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Local Droughts and Income Smoothing among Thai Households

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Abstract

In the analysis of household responses to income risk, the topic of income smoothing has extensively been studied in relatively poor, primarily agrarian, village economies in rural India. This paper extends the analysis of these forces to a middle-income context where income portfolios are more diversified. It investigates the extent to which households in rural Thailand across the income distribution are able to smooth income in the face of shocks. It uses especially high-quality household income and consumption data spanning sixty-four Thai villages over fifteen years. The paper instruments income shocks by village-level variations in the probability and prevalence of drought conditions. It finds that richer households are better able to engage in income-smoothing insurance strategies than poorer households, in contrast to some studies of the South Asian sub-continent. These possibilities for income-smoothing are shown to be correlated with the type of contract the head of household is likely to be employed in, the share of salaries in total household income, the education level of the head, and the relative youth of the heads of richer households. (*JEL:* O12, O15, D31, D15, I32)

Keywords: Asia, Thailand, Inequality, Poverty, Risk.

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1. Introduction

In low and middle-income countries access to credit markets may be incomplete especially for poor or rural households. These households may therefore have an incentive to insure their consumption by obtaining their income from less volatile sources, or by diversifying their income sources. In an influential pair of papers, Morduch (1994, 1995) used the term ‘income smoothing’ to describe this phenomenon and contrasted it with ‘consumption smoothing’ that is commonly observed in richer countries. A number of papers have documented income smoothing among relatively poor people in rural communities in low-income countries. Morduch (1995) presents evidence that asset-poor households in rural India, whose consumption is most vulnerable to income shocks devote a greater proportion of their land to safer, but lower yielding, traditional varieties of crops than richer households. Rosenzweig and Binswanger (1993) demonstrated that rural Indian households in lower wealth quartiles used production techniques that were less susceptible to rainfall variation, even though on average these techniques were less productive. Kochar (1999) found that when faced with a crop failure, such households protected their consumption levels by diverting labour from farm employment to off-farm employment, thereby reducing income variability by diversification rather than smoothing consumption directly through borrowing or dissaving.

However, another strand of the literature has observed that poorer households may be constrained in their ability to enter low-risk income generating activities. Dercon and Krishnan (1996) find that, in rural Ethiopia and Tanzania, poorer households lack the lumpy assets required to enter high return, low risk activities (such as cattle rearing or shop keeping). They also find that low levels of education restrict the ability of relatively poor households to gain low-risk salaried employment, a result that has recently been generalized to the Mexican context (Gutierrez, 2014). Dercon (2002) surveys the various constraints to effective risk management faced by poor households.

If this last evidence is general, then while richer households are less likely to be liquidity constrained and therefore *less in need* of insuring themselves through smooth income; they may have privileged access to low-risk income streams, and therefore *more able* to insure themselves using smooth income. It is then an empirical question as to whether or not richer households are more likely to utilise low-risk incomes to satisfy their insurance needs than their poorer counterparts. The present paper examines this empirical question of the distributional impact of income smoothing activities using a long running panel of high-quality household surveys from rural Thailand (see Townsend, 2011) spanning 64 villages over fifteen years from 1997 to 2011. In doing so, it extends the analysis of income smoothing from relatively poor, primarily agrarian, village economies in rural India to a middle income context, where the income portfolios of village households are more diversified.

To distinguish between relatively rich and relatively poor households, I compute observed 'permanent income' for each household. In the spirit of Friedman (1957), I take the average over time of real, equivalised consumption for each household in the fifteen years for which I have data as a proxy for permanent income. I show that consumption volatility as measured by the standard deviation of real, equivalised consumption is largely constant over the distribution of permanent income, but a similarly constructed measure of income volatility declines systematically with the level of permanent income. These findings are not consistent with models of income smoothing which predict that low-income households will rely more heavily on low volatility income (as in Morduch 1994). Rather, they lend support to Dercon and Krishnan's (1996) hypothesis that poorer households may be excluded from low-risk income opportunities.

The paper adopts a formalised model of the income-generating process of households where household income is composed of a permanent component and a transitory, stochastic component (as in any number of studies of consumption smoothing including Friedman, 1957 and Hall, 1978). In formal empirical modelling, I follow Paxson (1992) and further decompose transient income into a village-wide component and a household-specific component. I use information gathered by the Townsend Thai Project from key informant interviews with village headmen on the proportion of households in each village affected by a drought in each of the survey years as a source of exogenous variation in the transient income of all surveyed households within that village cluster.

The empirical section of this paper tests for differences in the extent to which the income streams of individual households are insured against the cluster-level prevalence of drought by the level of household permanent income. The identifying assumption is that in the absence of insurance, covariate shocks would have had the same proportionate effect on household incomes across the income distribution within each cluster, on average. I find that the income streams of relatively rich households are indeed better insured against this covariate shock than their poorer counterparts. This result is robust to a specification that allows for endogenous household responses to income shocks, such as added worker effects and labour displacement to alternative activities and to a specification that splits the sample into relatively rich households and relatively poor ones.

To identify the constraints that prevent poorer households from accessing low-risk income streams, the paper tests for heterogeneity in the effect of drought on household transient income by different household characteristics. Households with heads who are educated above the primary level, who were born in later cohorts, who are earn regular monthly salaries in their primary occupation and households in the Central region suffer significantly smaller proportionate losses from drought than the sample mean. These results are consistent with Dercon and Krishnan's (1996) view where relatively poor households are constrained in their ability to secure low-risk income by factors such as human capital and location.

Heterogeneity analysis also reveals that some of the channels through which income smoothing takes place in poorer, more agrarian settings (such as those studied by Rosenzweig and Binswanger, 1993; Morduch, 1994 and 1995; Dercon and Krishnan 1996; and Kochar, 1999) and do not appear to be as vital in the middle-income Thai context where income portfolios are more diversified. Specifically, I find no evidence that differences in crop portfolios, holdings of large livestock, business ownership and the presence of additional breadwinners in the household drive the observed differences in income smoothing across the distribution.

The empirical analysis concludes by using the econometric model of household income developed in this paper to construct counterfactual distributions of income risk. These distributions appear to confirm the result that privileged access to salaried employment is indeed the key channel through which richer households in this sample are able to mitigate income risk.

The rest of the paper is organized as follows. Section 2 reviews the literature that this paper builds on. Section 3 describes the data from the Townsend Thai Project. Section 4 presents some descriptive evidence that richer households depend more heavily on low-risk income to satisfy their insurance needs than poorer ones, in contrast standard models of income smoothing. Section 5 presents the main empirical results of this paper. Section 6 concludes.

2. Literature Review

Liquidity Constraints, Insurance and Low-Risk Income

In economies where households have access to well-functioning capital markets, even risk-averse households are likely to make production decisions that maximize the mean of income (even though this usually implies a higher variance) and use borrowing and lending to smooth consumption against the resulting risk in their income streams (Fisher, 1930). A number of studies have documented the extent of consumption smoothing in the Thai panel (Gine and Townsend, 2004; Paulson and Townsend, 2004; Alem and Townsend, 2014; among others). However, studies of this panel have also yielded clear evidence that households are liquidity constrained (most notably Kaboski and Townsend, 2011 and 2012) so that the degree to which consumption is smoothed is imperfect.

Credit constraints imply that even a temporary income fluctuation can provoke a shortfall in consumption levels (Deaton 1991) so that risk averse households may prefer lower risk income streams, even at the expense of a lower mean. Elsewhere, Morduch (1994) formalises this decision as a portfolio choice problem, where households can choose the share of income generated using a risk-free technology and a risky technology that has a higher mean return. He shows that the share of income generated using the risk-free asset is greater when the household is liquidity constrained than when it is not.

Much of the empirical evidence in this literature has been informed by household-level data on Indian villages gathered by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). Morduch (1995) presents evidence that asset-poor households, whose consumption is most vulnerable to income shocks, devote a greater proportion of their land to safer, but lower yielding, traditional varieties of crops than richer households. Also using the ICRISAT data, Rosenzweig and Binswanger (1993) demonstrate that Indian households in lower wealth quartiles choose agricultural input combinations which are less susceptible to rainfall variability but also return a substantially lower yield. Using the same data, Kochar (1999) finds that when faced with crop failure, poor households which cannot protect consumption by borrowing divert labour from farm employment to off-farm employment thereby mitigating variation in their income streams. The present paper complements this literature by studying a set of village households at a more advanced state of economic development with a more diversified set of income portfolios.

Income smoothing can have far reaching implications for a range of important economic issues. If this strategy is effective at providing some degree of insurance, the welfare loss associated with the absence of markets for insurance and credit will be relatively small (Morduch, 1995). As smoother income typically implies a lower mean, a widespread reliance on income smoothing to satisfy insurance needs may cause economy-wide output to be lower than it would otherwise be (Morduch, 1995). If income smoothing is concentrated at the lower quantiles of the income distribution, income inequality will be exacerbated over time (Rosenzweig and Binswanger, 1993, pp. 98). It may also affect poverty as relatively low mean incomes are likely to be an impediment to asset accumulation and may leave households in a poverty trap (Carter and Barrett, 2006 and Dercon, 2006).

Constrained Income Choice

Dercon and Krishnan (1996) present evidence that, notwithstanding liquidity constraints, poorer households in Ethiopia and Tanzania are also constrained in their ability to access high-return income earning activities. In their sample, cattle rearing, and in some cases shop keeping, are associated with higher consumption and asset accumulation. The authors find evidence that poorer household are excluded from entering these activities because they require lumpy, up-front investments. They identify liquidity constraints, small farm size, a lack of male labour within the household and geographic location as factors which prevent poorer households from entering these high return activities. Instead, poorer households are restricted to taking up low-return off farm activities such as collecting firewood, which do not require up-font entry costs.

Many of these forces are also salient to villages sampled by the Townsend Thai Project which also exhibit important regional differences (Samphantharak and Townsend, 2017; Townsend 2013; and Pawasutipaisit and Townsend, 2011). The present paper will show that this geographical variation also extends to the availability of low-risk income opportunities, to the exclusion of households from the poorer Northeastern region, generalizing Dercon and Krishnan's (2006) result to the Thai context.

Over the period that I observe these Thai villages, Thailand was a rapidly growing, developing economy. In a study of labour contracts in Mexico, Gutierrez (2014) observes that economic development is often accompanied by an increase in the share of salaried jobs in the economy. Where workers are risk averse and insurance is costly, these jobs not only enhance welfare by offering higher mean incomes than the self-employment or the agricultural jobs which they displace, but also by reducing the variance of income. However, entry into these jobs may also require large investments in human capital, such as post-secondary education, that poorer households are not endowed with or cannot afford. This raises potential issues regarding the distributional effects of the insurance possibilities offered by the increased prevalence of wage labour.

These forces motivate the key research questions of this paper. First, does the degree of insurance in household income differ across the income distribution? Second, are differences in the observable characteristics of households empirically linked to these differences in insurance behavior?

3. Data and Descriptive Statistics

Income and Consumption in the Annual Series of the Townsend Thai Project

This paper uses data that has been collected and made publicly available by the Townsend Thai Project. It is based on the annual series of household surveys which have been fielded in 64 villages in every year from 1997 to 2011. As this data series has already been used in a wide variety of highly regarded and well-known empirical work, I discuss only those aspects of the data that are immediately relevant to this paper. Townsend (2016) provides a detailed account of the data as well as an overview of the numerous contributions that these data have yielded. In each year, a total of 960 households are sampled across these villages. Because I am interested in the dynamics of the income and consumption streams of these households, I focus on the balanced panel of 609 households who do not report missing, negative or obviously spurious values for income or consumption in any period, so as not to conflate these dynamics under analysis with the entry and exit of households to and from the panel.

The key outcome variable that will be discussed in this paper is household income which is defined as follows. Net income is the difference between a household's gross income and agricultural and business expenses over the last twelve months. These numbers are then revalued to 2011 prices using Bank of Thailand data and equivalised using the OECD Scale (OECD, 1982). The summary statistics for the resulting income data are reported in the first row of Table 1.

The second row of Table 1 presents analogous summary statistics for real, equivalised household consumption. The consumption variable that I use is constructed from two distinct parts of the questionnaire: annual consumption items and monthly consumption items. The annual consumption items include spending on household and vehicle repairs, education, clothing and eating outside the home. Monthly consumption items include various food items, gasoline, alcohol and tobacco as well as expenditure on rituals. These consumption measures do not include durable goods such as televisions, motor vehicles, and refrigerators which are instead included in the measure of household assets. As a result, average (non-durable) consumption is noticeably less than average income. Consumption is also considerably less volatile than income as households in this setting are expected to pool income risk (Chiappori et al., 2013; Chiappori et al. 2014) and to smooth consumption over time against shocks to income, albeit imperfectly (Kaboski and Townsend, 2012; Townsend 2013).

Shocks

To identify differences in the degree to which the income streams of different households are insured, I require variables which exogenously affect household productivity. A standard approach uses adverse weather shocks (Rosenzweig and Binswanger, 1993; Dercon 2004; Kochar, 1999). These studies have used meteorological data on rainfall variation. However, the villages used for the current study are drawn from relatively tightly packed geographic units in central and Northeastern Thailand (Townsend 2016) so that rainfall data cells are unlikely to exhibit sufficient variation between villages to be useful. Furthermore, exact village geolocations, which are necessary to effectively utilise rainfall data, are not made publicly available by the Townsend Thai Project. Rather, the Project collects information on the occurrence and incidence of adverse weather shocks by interviews with a village 'key informant', who is typically the village headman. In each year from 1998 to 2011 (i.e. with the exception of the first year for which household data are available), the key informant reports the number of households affected by drought for each village.

This figure exhibits substantial variation over time. Over the 14 years for which this data is recorded, the minimum number of households affected by drought in a given year is as low as 492, whereas the maximum is as high as 6,396 (these numbers apply to all households in the sampled villages, as opposed to sampled households). When a village does experience a drought, a large number of the households within that village are usually affected. The mean of the share of village households affected by a drought conditional on the village experiencing a drought in a given year is 51.9%. These features of the distribution of drought recommend its use as an exogenous, covariate shock to the income streams of the households that are resident in these villages.

4. The Distributions of Consumption Risk, Income Risk and Household Characteristics

As preliminary evidence, Figures 1 to 3 study the distribution of income risk and consumption risk across the distribution of households.

The variable on the *x*-axis of these figures is the observed level of 'permanent income' for each of the 609 households in the balanced panel, with permanent income as defined previously. Temporary fluctuations in income and measurement error will cause any ranking of households based on the level of income in a particular period to be an unreliable measure of underlying relative wellbeing. Averaging over observed incomes for the duration of the panel partially addresses this concern, though such an average may continue to provide a misleading impression of relative wellbeing if two households are at different stages of the lifecycle, as households headed by retirees may consume out of savings rather than income, and may therefore have systematically higher wellbeing than their incomes indicate. In the permanent income view (Friedman 1957, Ch3; Ando and Modigliani 1963) averaging over consumption will be a more reliable signal of permanent income. Therefore, the *x*-axis of these figures uses the average over time of real, equivalised consumption of each of these households as a proxy for 'permanent income'.

To validate mean consumption as a measure of permanent income I plot it against a similarly constructed measure of mean income in Figure 4. The figure evidences a strong, positive relationship between the two variables. A univariate linear regression confirms that mean income explains 66% of the variation in mean consumption, and yields a resounding rejection of the null hypothesis that mean income is independent of mean consumption (*t*-stat: 34.5).

Returning to Figure 1, the *y*-axis measures the sample standard deviation in the log of each individual household's real, equivalised level of consumption over the fifteen years of the panel, $\hat{\sigma}_c$. This is a crude measure of the extent to which the consumption streams of these households exhibit a lack of insurance. The figure plots this measure of consumption variability against the measure of permanent income for the 609 households that comprise the balanced panel in the annual series of the Townsend Thai data. The line of best fit through these points suggests (and a *t*-test reported in the first column of Table 2 confirms) that the degree of insurance does not differ significantly across the spectrum of household permanent income.

Figure 2 plots the estimated standard deviation of log income, $\hat{\sigma}_y$, against mean consumption for the same 609 households. Here there is a clear downward trend, the coefficient for which is reported in the second column of Table 2. Thus, relatively well-off households have significantly smoother income streams than their worse-off counterparts.

I now compute the ratio, $\hat{\sigma}_c/\hat{\sigma}_y$, to gauge the extent to which consumption is smoothed, relative to income. Figure 3 plots estimates of this consumption smoothing measure against mean household consumption. The proportion of income variation that is allowed by households to pass uninsured into consumption variation increases with the level of mean consumption. Poorer households smooth consumption more, relative to income, whereas better-off households seem to achieve the same degree of insurance in their consumption stream (from Figure 1) by relying more heavily on low variance income streams. These patterns are also robust to an alternative measure of variability, namely the coefficient of variation (Table 2, column 4) and also to a more restrictive definition of consumption that includes only food, alcohol, tobacco, and gasoline expenditure but excludes expenditure on rituals, clothing, repair of durable goods and homestead repairs (Table 2, column 5).

These patterns of insurance are not compatible with theories of income smoothing that emphasize that the relatively poor will use more income smoothing for their insurance needs. This may be because the relatively poor are observably different from the rich in characteristics that exclude them from income opportunities that offer greater insurance possibilities.

Table 3 assesses whether or not the observable characteristics of households differ by the level of permanent income by dividing the sample into two groups. Households with permanent income above the median are significantly more likely to be headed by people who are in government work, other jobs that pay steady monthly wages or business owners, as opposed to varying daily wages, piece rates or unpaid family work. The heads of these richer households are also on average younger, better educated, more likely to have more than one source of income and to be male. These households are less likely to be dependent on a sole breadwinner and slightly *more* likely to be involved in agriculture. Despite this last result, the analysis of the income portfolio weights in the last three rows of Table 3 show that poorer households derive a greater share of their income from rice (the main crop), in contrast to richer households which derive a greater share of their income from salaried labour.

In contrast to Dercon (2002) and Dercon and Krishnan's (1996) findings in Tanzania and Ethiopia that the poor are excluded from rearing large livestock, poorer households in Thailand derive a relatively large share of their income from holdings of pigs, cows and buffalo, implying that this is not a dimension along which their income choices are constrained.

5. Estimating the Effect of a Covariate Shock on Income

My goal is to test for differences in the degree to which household income is insured against risk. This requires that I identify an exogenous source of variability in the incomes of different households. To this end, I decompose household income into the following components:

1. A permanent component, which may be a function of 'fixed' household characteristics, such as education and year of birth of the head of household.

2. Village–level characteristics, such as soil fertility and distance to nearest city.
3. A transitory, household-specific component.
4. Village-level shocks, such as the occurrence of a drought.

The observed income of household i in village v at time t, which I denote by y_{ivt}, is therefore composed of the following:

$$y_{ivt} \equiv \bar{y}_i + \bar{y}_v + y_{vt} + y_{it} + \varepsilon_{ivt}, \quad (3)$$

where $\bar{y}_i$, $\bar{y}_v$, y_{it}, and y_{vt} denote the components described by 1, 2, 3 and 4 above, respectively. Finally, ε_{ivt} is a mean zero error term.

The average level of household i's income, $\bar{y}_i$, is determined by that household's 'innate,' characteristics, such as the year of birth, sex and the level of education of the head of household, the stock of household assets and the demographic composition of the household. Holding these characteristics constant, the average level of household income may vary systematically with the village in which a household is resident. Some villages may be more fertile than others, increasing returns to agricultural labour; some may be better connected to urban centres, increasing returns to other forms of human capital. Such heterogeneity between villages (if it exists) will be a component of permanent household income for all households in that village, and is denoted by $\bar{y}_v$[1]. Section 5.1 models the permanent component of household income.

The transitory, household-specific component of income, y_{it}, will in principle include shocks to household income such as involuntary unemployment and waves of illness. However, as discussed above, the likelihood that a household is subject to these shocks will vary systematically with household characteristics such as wealth and human capital that also predict permanent income. Thus, they do not provide suitable instruments for the current paper which identifies differences in income risk across the distribution of household permanent income.

Observed y_{it} will also include endogenous household responses to unanticipated shortfalls to income. There is a large literature on 'the added worker effect' (Mincer, 1962) where the presence of an adverse shock to household income causes an increase in the labour supply of household members who do not otherwise provide labour to the market. Households also may also respond to temporarily low returns to labour in one market by taking on additional work in another (Kochar, 1999).

[1] It is of course possible that over time, households respond to heterogeneous payoffs by migrating to villages that offer better employment opportunities, driving down wages at these destinations, until such differences no longer exist.

In this context, it may also not be feasible to separate y_{it} from the error term, ε_{ivt}, because of measurement error and unobserved heterogeneity. If measurement error is independently and identically normally distributed across households and over time, and 'shocks' are used as explanatory variables (as they will be here), these errors decrease the efficiency of estimates. If, however they are systematically related to any variable of interest (for example, if richer households are more likely to underreport their income) then estimated coefficients may be biased and inconsistent. Insofar as unobserved heterogeneity is time invariant, one could take the first difference of these panel data during analysis to remove the effect of this potential bias. But if the effects of heterogeneity varied over time, for example if poorer households were more likely to receive 'gifts' during lean times than their wealthier counterparts, y_{it} and ε_{ivt} would be correlated. For these reasons, and given the available data, it is not feasible for me to identify exogenous shocks to household income in this context.

The empirical results that follow will focus on the village level transient component of household income, y_{vt}, in the spirit of Paxson (1992). As discussed in section 3, the key informant interviews performed by the Townsend Thai Project allow me to compute the proportion of villages affected by a drought in each year. This variable allows me to identify an exogenous source of variation in the income streams of the cluster of households within a specific village. The focus on aggregate risk is also supported by previous work which has demonstrated that this type of aggregate risk (as opposed to idiosyncratic risk) is especially damaging to the welfare of sampled households as these risks are difficult to insure against (Chiappori et al. 2011, Samphantharak and Townsend, 2017).

5.1 The 'permanent' component of household income

To model the permanent component of household income I estimate:

$$y_{iv} = \alpha_i + \beta' X_i + \gamma V + e_{iv} \quad (4)$$

where y_{iv} is the average over time of household income from 1997 to 2011. X_i is a vector of innate household characteristics and V is a matrix of village dummies, and e is a mean zero error term[2]. The parameters that will be estimated are α, β *and* γ. The results of this regression are presented in the first column of Table 4.

Equivalised real income is on average, 16.8%[3] lower in households that are headed by people who have not completed a primary education, than in households headed by people who

[2] Standard errors are clustered at the village level, since the variables include a mix of observations at the household and village level.

[3] exp[-0.184]-1 = -0.168

completed only primary school. Those who have attained an educational qualification higher than the primary level (for example, secondary, vocational or a university degree) on average receive equivalised real income that is 53.4% more than those who have completed only a primary education. Households headed by people whose primary occupation pays a monthly wage (including government employees) on average earn 65.4% more real income per adult equivalent than those which are headed by people who do not receive monthly wages. On average, an increase in household size of one person, is associated with a fall in real equivalised income of 9.1%. There are no statistically significant differences in income levels between households that are headed by men as opposed to women, or between households which are, and are not involved in agriculture.

5.2 The transient component of household income

The number of household members in employment and the number of jobs held by the head of household were not included as explanatory variables in the model of 'permanent' household income because households may adjust these variables over time (Mincer, 1962; and Kochar, 1999). Now, I introduce these time varying components of household income. I also introduce the primary variable of interest, the proportion of households in the village a household is resident in which are affected by a drought in a given year, d_{vt}. I also allow for a time trend, T, in the evolution of income. Thus, I estimate the equation:

$$y_{ivt} = \alpha_i + \beta' X_{it} + \delta d_{vt} + \gamma V + \tau T + e_{ivt} \, , \qquad (5)$$

where δ and τ are parameters to be estimated and all other variables remain as they have been defined above. The second column of Table 4 presents the results of this regression. Introducing these transient components of household income has no significant effect on the parameter estimates of the 'permanent' component. The coefficient on the variable for the proportion of households in each village affected by drought has the correct sign, and a reasonable magnitude: at the sample mean, a ten-percentage point increase in the proportion of households affected by drought decreases the real, equivalised income of the mean household in that village by 0.8%.

As discussed above, the effect of drought on the income streams of these households is potentially confounded in the data by endogenous household responses to the shocks, which may cause OLS estimates to be biased and inconsistent. Specifically, if the head of household takes on a non-agricultural job in the event of drought, the OLS estimates of the effect of drought on income would be biased towards zero. A similar argument applies to the number of household members in employment.

I therefore use lags of the endogenous variables as instruments in a Two Stage Least Squares estimation strategy. While lags are highly correlated with contemporaneous values, they are not likely to vary in response to unpredictable shocks to transient income that have not yet materialized. Indeed, I find that the first and second lags of both instruments are highly relevant. When I perform two, separate regressions with the employment rate within the household as the dependent variable, and its first and second lags as independent variables, the regressions yield *R*-squared values of 0.498 (8457.62) and 0.330 (3905.20), respectively (*F*-statistics in parentheses). Similar regressions performed on the variable for whether or not the head of household has multiple jobs yield R-squared values of 0.352 (4619.04) and 0.238 (2475.66). A Sargan test of the null hypothesis that the instruments are jointly uncorrelated with the error term fails to reject the null for both the employment rate within the household (*p*-value: 0.558) and for the whether the head holds multiple jobs (*p*-value: 0.279). Proceeding by using two lags of the potentially endogenous variables to instrument for their current values Equation 5, thus becomes:

$$y_{ivt} = \alpha_i + \boldsymbol{\beta}'\boldsymbol{X}'_{it} + \theta'\widehat{\boldsymbol{x}_{it}} + \delta d_{vt} + \gamma V + \tau T + e_{ivt} \qquad (6)$$

where the vector $\boldsymbol{X}'_{it}$ no longer includes the potentially endogenous variables and θ is a parameter to be estimated.

The third column of Table 4 presents these 2SLS results. The estimated coefficient of drought on income increases in magnitude, so that a 10-percentage point increase in the number of households affected by drought decreases income per adult equivalent by 1%. This increase in the estimated coefficient when compared to that of the second column suggests that heads of household may indeed take on additional jobs or that other household members may bring their labour to market to reduce shortfalls to income brought about by a drought.

5.3 Are the incomes of the better off more insured against drought?

I now extend that model to answer the key research question of this paper, namely to test for heterogeneity across the distribution of income in the extent to which household income streams are insured against shocks.

I adopt a reduced form approach to answering this question by interacting drought measured permanent income, defined above. This frames the problem as a moderated relationship (Jaccard and Turrisi, 2003; Aiken and West, 1991) where I test if the effect of drought on income is moderated by permanent income. The identifying assumption is that in the absence of different insurance strategies, households across the income distribution in each cluster would on average have suffered similar proportionate losses in income if that cluster were affected by drought. Of course, these results should not be interpreted as a causal effect of high permanent income on income risk, but rather as an attempt to test whether or not an economically meaningful correlation exists.

In the empirics below, I follow the textbook advice (Jaccard and Turrisi, 2003) and subtract the mean value of $\bar{c}_i$ over the entire sample from each household's estimated permanent income so as to ease interpretation. That is, I define the quantity,

$$\bar{c}_{\mu i} = \bar{c}_i - \mu, \quad (7)$$

where μ is the average $\bar{c}_i$ observed in the sample. I estimate:

$$y_{ivt} = \alpha_i + \boldsymbol{\beta}'\boldsymbol{X}'_{it} + \theta'\widehat{\boldsymbol{x}_{it}} + \delta d_{vt} + \chi(d_{vt} \times \bar{c}_{\mu i}) + \gamma V + \tau T + e_{ivt} (8)$$

where $\bar{c}_{\mu i}$ is also an element of the vector of household characteristics, $\boldsymbol{X_i}$. As before, I account for the endogeneity of the number of jobs held by the household head and the employment rate.

If the income streams of households with higher levels of permanent income are better insured against covariate shocks, χ will be positive and significant. The first column of Table 5 presents the results. The coefficient on the interaction term, χ, is positive and different from zero at all conventional levels of statistical significance so that the adverse effect of drought on income is indeed moderated by high levels of permanent income. The magnitude of the coefficient is such that at the sample mean, a one standard deviation increase in mean consumption (0.459 log points) nullifies the impact of drought on income.

These results are corroborated when I split the sample into households with permanent income above or below the sample median and re-estimate Equation 6, as presented in the second and third columns of Table 5, respectively. Column 2 shows that there is no statistically significant effect of drought on income for households whose permanent income is above the sample median, whereas the third column confirms a strong negative effect of drought for relatively poor households. The coefficient in this sub-sample is almost double that estimated at the mean of the entire sample.

Thus relatively well-off households in rural Thailand enjoy income streams that are better insured against this covariate shock.

5.4 The Effect of Drought by Households' Observable Characteristics

Table 3 illustrated that households which have levels of permanent income higher than the median differ in a variety of observable characteristics from those which have lower than median permanent income. To understand if any of these differences are empirically related to the ability of households to insure their income streams against drought, I re-estimate Equation 6 on groups of households which exhibit each of these characteristics.

The first column of Table 6 restricts attention to those households who are headed by people in government work or other jobs that pay monthly wages. Here, the drought coefficient is statistically indistinguishable from zero. Even though these households are disproportionately drawn from among the better off (evidenced in Table 3), this result is subject to the caveat that it applies to only 5.2% of the sample and so is of limited use in explaining the overall distribution of income risk. Therefore, the second column of Table 6 tests if the result generalizes to the case where a household in a particular year derives any income at all from monthly salaries. This much broader group includes 11.5% of relatively poor households and 31.5% of relatively well-off ones. The estimated coefficient of drought on income among households that have access to monthly salaried jobs is roughly one-tenth the magnitude of that of the overall sample and statistically indistinguishable from zero. Thus, salaried jobs appear to constitute an important channel through which the income streams of richer households are insured.

Tellingly, in the subgroup of households headed by people who earn monthly salaries there were no observations of household heads with less than a primary education. This supports the hypothesis that the income streams of better-off households are better insulated against shocks, in part, because their endowments of human capital enable them to access jobs with low income-risk. The results in the third column complement this finding by restricting attention to households where the head has completed an educational qualification greater than the primary level, that is one of secondary, university or vocational degrees. The effect of drought on the income streams of these households is also statistically indistinguishable from zero. Households with above median permanent income are more than six times as likely to be headed by people with these high levels of education than households with below median permanent income, as was documented in Table 3.

The fourth, fifth, sixth and seventh columns of Table 6 restrict the sample to households which are headed by people born in the 1930s, 1940s, 1950s and 1960s respectively. Drought has a statistically significant, large, negative effect only on the income streams of households headed by the eldest of these cohorts. For households headed by cohorts born after 1940, the estimated effect of drought is never significantly different from zero at the 5% level. The data thus suggest that households headed by people born after 1940 are better able to adapt to covariate shocks. This may be because younger households are better equipped to access information on changing market conditions and they may have human capital such as information technology skills that enable them to better respond to such changes. Alternatively, the heads of richer households may self-select into early retirement leaving such households with younger heads. If households with younger heads enjoy inherently better insurance possibilities, this form of selection may also be an important mechanism underpinning this result.

The eighth and ninth columns of Table 6 allow for drought to affect village households differently in central and Northeastern villages respectively. In the relatively affluent central region which is close to the capital, Bangkok, the presence of drought does not exert a statistically significant effect on household income. In contrast, the presence of a drought exerts a strong, negative effect on household income in the relatively poor Northeastern region. Thus, there is some evidence that geographic factors may also constrain the ability of relatively poor households to generate low-risk income.

A robust finding of the income smoothing literature from poorer, exclusively agrarian contexts, is that differences in the share of specific crops in household income portfolios are likely to be a key driver of this type of smoothing (Dercon, 2002; Rosenzweig and Binswanger, 1993; and Morduch, 1995). Rice is the single most important crop in the Thai context, with the proceeds from rice farming accounting for on average 31.1% and 26.3% of the net incomes of relatively poor and rich households respectively (Table 3). The tenth column of Table 6 reports the estimated effect of drought on income for the 58% of sample households that farm rice. This coefficient is not significantly different from that obtained for the whole sample (t-stat: 0.579), nor is it significantly different from the analogous coefficient for households who do not farm rice (t-stat: 1.09). Thus, despite the increased prevalence of rice farming among the relatively poor, there is little evidence relating rice farming to the insurance possibilities available to these households.

Appendix 1 presents further heterogeneity analysis of the effect of drought on household income by restricting attention to business owning households, female headed households, households where the head has more than one job, and households where there is more than one breadwinner and households that report being involved in at least some form of agriculture. The degree to which drought affects the income streams of all these subgroups is similar to the result for the whole sample, and therefore not informative of differences in the extent to which the income streams relatively well-off households are insured against drought.

5.5 Salaries and Counterfactual Distributions of Income Risk

Of the constraints to household income choice identified above, the role of salaried jobs is especially interesting as it is well known that the increased prevalence of this kind of employment is part and parcel of the process of economic development and industrialization. Gutierrez (2014) highlights the importance of understanding the insurance function served by salaried employment in rapidly industrializing countries. These observations and the sharp differences in the access to salaried work across the income distribution documented in Table 3 beg the question: "Are receipts of salaried income sufficient to explain the heterogeneity in income risk documented in the second column of Table 2?" Table 7 answers precisely this question by reporting on counterfactual distributions of income risk.

The simplest counterfactual one can construct in this regard is obtained by subtracting the contribution of salaries from net household income and analyzing risk in the resulting component of the income distribution. The first column of Table 7 presents the results of a regression of the non-salary component of real, equivalised income on revealed household 'permanent income'. These results are exactly analogous to and should be compared with the results in column two of Table 2. The non-salary component of household income does not exhibit the decreasing riskiness with permanent income documented earlier. To the contrary, this component of household income exhibits higher risk among the relatively well off in a manner that is consistent with traditional narratives of income smoothing.

Admittedly, the distribution of income underpinning the results in the first column of Table 7 does not constitute a true counterfactual – household members that are currently in salaried employment would presumably have been in some other productive enterprise even if they did not have salaried jobs. To account for this I use the 2SLS estimates of the econometric model in equation (6) to predict what household income would have been in the absence of salaried employment, holding other things (such as cohort and educational attainment of the head of household, and village characteristics) constant. The second column of Table 7 studies simulated income risk across the (observed) distribution of permanent income. The estimated coefficient is statistically indistinguishable from zero. This evidence suggests that richer households would not have continued to enjoy lower-risk income streams than their poorer counterparts if not for the insurance function served by salaried employment.

6. Conclusions

This paper has studied heterogeneity in the insurance strategies adopted by households in rural Thailand across the income distribution. The finding that the income streams of relatively well-off households are better insured against covariate shocks is a novel contribution within the income smoothing literature, which has usually focused on identifying this type of insurance among the relatively poor and vulnerable in exclusively agrarian settings in South Asia. In contrast to this earlier literature (but consistent with Gutierrez's (2014) more recent findings on Mexico), among the more diverse income portfolios of rural Thai households, low-risk income is associated with human capital and the ability to take up salaried employment.

The results suggest that in rapidly industrializing parts of the world, particular attention should be paid in evaluating the impact of increasing access to jobs that pay monthly salaries. These jobs have the potential to contribute to household welfare not only by increasing average earnings, but also by serving a potentially crucial insurance function for households. This insurance function is likely to benefit households that are able to secure these high-return, low-risk opportunities. However, to the extent that these opportunities are restricted to the relatively well-off who are more likely to be younger, well-educated, and living close to urban hubs, their distributional consequences may be more severe than previously thought.

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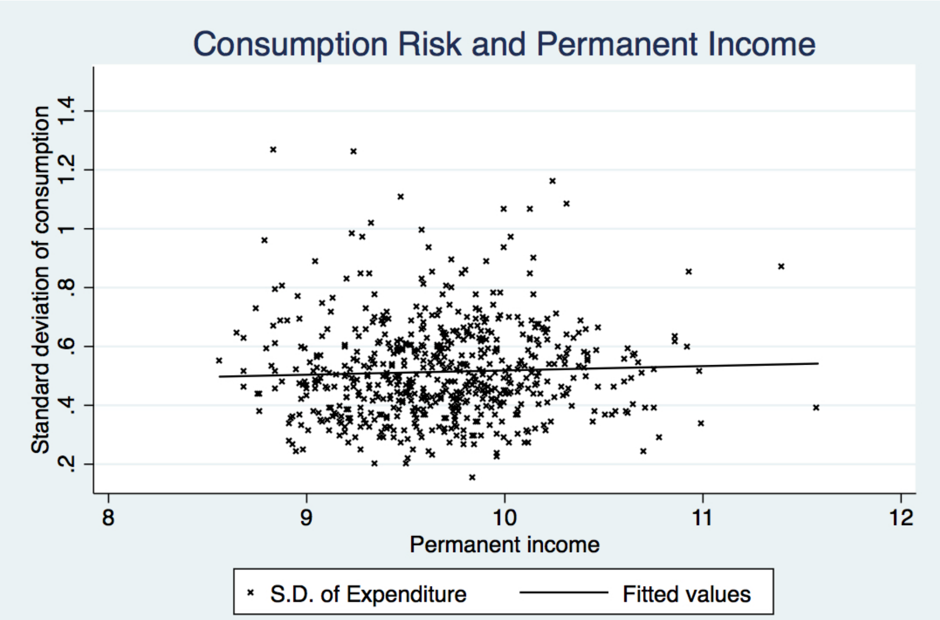

Figure 1

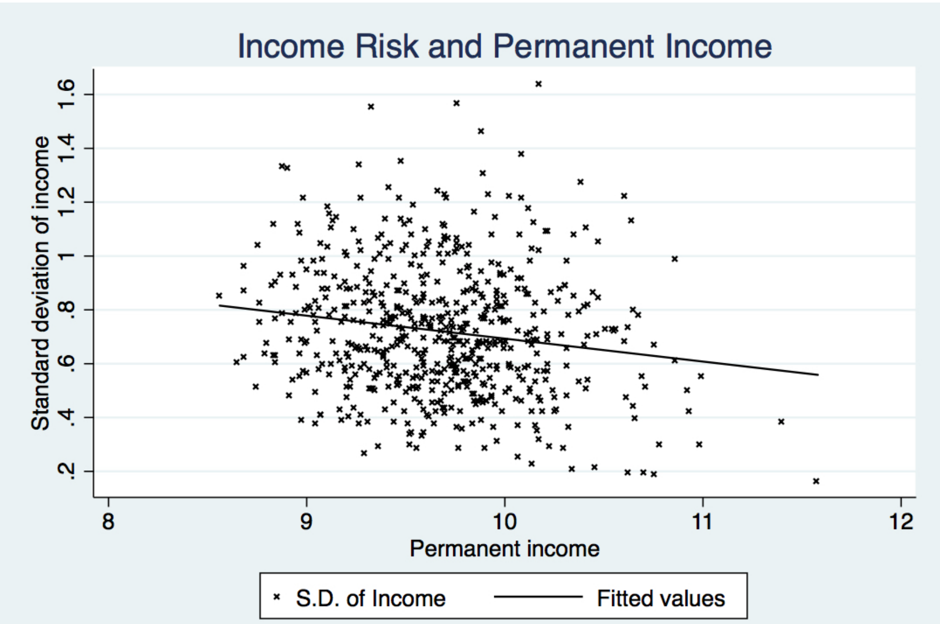

Figure 2

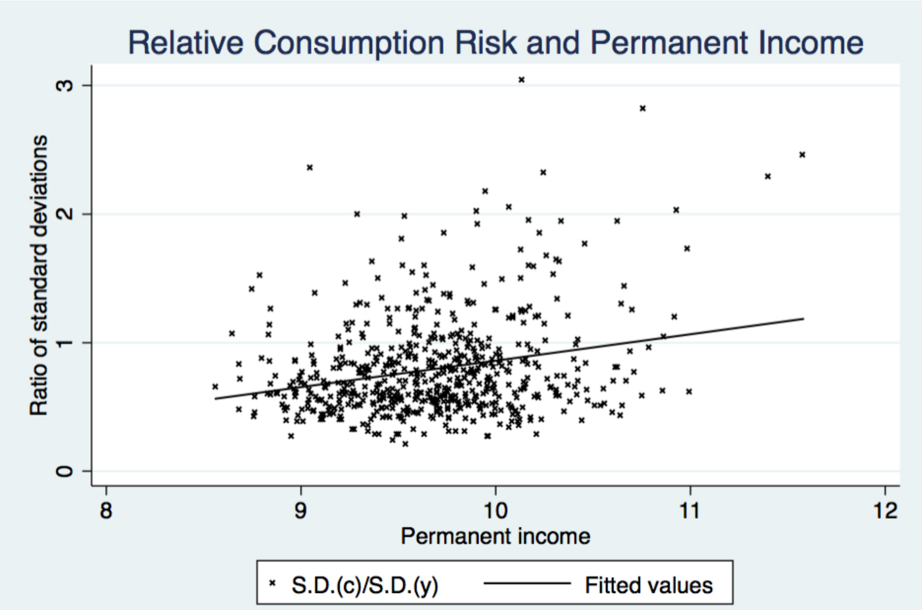

Figure 3

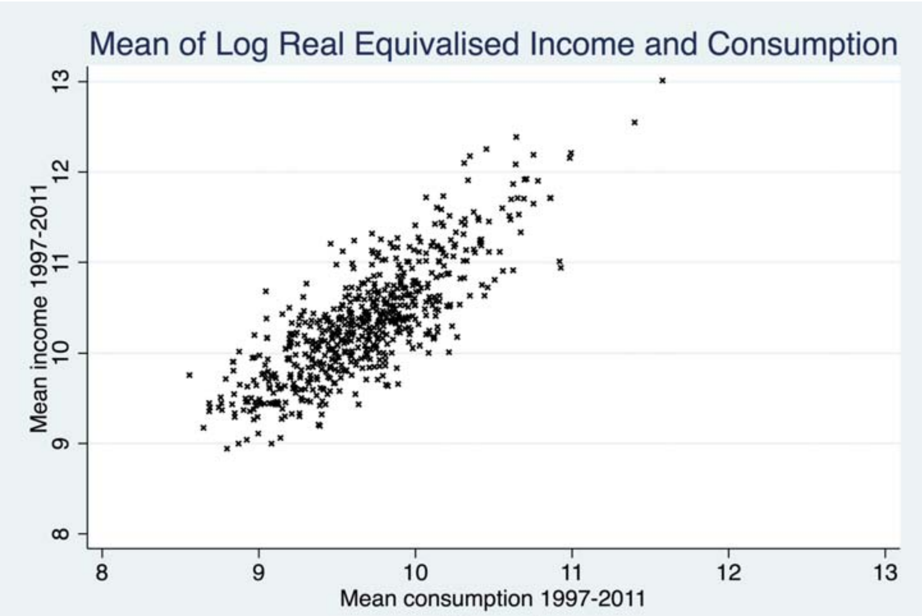

Figure 4

TABLE 1: SUMMARY STATISTICS OF HOUSEHOLD INCOME AND CONSUMPTION

Variable	Mean	Std. Dev.	Min	Max
Income	49,510	71,087	175	1,956,726
Consumption	21,128	22,817	466	667,738

* *31.5147 Thai Baht = 1 U.S. Dollar on 31st Dec. 2011 (source: exchangerates.org.uk)*

TABLE 2: INCOME SMOOTHING AND CONSUMPTION SMOOTHING

Dependent	(1) SD(c)	(2) SD(y)	(3) SD(c)/SD(y)	(4) CV(c)/CV(y)	(5) SD(f)/SD(y)
Mean	0.0147	-0.0852***	0.206***	.227***	.0906***
Consumption	(1.02)	(-4.06)	(6.21)	(6.21)	(2.81)
Constant	0.372***	1.545***	-1.201***	-1.349***	.0296
	(2.65)	(7.60)	(-3.73)	(-3.8)	(0.14)
N	609	609	609	609	609

Notes: SD(c) is the standard deviation of real, equivalised, non-durable consumption for each household over the duration of the panel. SD(y) the analogously defined standard deviation of household income. SD(f) is the analogously defined standard deviation for food, alcohol, tobacco and fuel consumption. CV is the coefficient of variation. Mean consumption is the mean of real, equivalised household consumption over the fifteen-year duration of the panel, an empirical proxy for household permanent income. *t*-statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 3: OBSERVABLE CHARACTERISTICS OF HOUSEHOLDS WITH BELOW AND ABOVE MEDIAN PERMANENT INCOME

Level of permanent income:	*Below median*	*Above median*	*t-statistic*
Education level of head (%)			
Less than primary	21.82	9.73	16.08***
Primary	75.88	76.50	-0.7018
More than primary	2.28	13.77	20.66***
Primary contract type of head			
Government work	0.24	4.03	-12.13***
Other monthly wages	1.15	4.92	-9.720***
Daily wages	17.86	10.50	11.76***
Piece rates	1.32	1.80	-1.2455
Business owner	59.84	68.02	2.5312***
Other	0.16	0.35	-1.502
Decade of birth of head (%)			
1930s	26.05	14.45	13.95***
1940s	23.51	18.51	5.870***
1950s	22.65	37.22	-15.40***
1960s	13.49	21.62	-10.27***
Other characteristics			
More than one breadwinner (%)	62.68	64.74	-3.461***
Any salaried income (%)	11.51	31.45	-23.90***
Head holds multiple jobs (%)	58.60	71.27	-12.40***
Headed by women (%)	36.14	24.54	12.09***
Involved in agriculture (%)	90.30	91.20	-2.318**
Lagged log of assets	9.73	11.10	-31.44***
Share of household income (%)			
Rice farming	31.13	26.32	6.580***
Livestock (pig, cow & buffalo)	6.68	5.53	3.37***
Salaries	5.73	15.46	-19.52***

Notes: Each *t*-statistic presents the result of a difference in means test between the preceding columns * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 4: MODELS OF LOG HOUSEHOLD INCOME WITH FIXED AND TIME VARIANT COMPONENTS

	(1)	(2)	(3)
	OLS estimates of log 'permanent' household income	OLS estimates of drought on log income	2SLS estimates of drought on log income
Less than primary education	-0.184***	-0.143**	-0.135**
	(-2.83)	(-2.23)	(-2.17)
More than primary education	0.428***	0.376***	0.375***
	(4.84)	(4.55)	(4.55)
Female head of household	0.0606	0.0551	0.0575*
	(1.51)	(1.54)	(1.70)
Lagged log assets	0.143***	0.163***	0.162***
	(11.91)	(13.65)	(13.18)
Head earns monthly wages	0.503***	0.608***	0.617***
	(5.03)	(6.62)	(6.62)
Household size	-0.0914***	-0.0530***	-0.0474***
	(-8.49)	(-4.68)	(-3.81)
Involvement in agriculture	-0.0952	-0.0560	-0.0458
	(-1.51)	(-0.98)	(-0.73)
Time		0.0717***	0.0767***
		(18.95)	(19.80)
Drought		-0.000848***	-0.00105***
		(-2.78)	(-3.40)
Head has more than one job		0.0687**	0.0582
		(2.19)	(0.88)
Employment rate within household		0.345***	0.365***
		(4.62)	(3.37)
Constant	10.07***	7.806***	7.686***
	(28.58)	(35.33)	(34.79)
N	8290	8289	7699

Notes: All specifications include decade of birth cohort and village fixed effects. Standard errors are clustered at the village level. The final specification instruments for 'Head has more than one job' and 'Employment rate within the household' using two lags of each of these endogenous variables. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

TABLE 5: 2SLS ESTIMATES OF HETEROGENEOUS EFFECTS OF DROUGHT ON CONTEMPORANEOUS LOG INCOME BY LEVEL OF PERMANENT INCOME.

	(1)	(2)	(3)
	Permeant income moderates the effect of drought	Households with above median permanent income	Households with below median permanent income
Drought	-0.00120***	-0.000555	-0.00170***
	(-4.50)	(-1.46)	(-4.26)
Drought × permanent income	0.00260***		
	(4.18)		
Constant	9.148***	7.501***	8.859***
	(42.05)	(27.02)	(36.10)
N	7699	3950	3749

Notes: All specifications include dummy variables for the head of household having less than a primary education, the head of household having more than a primary education, the head of household being in a form of employment that pays a monthly wage, the household being involved in agriculture, the sex of the head of household, a set of decade of birth of the head of household fixed effects and a set of village fixed effects. Continuous regressors for the lagged log of assets, household size and time are also present. Standard errors are clustered at the village level. As in Table 4, lags of 'Head has more than one job' and 'Employment rate within the household' are used as identifying instruments to address the endogeneity of these variables to the onset of drought. Specification (1) also conditions on the level of revealed household permanent income. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 6: EFFECT OF DROUGHT ON LOG INCOME BY HOUSEHOLD CHARACTERISTIC

Sub-group	(1) *Monthly salary: head*	(2) *Monthly salary: any member*	(3) *Head more than primary education*	(4) *Head born in 1930s*	(5) *Head born in 1940s*	(6) *Head born in 1950s*	(7) *Head born in 1960s*	(8) *Central Region*	(9) *North Eastern Region*	(10) *Rice Farmers*
Drought	-0.000127	-0.000129	-0.000724	-0.00194***	-0.00107	-0.000716*	-0.000571	-0.000170	-0.00197***	-0.00134***
	(-0.10)	(-0.21)	(-0.74)	(-3.26)	(-1.53)	(-1.76)	(-0.89)	(-0.48)	(-4.84)	(-3.51)
Less than primary education	0	0.0377	0	-0.103	-0.0706	-0.360**	-0.441**	-0.242***	-0.0419	-0.0334
	(.)	(0.30)	(.)	(-0.57)	(-0.50)	(-2.34)	(-2.31)	(-2.77)	(-0.51)	(-0.41)
More than primary education	0.730***	0.286***	0	0.122	0.157	0.535***	0.288	0.341***	0.414***	0.277***
	(3.21)	(2.94)	(.)	(0.49)	(0.56)	(4.66)	(1.27)	(3.01)	(3.56)	(2.95)
Head earns monthly wages	0	0.242***	0.0902	0.770***	0.436***	0.690***	0.105	0.623***	0.616***	0.519***
	(.)	(3.57)	(1.20)	(3.65)	(3.55)	(5.34)	(0.78)	(4.55)	(5.90)	(5.17)
Cohort fixed effects	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes
Constant	8.895***	8.217***	7.534***	8.231***	8.005***	7.993***	8.165***	7.605***	7.869***	7.657***
	(15.43)	(24.71)	(10.30)	(25.14)	(17.59)	(26.82)	(20.49)	(17.74)	(28.51)	(22.30)
N	410	1728	664	1520	1612	2379	1389	3460	4239	4461

Notes: All specifications include dummy variables for the household being involved in agriculture and a set of village fixed effects. Continuous regressors for the lagged log of assets, household size and time are also present. Standard errors are clustered at the village level. As in Table 4, lags of 'Head has more than one job' and 'Employment rate within the household' are used as identifying instruments to address the endogeneity of these variables to the onset of drought. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 7: DISTRIBUTIONS OF COUNTERFACTUAL INCOME RISK

Dependent variable	(1) SD(y')	(2) SD($\hat{y}$)
Mean	.0693***	0.0120
Consumption	(2.96)	(1.44)
Constant	0.130	.229***
	(0.57)	(2.83)
N	609	609

Notes: SD(y') is the standard deviation of the real, equivalised, non-salary income for each household over the duration of the panel. SD($\hat{y}$) is the analogously defined standard deviation of predicted income in the absence of wage labour. Mean consumption is the mean of real, equivalised household consumption over the fifteen-year duration of the panel, an empirical proxy for household permanent income. *t*-statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix 1:

TABLE A1.1: EFFECT OF DROUGHT ON LOG INCOME BY HOUSEHOLD CHARACTERISTIC

Sub-group	(1) *Head is Business owner*	(2) *Female Head*	(3) *Head has multiple jobs*	(4) *Multiple earners in household*	(5) *Involved in agriculture*
Drought	-0.00115***	-0.00108***	-0.00116***	-0.00107***	-0.00118***
	(-3.05)	(-2.92)	(-3.20)	(-3.08)	(-3.67)
Less than primary	-0.182*	-0.0547	-0.155*	-0.111*	-0.112*
education	(-1.94)	(-0.71)	(-1.66)	(-1.79)	(-1.78)
More than	0.253***	0.335***	0.313***	0.339***	0.334***
primary education	(3.09)	(3.73)	(3.95)	(4.05)	(4.06)
Head earns monthly	0	0.634***	0.482***	0.623***	0.596***
wages	(.)	(6.47)	(6.06)	(6.67)	(7.36)
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	7.913***	8.194***	7.731***	7.583***	7.747***
	(22.56)	(31.02)	(23.92)	(27.99)	(33.46)
N	4930	5380	5071	6749	6988

Notes: All specifications include dummy variables for the household being involved in agriculture (except (5)) and a set of village fixed effects. Continuous regressors for the lagged log of assets, household size and time are also present. Standard errors are clustered at the village level. As in Table 4, lags of 'Head has more than one job' and 'Employment rate within the household' are used as identifying instruments to address the endogeneity of these variables to the onset of drought. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.