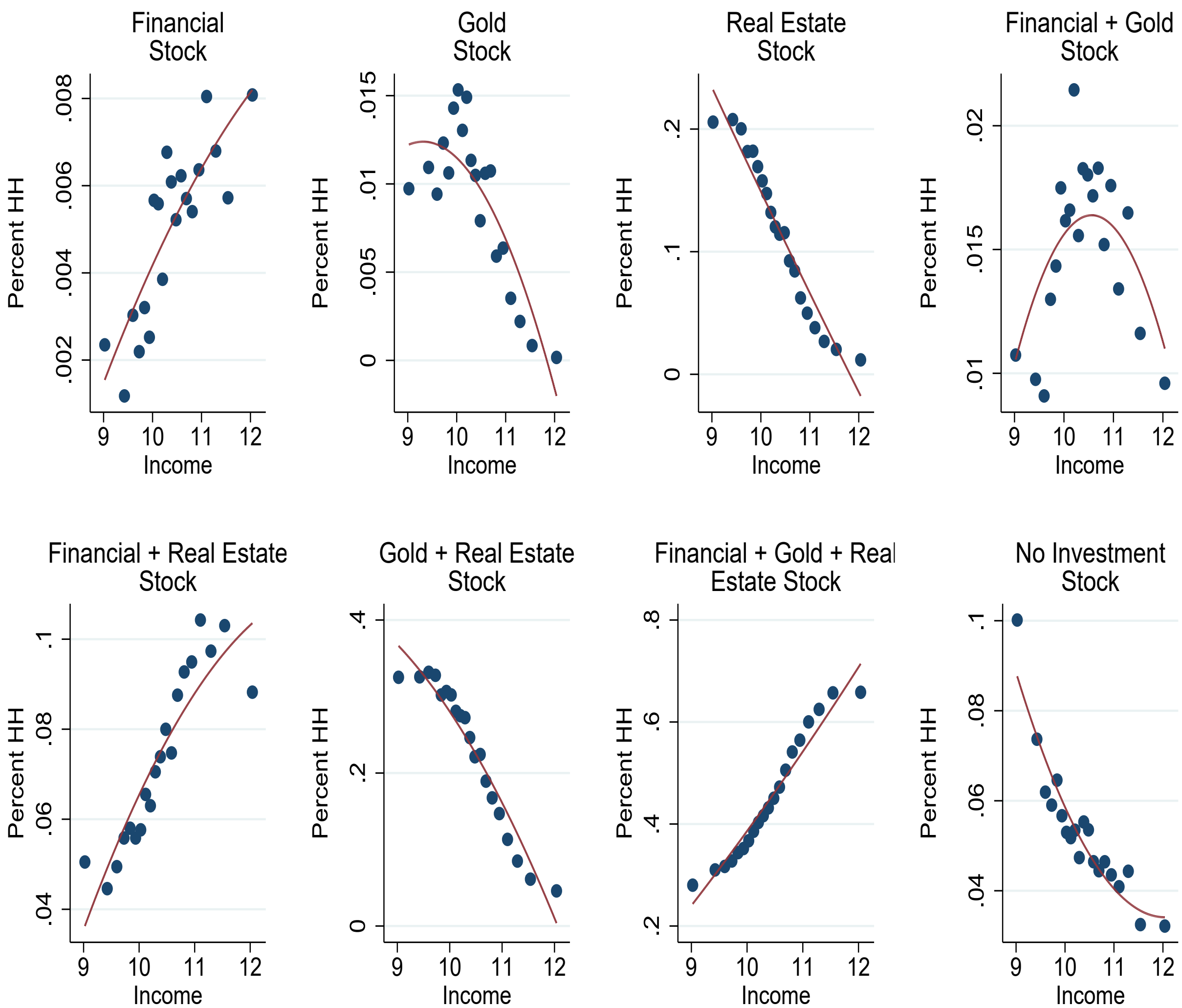
Notes: The above figure contrasts outstanding stock of household assets in 2014 against average household participation across asset classes between 2014 and 2018. The top panel presents the flows measure: the bottom panel the stock. The left hand side is for urban households; the right hand side for rural households. The asset classes are divided into 8 mutually exclusive categories: only financial assets; only gold; only real estate (RE); financial assets and gold; gold and real estate; financial assets and real estate; and financial assets, gold and real estate. The stock measures are based on the outstanding portfolio of the household the first time it is interviewed in 2014.

Figure 2: Descriptive Trends in Household Asset Participation Across Household Per Capita Income



Notes: The above figure presents the average likelihood of household participation between 2014 and 2018 across nine mutually exclusive categories. Each figure is a binned scatter plot with the x-axis divided into 20 bins of household per capita income. Each point represents the average share of households corresponding to that bin, which invested in the asset category of interest. The asset categories are: only financial assets; only gold; only real estate (RE); financial assets and gold; gold and real estate; financial assets and real estate; and financial assets, gold and real estate.

Figure 3: Descriptive Trends in Outstanding Household Asset Stocks Across Household Per Capita Income in 2014



Notes: The above figure presents the share of households holding asset stocks in 2014 across nine mutually exclusive categories. Each figure is a binned scatter plot with the x-axis divided into 20 bins of household per capita income in 2014. Each point represents the average share of households corresponding to that bin, which had any outstanding asset in the asset category of interest. The asset categories are: only financial assets; only gold; only real estate (RE); financial assets and gold; gold and real estate; financial assets and real estate; and financial assets, gold and real estate. The stock measures are based on the outstanding portfolio of the household the first time it is interviewed in 2014.

9 Tables

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.
Household Size	4.5	1.7	1	27
Average Household Age (Yrs)	34.29	12.3	7.92	99
Children in Household	0.88	1.08	0	12
Average Household Years of Education	6.99	3.74	0	20
Annual Household Income (Rs.)	181945.95	135804.12	0	760000
Annual Household Expenses (Rs.)	107148.95	51007.7	6787	308876
Head of Household Employed in Agriculture	0.16	0.37	0	1
Head of Household Employed in White Collar	0.13	0.33	0	1
Head of Household Employed in Business	0.11	0.31	0	1
Head of Household Not in Labour Force	0.21	0.41	0	1
Head of Household with Secondary Education	0.51	0.5	0	1
Annual Participation in Financial Assets	0.45	0.5	0	1
Annual Participation in Gold	0.13	0.34	0	1
Annual Participation in Real Estate	0.13	0.33	0	1
Annual Participation in Household Durables	0.11	0.31	0	1
Average Monthly Precipitation (‘00 cms)	1.86	1.43	0.19	11.17
Pr(Consecutive Positive Rainfall Shock)	0.32	0.47	0	1
Branches Per Million Persons	88.40	44.06	32.34	278.46

Table 2: Flow Asset Holding Pattern of households

Asset Holding Type	Total Households	% share (out of Investors)
Financial	62,329	54.75
Gold, Real Estate, Financial	32,592	28.63
Gold, Financial	7,011	6.16
Real Estate, Financial	5,177	4.55
Gold, Real Estate	2,463	2.16
Real Estate	1,732	1.52
Gold, Real Estate, Financial, Risky	753	0.66
Gold	741	0.65
Total Investor Households	113,849	100
Total Households	174,223	

Table 3: Consecutive Weather Shocks and Household Asset Choices

	(1) Savings Rate	(2) Financial Asset	(3) Gold	(4) Real Estate	(5) Savings Rate	(6) Financial Asset	(7) Gold	(8) Real Estate
Contemp Shock	-.003***	.049***	-.017***	-.008***				
	(.001)	(.003)	(.002)	(.002)				
Cons Shock					.029***	-.031***	.027***	.051***
					(.002)	(.005)	(.004)	(.003)
Observations	375504	271325	271325	271325	375504	271325	271325	271325
R^2	.67	.67	.67	.66	.67	.67	.67	.66
Dep Var Mean	.28	.45	.13	.13	.28	.45	.13	.13

This table presents the results from a linear probability model regressing household asset choices on rainfall variations. The unit of observation is the household. The independent variable of interest in columns (1)-(4) is a single contemporaneous positive rainfall shock; the independent variable of interest in columns (5)-(8) is consecutive positive rainfal shocks. Positive rainfall shock indicates years in which the annual rainfall incidence in the district exceeds the median long-run rainfall incidence in the district. The dependent variable in columns (1) and (5) is the household savings rate; the dependent variable in columns (2) and (6) is a binary equaling 1 if the household invested in a financial asset in the past year; the dependent variable in columns (3) and (6) is a binary equaling 1 if the household invested in gold in the past year; the dependent variable in columns (4)-(8) is a binary equaling 1 if the household invested in real estate in the past year. Household savings rate is defined as the average income per month of the household, less the average expenditures, scaled by average income. All specifications include household, year and head of household fixed effects, along with district-specific time trends. Specifications also control for household size, total number of children, total elderly, average household age, average years of education, total females, and dummy for whether at least one member has completed higher education. The specifications also control for past year asset choices for all assets except the outcome variable of interest. Standard errors are in parentheses, clustered at the household level.

Table 4: Consecutive Weather Shocks and Household Asset Choices

	(1) Financial Asset	(2) Gold	(3) Real Estate	(4) Financial Asset	(5) Gold	(6) Real Estate	(7) Financial Asset	(8) Gold	(9) Real Estate
Cons Shock	-.024***	.038***	.055***	-.036***	.025***	.050***	-.035***	.025***	.051***
	(.006)	(.004)	(.004)	(.005)	(.004)	(.004)	(.006)	(.004)	(.004)
Rural*Cons. Pos. Shock	-.022***	-.033***	-.013***						
	(.007)	(.005)	(.005)						
Cons Shock*High Exp				.023***	.009*	.005			
				(.008)	(.005)	(.005)			
HoH Secondary*Cons Shock							.008	.005	-.001
							(.006)	(.004)	(.004)
Observations	271325	271325	271325	266984	266984	266984	271325	271325	271325
R^2	.67	.67	.66	.67	.66	.66	.67	.67	.66
Dep Var Mean	.45	.13	.13	.45	.13	.13	.45	.13	.13

This table presents the results from a linear probability model regressing household asset choices on consecutive positive rainfall shocks. The unit of observation is the household. Consecutive positive rainfall shocks is a dummy equaling 1 if the household resides in a district which has received two successive rainfall shocks. Positive rainfall shock indicates years in which the annual rainfall incidence in the district exceeds the median long-run rainfall incidence in the district. The dependent variable in columns (1), (4) and (7) is a binary equaling 1 if the household invested in a financial asset in the past year; the dependent variable in columns (2), (5) and (8) is a binary equaling 1 if the household invested in gold in the past year; the dependent variable in columns (3), (6) and (9) is a binary equaling 1 if the household invested in real estate in the past year. All specifications include household, year and head of household fixed effects, along with district-specific time trends. Specifications also control for household size, total number of children, total elderly, average household age, average years of education, total females, and dummy for whether at least one member has completed higher education. The specifications also control for past year asset choices for all assets except the outcome variable of interest. Standard errors are in parentheses, clustered at the household level.

Table 5: Consecutive Weather Shocks and Household Asset Choices: Differential Effects by Past Year Household Asset Choices

	(1) Financial Asset	(2) Gold	(3) Real Estate	(4) Financial Asset	(5) Gold	(6) Real Estate	(7) Financial Asset	(8) Gold	(9) Real Estate
Cons Shock	-.034***	.031***	.055***	.012**	.023***	.046***	-.036***	.034***	.052***
	(.005)	(.003)	(.003)	(.005)	(.004)	(.004)	(.005)	(.003)	(.003)
Real Estate Past Yr*Cons Shock	.038***	-.046***	-.071***						
	(.010)	(.009)	(.008)						
Fin Asset Past Yr*Cons Shock				-.041***	.009**	.010**			
				(.006)	(.004)	(.004)			
Gold Past Yr*Cons Shock							.043***	-.025***	-.012
							(.009)	(.008)	(.008)
Observations	271325	271325	271325	271325	271325	271325	271325	271325	271325
R^2	.67	.67	.68	.69	.67	.66	.67	.68	.66
Dep Var Mean	.45	.13	.13	.45	.13	.13	.45	.13	.13

This table presents the results from a linear probability model regressing household asset choices on consecutive positive rainfall shocks, conditional on previous year's investments. The unit of observation is the household. Consecutive positive rainfall shocks is a dummy equaling 1 if the household resides in a district which has received two successive rainfall shocks. Positive rainfall shock indicates years in which the annual rainfall incidence in the district exceeds the median long-run rainfall incidence in the district. The dependent variable in columns (1), (4) and (7) is a binary equaling 1 if the household invested in a financial asset in the past year; the dependent variable in columns (2), (5) and (8) is a binary equaling 1 if the household invested in gold in the past year; the dependent variable in columns (3), (6) and (9) is a binary equaling 1 if the household invested in real estate in the past year. All specifications include household, year and head of household fixed effects, along with district-specific time trends. Specifications also control for household size, total number of children, total elderly, average household age, average years of education, total females, and dummy for whether at least one member has completed higher education. The specifications also control for past year asset choices for all assets except the outcome variable of interest. Standard errors are in parentheses, clustered at the household level.

Table 6: Consecutive Weather Shocks and Household Asset Choices: Differential Effects by Financial Infrastructure

	(1) Financial Asset	(2) Gold	(3) Real Estate	(4) Financial Asset	(5) Gold	(6) Real Estate
Cons Shock	-.094***	.032***	.027***	-.095***	.034***	.026***
	(.007)	(.005)	(.005)	(.008)	(.005)	(.005)
High Branch*Cons Shock	.111***	-.010	.043***	.107***	-.017**	.043***
	(.010)	(.007)	(.007)	(.011)	(.007)	(.007)
Cons Shock*High Exp				.010	-.007	.001
				(.012)	(.008)	(.008)
High Branch*Cons Shock*High Exp				.007	.027**	.002
				(.016)	(.011)	(.010)
Observations	271325	271325	271325	266984	266984	266984
R^2	.67	.67	.66	.67	.66	.66
Dep Var Mean	.45	.13	.13	.45	.13	.13

This table presents the results from a linear probability model regressing household asset choices on consecutive positive rainfall shocks, conditional on districts' financial infrastructure. The unit of observation is the household. Consecutive positive rainfall shocks is a dummy equaling 1 if the household resides in a district which has received two successive rainfall shocks. Positive rainfall shock indicates years in which the annual rainfall incidence in the district exceeds the median long-run rainfall incidence in the district. District financial infrastructure is measured using bank branches per capita in the district. The dependent variable in columns (1), (4) and (7) is a binary equaling 1 if the household invested in a financial asset in the past year; the dependent variable in columns (2), (5) and (8) is a binary equaling 1 if the household invested in gold in the past year; the dependent variable in columns (3), (6) and (9) is a binary equaling 1 if the household invested in real estate in the past year. All specifications include household, year and head of household fixed effects, along with district-specific time trends. Specifications also control for household size, total number of children, total elderly, average household age, average years of education, total females, and dummy for whether at least one member has completed higher education. The specifications also control for past year asset choices for all assets except the outcome variable of interest. Standard errors are in parentheses, clustered at the household level.

10 Appendix

10.1 Tables

Table 1: Weather Shocks and Household Portfolio Choices: No Household-Level Covariates

	(1) Income Per Capita	(2) Savings Rate	(3) Income Per Capita	(4) Savings Rate
Cons Shock	.033***	-.037***	.019***	.041***
	(.002)	(.005)	(.004)	(.004)
Observations	274335	274347	274347	274347
R^2	.74	.66	.65	.64
Dep Var Mean	.28	.45	.13	.13

This table presents the results from a linear probability model regressing household asset choices on rainfall variations. The unit of observation is the household. The independent variable of interest is consecutive positive rainfall shocks. Positive rainfall shock indicates years in which the annual rainfall incidence in the district exceeds the median long-run rainfall incidence in the district. The dependent variable in column (1); in column (2), a binary equaling 1 if the household invested in a financial asset in the past year; in column (3), a binary equaling 1 if the household invested in gold in the past year; in columns (4), a binary equaling 1 if the household invested in real estate in the past year. Household savings rate is defined as the average income per month of the household, less the average expenditures, scaled by average income. All specifications include household, year and head of household fixed effects, along with district-specific time trends but no other covariates. Standard errors are in parentheses, clustered at the household level.

Table 2: Weather Shocks and Household Portfolio Choices: Weighted by Household Weights

	(1) Savings Rate	(2) Financial Assets	(3) Gold	(4) Real Estate
Cons Shock	.037***	-.056***	.008**	.032***
	(.003)	(.007)	(.004)	(.004)
Observations	375504	271325	271325	271325
R^2	.65	.68	.68	.67
Dep Var Mean	.24	.40	.13	.13

This table presents the results from a linear probability model regressing household asset choices on rainfall variations. The unit of observation is the household. The independent variable of interest is consecutive positive rainfall shocks. Positive rainfall shock indicates years in which the annual rainfall incidence in the district exceeds the median long-run rainfall incidence in the district. The dependent variable in column (1); in column (2), a binary equaling 1 if the household invested in a financial asset in the past year; in column (3), a binary equaling 1 if the household invested in gold in the past year; in columns (4), a binary equaling 1 if the household invested in real estate in the past year. Household savings rate is defined as the average income per month of the household, less the average expenditures, scaled by average income. All specifications include household, year and head of household fixed effects, along with district-specific time trends but no other covariates. Specifications also control for household size, total number of children, total elderly, average household age, average years of education, total females, and dummy for whether at least one member has completed higher education. The specifications also control for past year asset choices for all assets except the outcome variable of interest. All the estimates are weighted by the assigned household weights. Standard errors are in parentheses, clustered at the household level.