Informal Risk Sharing, Index Insurance and Risk-Taking in Developing Countries

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Abstract

This paper presents preliminary findings from a research project that examines the interaction between informal risk sharing, index insurance and risk-taking. We have randomized rainfall insurance contracts offered to cultivating and landless households in a set of Indian villages where pre-existing census data on caste networks allows us to characterize the nature and extent of informal risk sharing. In a series of papers, we study (a) how informal risk sharing mediates the demand for index insurance, (b) whether index insurance or informal indemnification allows farmers to invest in risky technologies, and (c) the general equilibrium effects of offering insurance contracts to cultivators or to agricultural laborers.

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1. Introduction

The penetration of formal insurance markets is puzzlingly low in agrarian areas of developing countries, although agriculture is highly susceptible to fluctuations in weather. Most rural households participate in informal risk sharing schemes (Rosenzweig and Stark 1989; Townsend 1994), and this may itself affect the development of formal insurance markets, as well as the propensity of agrarian households to invest in risky technologies. To understand the complex interactions between informal risk sharing, formal insurance, and risk-taking, we have randomized offers of rainfall insurance contracts to a set of households living in Indian villages for which we had pre-existing census data that permits a rich characterization of the nature and extent of informal risk sharing within readily-identifiable, exogenously formed networks: the sub-caste, or *jati*. This article describes preliminary findings from three studies undertaken or underway (Mobarak and Rosenzweig 2012, 2013a, 2013b) that use the resulting experimental and non-experimental data to explore various facets of the interactions between informal risk sharing, index insurance and risk choices.

We first examine whether and how caste-based risk sharing affects the demand for formal insurance. Next we compare the effects of index insurance provision and informal risk sharing on farmers' willingness to invest in risky production methods and technologies. Finally, we assess the general-equilibrium effects of offering insurance contracts to cultivators and to agricultural laborers on wage levels and volatility by estimating labor supply and labor demand effects. This last piece is particularly policy relevant because our analysis indicates that marketing insurance to only those who possess an insurable asset (land), as is typically done in developing countries, *increases* the risk exposure of landless laborers, a group that is typically least able to handle risk.

Four distinct features of the research design allow us to empirically identify these relationships. First, we use the listing data from the 2007/8 round of the national NCAER Rural

Economic Development Survey (REDS) as the sampling frame for the experiment, which allows us to stratify the randomization across and within caste-based risk-sharing groups identified in REDS, as well as within and across villages. *Jatis* are clearly the relevant risk sharing network[1]: the data indicate that the majority of loans and transfers to households are from fellow caste members, and the majority of informal loans and financial transfers to households from family and from fellow caste members originate outside the village.[2] *Jati* networks span villages and districts in India, and the spatial correlation in rainfall falls sharply as distance increases (see Figure 1). *Jatis* therefore have the potential to indemnify aggregate (village-level) rainfall risk in addition to household-specific idiosyncratic risk.

Jatis may directly substitute for formal insurance, but the relationship is actually more complex because informal networks can potentially help mitigate an imperfection of index insurance called "basis risk" – which is the imperfect correlation between rainfall measured at the weather stations (which is the basis for the index contract), and farmers' actual losses. A second feature of our project design is that we randomly place weather stations in some of the project villages. This allows us to explore whether basis risk deters index insurance purchase, and the extent to which informal risk sharing that indemnifies household-specific losses mitigates this effect.

A third key feature of the experimental design is that we offer the insurance product to both cultivators and landless households in which the head's primary occupation is agricultural laborer. We know of no governmental or private insurance agency in India that offers weather insurance to agricultural laborers. Yet, clearly the incomes of such workers are heavily dependent on weather

[1] The REDS also indicates that more than 95% of marriages in rural areas take place between members of the same *jati*, so these groups are effectively exogenous.

[2] Transfers are r**Error! Main Document Only.**emittances and "assistance received at the time of difficulty" from individuals and households excluding gifts for festivals and marriage**. Error! Main Document Only.**Only 9.2% of informal "assistance" transfers originated in the village, and outside-village remittances (excluding those few from outside the country) outnumbered inside-village remittances by 2 to 1.

outcomes. By offering the insurance product to landless agricultural workers we can assess to what extent their behavior and welfare is directly affected when protected against rainfall variation.

A fourth feature of our project design is that we can identify general-equilibrium effects at the village level. To the extent that the provision of insurance to farmers alters their input decisions and risk-taking behavior, as theory suggests and we confirm, such insurance will also affect the demand for and risk facing agricultural laborers. Because the REDS listing data describes the occupations and landholdings of all households in villages, our design enables us to characterize the general-equilibrium spillover effects of insurance provision to cultivators on the insurance take-up, incomes and risk-mitigating behavior of agricultural laborers and on village-level wage rates. We assess how the provision of rainfall insurance to the landless affects the incomes of cultivators.

2. Experimental Design

As noted, we used the REDS listing in three large states (Andhra Pradesh, Uttar Pradesh and Tamil Nadu) as the sampling frame to draw the RCT sample. The research design requires us to construct average *jati* characteristics with statistical precision, and our experiment and analysis therefore focuses on *jatis* with at least 50 households in this sample of populous castes. The 63 REDS villages in these three states contained 118 unique *jatis* meeting this size criterion in the REDS listing. We first randomly selected 42 (of the 63) sampled REDS villages to receive insurance marketing. To ensure that we retained a "pure control" group of households whose fellow caste members (or villagers) do not receive any insurance treatment, we first stratified the randomization by caste, so that members of 25 (of the 118) castes are randomly selected to not receive any insurance offers. Next we stratified by occupation, so that almost all insurance offers were made to agricultural households, with half the offers going to 'cultivators' (those who make planting decisions) and the other half going to households engaged purely in agricultural labor work. Two thirds of the cultivators and agricultural laborers in the 93 treatment castes, totaling about 4667 households, ultimately received insurance offers. 98% of these households had no prior exposure to formal insurance.

Stratification of random assignment by caste creates natural variation in the number and fraction of farming households in each village receiving insurance offers. For example, one of the 93 castes randomly chosen for treatment may have been relatively populous in village A but sparse in village B, whereas the dominant caste in village B may have been randomly assigned to be a 'control caste' not receiving the insurance treatment. The fractions of cultivators and agricultural laborers receiving insurance offers would be greater in village A under this scenario. About 26% (33%) of all cultivators (laborers) receive insurance marketing in the average treatment village, but this fraction varies from 0% to 56% (0% to 80%). This variation, induced by the stratified randomization, is useful for studying the labor market spillover effects of insurance offers to cultivators or laborers.

The stratification by occupation also creates similar variation in the fraction of fellow caste-members in the village receiving insurance offers. For example, if agriculture is the dominant occupation for one of the treatment castes in a specific village, then a high fraction of caste members in that village would receive insurance offers. If on the other hand cultivators or pure agricultural laborers are relatively minor shares of the caste, then the insurance marketing penetration would be relatively low within that caste. The average caste in the treatment villages had 21% of members receiving insurance offers, and this fraction varies between 0% (in control castes) and 100%. This variation will allow us to examine spillovers from insurance offers across caste members, including financial transfers, risk taking, or future insurance demand.

We designed and marketed a "Delayed Monsoon Onset" insurance product in collaboration with Agricultural Insurance Company of India Lombard (AICI). The product makes payouts if rainfall is delayed beyond an expected monsoon onset date, which was determined by AICI based on the historical rainfall data collected at block-level Automatic Weather Stations (AWS). Mobarak and Rosenzweig (2011) provides more details on the insurance product. The price of a unit of insurance varied from Rs. 80 to Rs. 200 (US$ 1.6-4), but every household receiving insurance marketing was given the opportunity to make a lottery pick that would provide a 0%, 10%, 50%, or 75% discount on this price. Each household faced a 10% chance of receiving no discount, and a 30% chance of receiving each of the other three levels of discounts. This price variation helps identify parameters in an insurance demand equation, but we only use the random binary variation in insurance offers (intent to treat) rather than the price variation to analyze the downstream effects of insurance.

Figures 2 shows the variation in insurance take-up at the different (randomly assigned) price points. Overall, roughly 40% of all households purchased some insurance. Of those, 38% purchased multiple units of insurance, with 17% purchasing 5 units or more. Purchasing 5 or more units of insurance could lead to payouts o Rs. 6000 (US$120) or more in the event of rainfall delayed by a month, so these were substantial purchases for rural, agricultural households in India. Both the take-up rates and the number of units purchased were greater at the higher levels of discounts. Agricultural laborers and cultivators have comparably strong demand for insurance (see Figure 2). The average price paid per unit of insurance in the sample, accounting for the various discounts, is Rs. 80.[3] There was substantial variation in realized rainfall, which we use for some of the analysis presented below. Figure 3 shows the variation for Andhra Pradesh, the only state where some insurance payouts were made.

Finally, as there were no pre-existing weather stations in the 19 REDS villages in the state of Uttar Pradesh, we randomly placed the weather station in 12 of those villages, with the rest placed

[3] In addition to the randomization of price discounts, we also randomly varied the content of the marketing scripts narrated to the sample households by the insurance marketers. The product was sometimes framed as "insurance" and sometimes as a gamble. For a subset of households, we added to the script information on historical rainfall variation on which the product was based, and some households were told that we would return the following year to market the product again. We do not rely on the variation arising from the different scripts in any analysis presented in this paper.

outside the villages as in other states. The randomization of weather station placement induces random variation across villages in the basis risk associated with the index insurance contract.

3. Informal Risk-Sharing, Basis Risk and the Demand for Weather Insurance

Mobarak and Rosenzweig (2012) embeds a model of index insurance with basis risk in Arnott and Stiglitz (1993)'s cooperative risk sharing model to show that:

(a) Basis risk, or the imperfect correlation between losses and insurance payouts due in part to the remote location of the rainfall gauge, lowers the take-up of index insurance,

(b) When the insurance contract carries no basis risk, demand for index insurance is independent of the extent of informal coverage of idiosyncratic (household-specific) losses,

(c) Informal risk sharing and index insurance can be complements when there is basis risk, because the *jati* network will cover household losses precisely when the index contract fails.

To test these predictions, we first use REDS survey data on inter-household transfers in response to village-level rainfall shocks and household-specific adverse shocks to construct indices of informal risk sharing that measure how well each caste in our RCT sample indemnifies against idiosyncratic losses, and against aggregate shocks.[4] We proxy for basis risk using the farmer's distance from the weather station used to measure rainfall on which insurance payouts are based, and the randomized placement of rainfall stations generates variation in basis risk. We estimate an insurance demand equation for the RCT sample to whom offers of insurance were made at randomly varying prices. Basis risk is interacted with informal indemnification of idiosyncratic losses, as implied by the theoretical model.

[4] To compute the nature and extent of informal risk sharing, net transfers are regressed on the rainfall and household-specific shocks interacted with a set of average caste characteristics (like land-holdings, occupational diversification, caste-presence in village) computed from the 118,000 sample REDS listing, controlling for caste fixed effects. Mobarak and Rosenzweig 2012) discuss identification issues and show using a Hausman specification test that losses do not appear to be endogenous.

It is important to first establish that basis risk exists in these insurance contracts, and that distance to the rainfall station (or more specifically, distance variation induced by the placement of rainfall stations in a random subset of villages) is a reasonable proxy for it. Figure 4 shows the relationship between farm output per acre in our follow up data and the realization of rainfall during the *Kharif* season. There is a clear positive relationship when rainfall is measured in the village (using the random subset of stations placed in village), but the slope is considerably attenuated when rainfall is measured further away at stations that are nonetheless used to compute insurance payouts for those village residents. Basis risk therefore is an important potential concern for consumers of insurance, and variation in rainfall station placement enables us to assess how the level of basis affects weather insurance take-up.

Figure 5 summarizes the key results from the insurance demand estimation. When the insurance contract does not carry any basis risk (a value of zero on the x-axis in Figure 5, i.e., when rainfall gauges are placed in the village), there is no difference in index insurance demand between castes who do not indemnify any idiosyncratic risk and castes that demonstrate the sample median level of informal risk sharing. However, as basis risk increases along the x-axis, members of castes that share idiosyncratic risk become much more likely to purchase index insurance than do members of castes that do not share risk. At the mean distance to the nearest rainfall gauge used to calculate payouts (4km), there is a 20 percentage point difference in insurance demand. The index insurance policy sometimes fails to cover losses because it measures rainfall "with error" from the farmer's perspective. Informal coverage of losses from the *jati* in such situations reduces the farmer's exposure to index risk and evidently makes investment in rainfall index insurance more attractive.

4. Informal Risk-Sharing, Rainfall Insurance and Risk-Taking

The Arnott-Stiglitz model of informal insurance with moral hazard - in which the level of indemnification and risk-taking are optimally-determined within the risk-sharing community -

predicts that informal coverage may be associated with *less* risk-taking. Mobarak and Rosenzweig (2013a) shows in the context of that model that small *reductions* in indemnification from the optimum level when the probability of a loss is high (>50%) always lead to *less* risk mitigation *ex ante*. When the loss probability is lower, the effect is ambiguous – communities less successful at risk mitigation may or may not take more risk.

To assess whether and how variations in informal indemnification of household losses affect risk taking, we exploit the idea that among farmers who take more risk, crop output, input use and profits should be more sensitive to rainfall.[5] From the REDS data we use random (and unanticipated) variation in village-level monthly rainfall over eight years to compute that part of rainfall that is unexpected during the survey year to assess the relationship between informal insurance coverage and farmer risk-taking. And we use the random variation in the offer of weather insurance and the indices of *jati*-level loss indemnification interacted with variation in rainfall to assess the effects of rainfall insurance and informal loss indemnification on risk-taking from the RCT survey data.

Using the response of inputs and outputs to rainfall variation is an indirect method of assessing risk taking. The REDS survey also elicited from households whether and how they had responded to loss-inducing adverse events in each of the eight years prior to the survey. Over that period 49.3% of farmers reported at least one loss, and among those more than a third took a subsequent risk-mitigating action, of which over 45% either changed their choice of crops or used "improved" technology. To examine whether the likelihood of taking a risk-mitigating action was related to informal indemnification, we estimated the effect of having a loss on whether or not a farmer had undertaken any one of the risk-reducing actions interacted with the two *jati* indemnification parameters we had obtained to carry out our analysis of the demand for rainfall

[5] Karlan *et al.* (2012) also exploit this idea, and obtain findings similar to ours with respect to formal rainfall insurance. They do not examine how informal risk-sharing affects risk-taking.

insurance. The fixed-effect *jati* estimates indicated that farmers in *jatis* with higher loss indemnification were actually significantly more likely to take action to reduce future losses than farmers in *jatis* with less effective indemnification – more loss-protected *jatis* were thus more conservative with respect to risk behavior.[6] On the other hand, *jati*s with higher protection against adverse rainfall shocks and who experienced a loss were less likely to take subsequent action, as would be expected with any index-type insurance.[7]

We find the exact same relationships after making randomized index insurance offers. Output was much more sensitive to rainfall among farmers offered the insurance product, while the sensitivity of output to rainfall was significantly lower the higher was *jati*-level loss indemnification. These relationships are strikingly apparent in the data. Figure 6 shows the lowess-smoothed relationships between log village daily rainfall and log per-acre output value in the *Kharif* season among cultivators (i) by whether or not the farmer had been offered the insurance product and, among farmers not offered rainfall insurance, (ii) by whether or not the farmer was in a *jati* with below or above the median of *jati*-specific loss indemnification.

Farm output rises steeply with rainfall for farmers offered weather insurance. Given the randomization, farmers in the control and treatment groups had no different informal levels of insurance. For farmers in the high-indemnification *jatis* without rainfall insurance, however, the rainfall-output relationship is almost flat, and perhaps downward sloping, consistent with such farmers selecting crops or technologies less sensitive to rainfall. Even among those farmers in the

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[6] We can only identify loss effects among those who had experienced a loss in the prior eight years. This sampling bias is likely to produce conservative estimates if more protected farmers (who are probably more risk-averse) had already adopted technologies or crop portfolios to reduce loss exposure in the pre-survey period, and are therefore under-represented in the estimation sample.

[7] Rainfall deviations do not depend on farmer actions, but only those who experienced a household-specific loss reported on risk-mitigating actions. Looking at the relationship between rainfall shocks and farm outcomes among all farmers avoids the sample selection problem. And caste fixed-effect estimates of these relationships from the REDS are consistent with the estimates of informal *ex post* risk protection on *ex ante* risk-mitigating actions: lower village rainfall in the crop year 2005-6 significantly reduced farm profits per acre in that year, but the adverse affect was significantly smaller for farmers in *jatis* with higher loss indemnification. This also indicates that higher levels of informal risk sharing are associated with lower risk taking in farm production.

low-indemnification *jatis*, per-acre output is lower than among farmers offered rainfall insurance at high levels of rainfall. Thus, while caste groups in India are evidently highly successful in mitigating risk, it appears to come at a substantial cost: significantly more risk-averse production, with lower average returns. Rainfall insurance, if some of the barriers to adoption can be overcome, however, allows farmers to increase risk-taking.

Finally, we study one of the mechanisms by which offering rainfall insurance contracts affects risk - the portfolios of rice seed varieties that farmers in Tamil Nadu (almost all of whom grow rice) choose to plant. We find that farmers that received insurance offers are significantly more likely to switch into rice varieties that are rated by the majority of farmers as being good for yield, and they switch away from varieties rated as drought tolerant compared with the control group (see Figure 7). Index insurance evidently allows farmers to shift to a riskier crop portfolio, even in the presence of pre-existing informal risk sharing.

5. Weather Insurance and Landless Agricultural Workers

The exclusive target of weather insurance programs is farmers[8], and we have seen that weather insurance induces farmers to take on more risk. Providing weather insurance to cultivators could therefore increase the wage risk borne by the large proportion of the (landless) population that is reliant on agricultural wage work.[9] Mobarak and Rosenzweig (2013b) studies the general-equilibrium effects of providing rainfall insurance to both cultivator and landless agricultural wage-worker households.

Jayachandran (2006) examined in the context of a general-equilibrium model how the provision of financial services to landless households that enabled them to smooth incomes affected their labor supply, and thereby the risk faced by cultivator households. If landless households cannot

[8] For example, our partner, the Agricultural Insurance Company of India (AICI), the largest public insurer for farmers, does not have a mandate to provide insurance products to agricultural wage laborers.
[9] 28.5% of households in our sample villages are landless and the primary occupation of the household head is agricultural wage work.

borrow, they can only smooth incomes over time by working more when rainfall is low and taking more leisure when rain is plentiful, thereby lowering equilibrium wage rates in bad times and raising them in good times. This increases the income volatility of wage workers but decreases the volatility of profits for farmers.

Our paper studies the effects of rainfall insurance on both the supply of and the demand for agricultural labor in a general-equilibrium context in which landless households supplying agricultural labor are unable to smooth. We first examined effects the supply of agricultural labor. We looked both at the intensive margin – days of agricultural wage work, and the extensive margin - the probability of migrating during the *Kharif* season. A standard model of labor leisure choice would suggest that, with borrowing constraints, at low levels of rainfall labor supply will be strongly positively related to rainfall – income is low and the substitution effect dominates. At high levels of rainfall, however, the income effect may dominate and labor supply will be less rain-elastic and pehaps even backward bending. In contrast, for landless households with weather insurance, labor supply will be relatively inelastic to rainfall at low levels of rainfall, when there are insurance payouts.

Figure 8 displays the lowess-smoothed relationship between *Kharif*-season rainfall per day and total days of labor supplied among the landless agricultural households by whether or not they were offered the insurance product. We see the inverted u-shape relationship for the uninsured households, with labor supply steeply-upward-sloped at low rain levels and then a negative relationship at high levels. For households offered insurance, however, labor supply is lower overall and much less sensitive to rainfall, especially at low rainfall levels as expected. Preliminary estimates indicate that for rainfall at the bottom 25th percentile of the rainfall distribution, households offered the insurance product work 12.7 (28.3%) fewer days than the uninsured.

Temporary migration is an increasingly pervasive option as a means of smoothing incomes *ex post*, with currently 20% of households in India engaging in temporary migration (Morten, 2012).

Because the focus of our RCT was in a major growing season, and most temporary migration occurs in the off-season, the number of migrants during the survey period was relatively low – among males 15 - 49 less than 4% left the village for work elsewhere. Nevertheless, we would expect that migration would be strongly responsive to realized rainfall among the landless and that weather insurance would decrease the effect of rainfall on migration. As shown in Bryan, Chowdhury and Mobarak (2012), migration is costly so that at low income levels many households who could benefit from migration do not leave the village when local labor demand is low. At very low levels of rainfall, therefore we might expect low levels of migration but migration to be positively related to rainfall (income effect) and then ultimately negatively (substitution effect). For landless households with weather insurance, again the effects of rainfall will be attenuated.

Figure 9 displays the lowess-smoothed relationship between the proportion of males aged 15 - 49 who migrated in the *Kharif* season and rainfall per day. For both the uninsured households and those offered insurance, the probability of migration increases with rainfall and then falls as rainfall increases, but among the households offered insurance the positive slope ends well before that for the uninsured and remains flat over most of the rainfall distribution. Point estimates indicate that at the 25th percentile of the rainfall distribution, the probability of a male migrating is 1.4 percentage points (35%) lower in households offered insurance compared with uninsured households.

In summary, insured landless households supply labor less intensively in times of low rainfall, but there are more laborers remaining in the village. The effect of providing insurance to the landless (but not cultivators) on the equilibrium wage is thus ambiguous. To assess the spillover effects of offering insurance to the landless on cultivator incomes and the effects of offering insurance to cultivators on the first and second moments of the incomes of the landless we estimated the determinants of the amounts of hired male harvest labor in the *Kharif* season by cultivating households. We have already seen that insurance induces cultivators to adopt more rain-sensitive crops and technologies. Does the use of hired harvest labor, which is most closely related to crop yields, also become more sensitive to rainfall and thus more volatile?

Figure 10 display the lowess-smoothed relationship between rain per day and per-acre days of male harvest labor hired in the *Kharif* season by whether or not farmers were offered the insurance product. The substantially shallower labor-rain slope among uninsured cultivators is readily apparent. For rainfall above very minimal levels, farmers offered insurance hire more male harvest labor at every level of rainfall, and these effects are statistically significant in our preliminary estimates.[10] Our preliminary estimates suggest that these differences are statistically significant. Moreover, we also find that, for given rainfall, more hired labor is employed by cultivators the higher the proportion of the landless offered insurance in the village, suggesting that of the two labor supply effects induced by offering weather insurance to the landless the reduced-migration effect dominates.

The relationships in Figure 10 imply that the increased risk-taking of insured farmers will increase wage levels but also labor demand volatility, and thus increase the wage risk of the landless. This suggests that, if landless households are aware of the impact of insurance on wage risk and levels, such households will be more receptive to purchasing weather insurance when farmers also take on insurance. To test this we estimated the determinants of the take-up of the weather insurance product among the landless agricultural worker households offered the product, including in the specification the proportion of cultivating households in the village also offered the insurance product. The preliminary estimates indicated that at the sample proportion of cultivating households (0.45), landless households are 12 percentage points (31.5%) more likely to purchase the insurance product if (all) cultivator households are offered weather insurance compared with having no cultivators included in the weather insurance program.

[10] In contrast, we find little effect of weather insurance on the demand for female labor (who do not migrate – see Morten 2012), or male planting labor (hired before the *Kharif* season migration decision).

6. Concluding Remarks

By combining an RCT with pre-existing census and survey data we have been able to examine the complex inter-relationships among informal insurance arrangements, basis risk, the demand for formal weather insurance, *ex ante* risk-taking and *ex post* risk-mitigation among both cultivator and landless labor households in a setting in which community risk-sharing is pervasive. In future work we will exploit the caste-based stratification of our experimental design to explore potential spillover effects of formal insurance availability within and across caste boundaries and, using additional rounds of data, to explore the dynamic and persistent effects of insurance provision.

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Figure 1:Lowess-Smoothed Relationship between Inter-Village Distance (Km) and June-August Rainfall Correlation, Andhra Pradesh and Uttar Pradesh 1999-2006

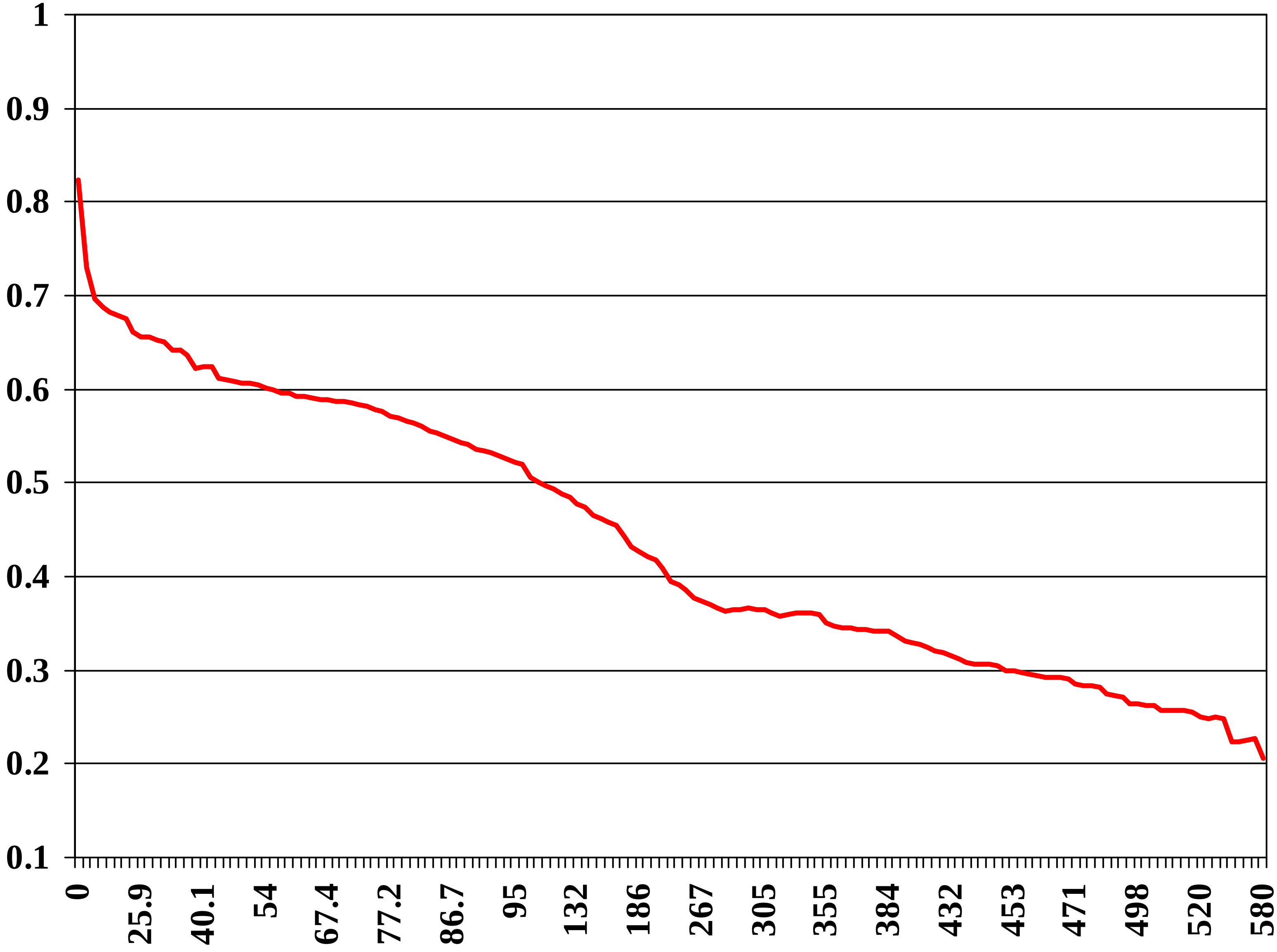

Figure 2

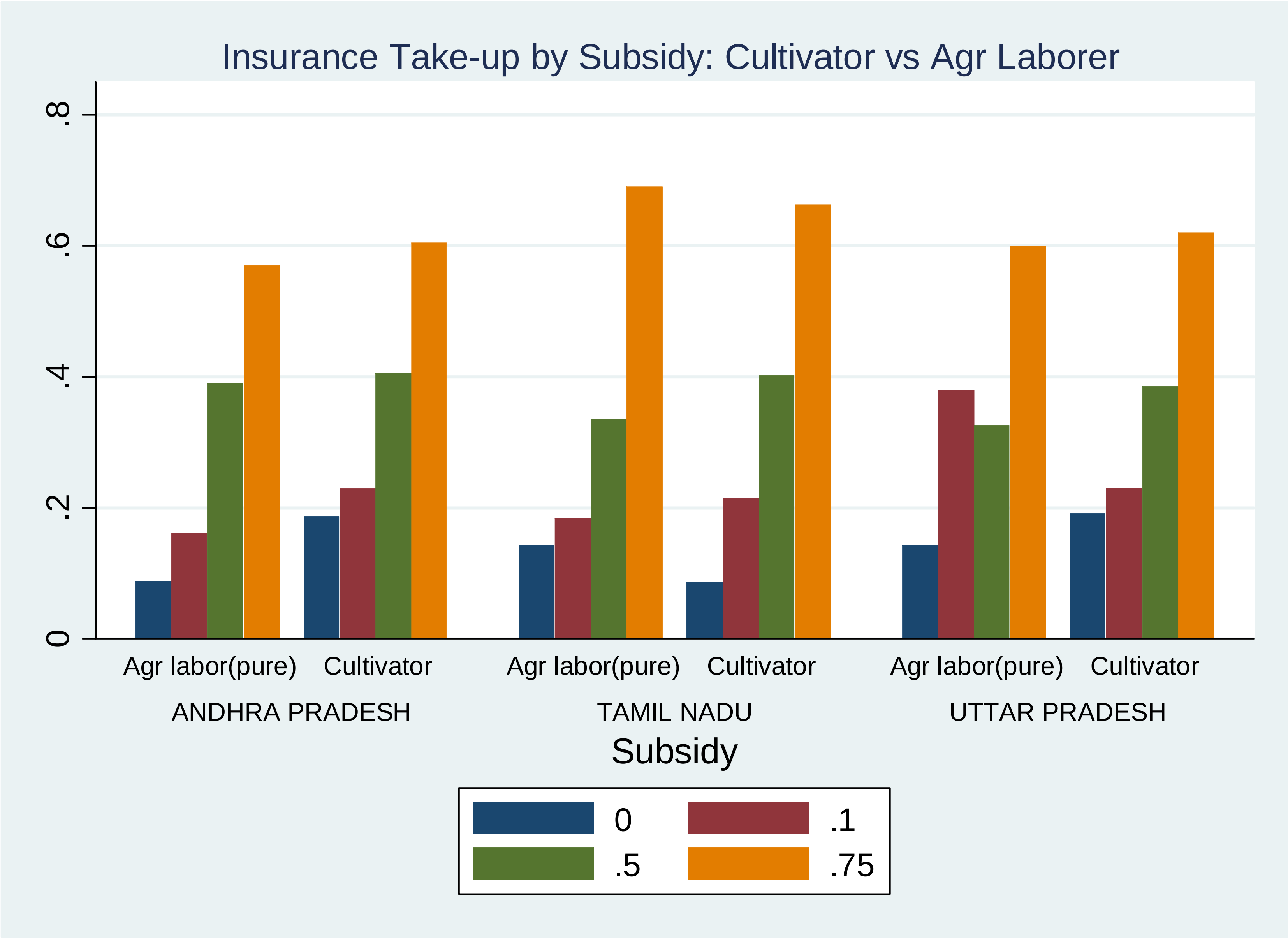
Insurance Take-up by Subsidy: Cultivator vs Agr Laborer
0
.2
.4
.6
.8
Agr labor(pure)
Cultivator
Agr labor(pure)
Cultivator
Agr labor(pure)
Cultivator
ANDHRA PRADESH
TAMIL NADU
UTTAR PRADESH
Subsidy
0
.1
.5
.75

Figure 3
Rain per Day in 2011 *Kharif* Crop Season in Andhra Pradesh, by Rainfall Station
Insurance Payout Stations in Red (with Rupee Amount)

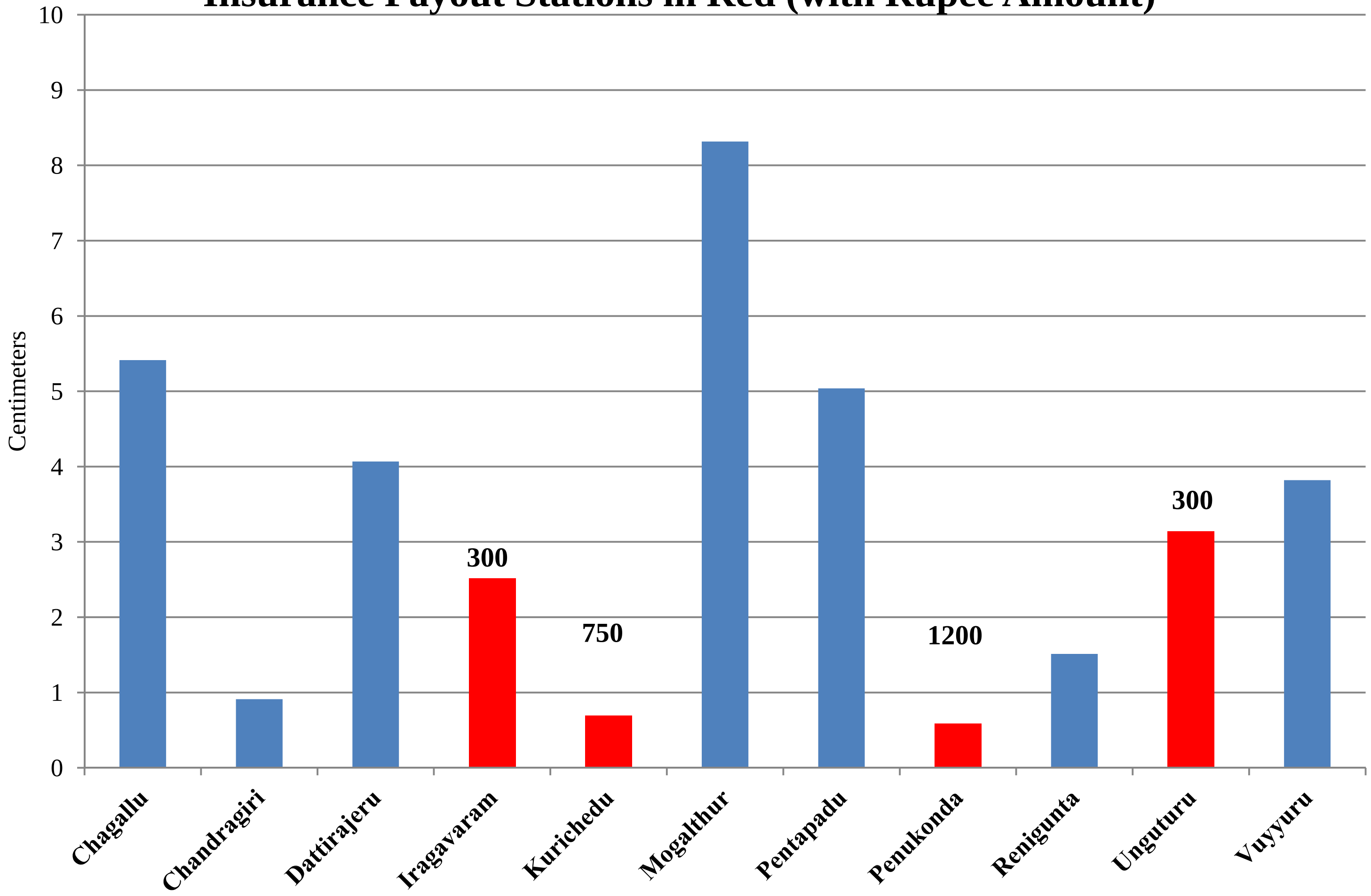

Figure 4: Lowess-Smoothed Relationship Between Log Output Value per Acre and Log Rain per Day in the *Kharif* Season, by Placement of Rain Station (UP Villages)

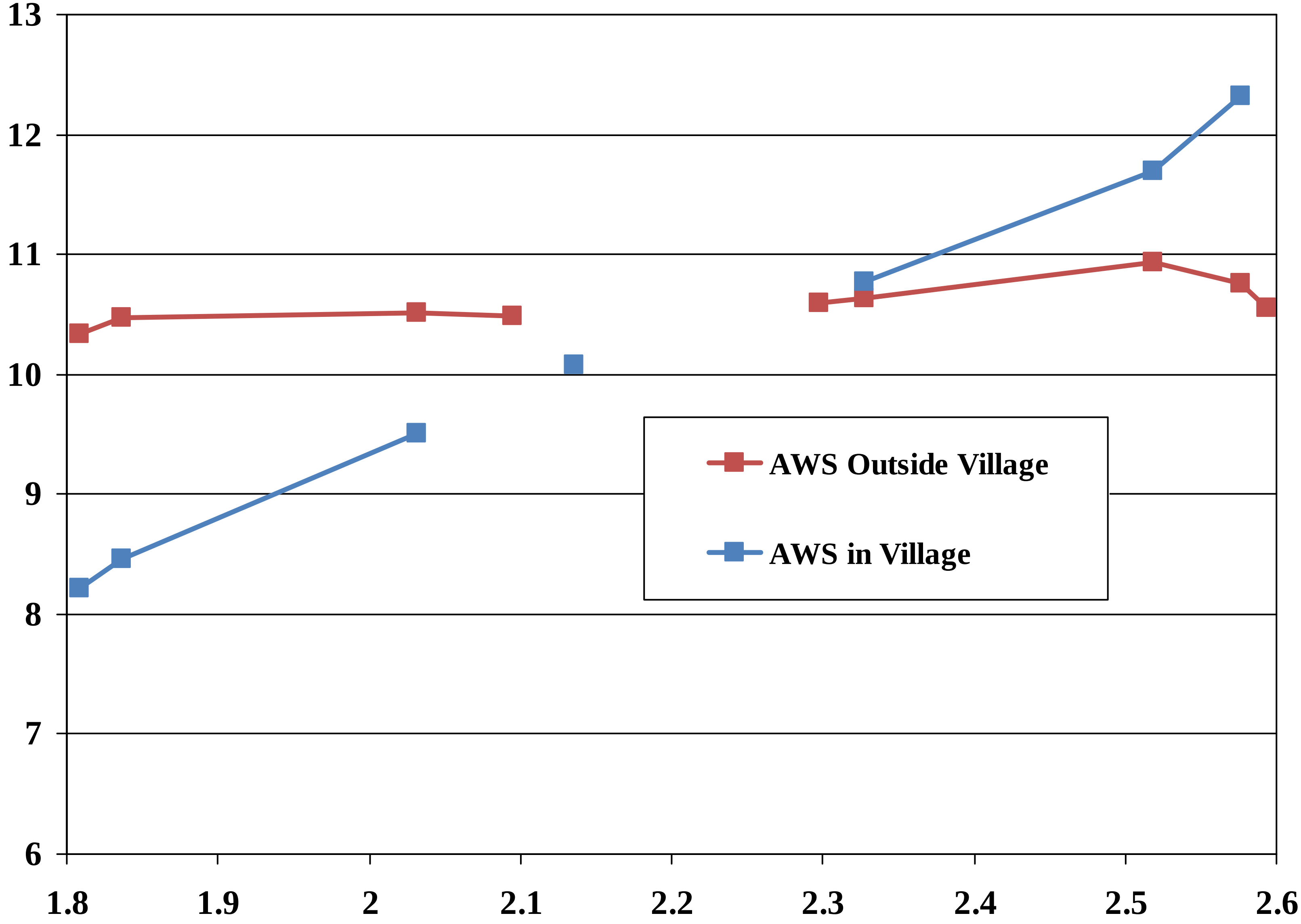

Figure 5: Relationship Between Distance to the Nearest AWS and the Probability of Index Insurance Take-up, by Level of Informal Risk-Sharing

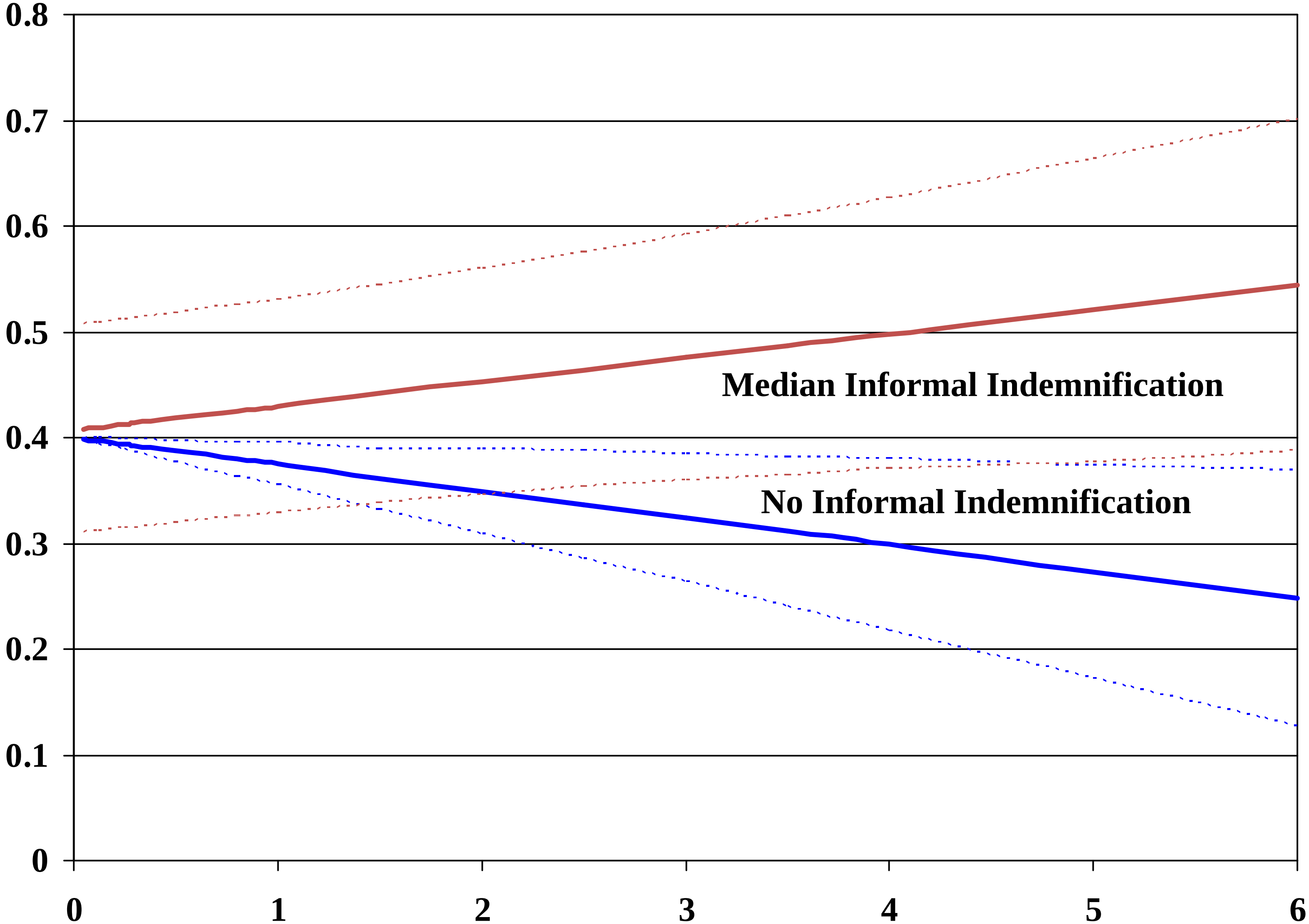

Figure 6: Lowess-Smoothed Relationship Between Log Per-Acre Output Value and Log Rain per Day in the *Kharif* Season, by Insurance Type and Level

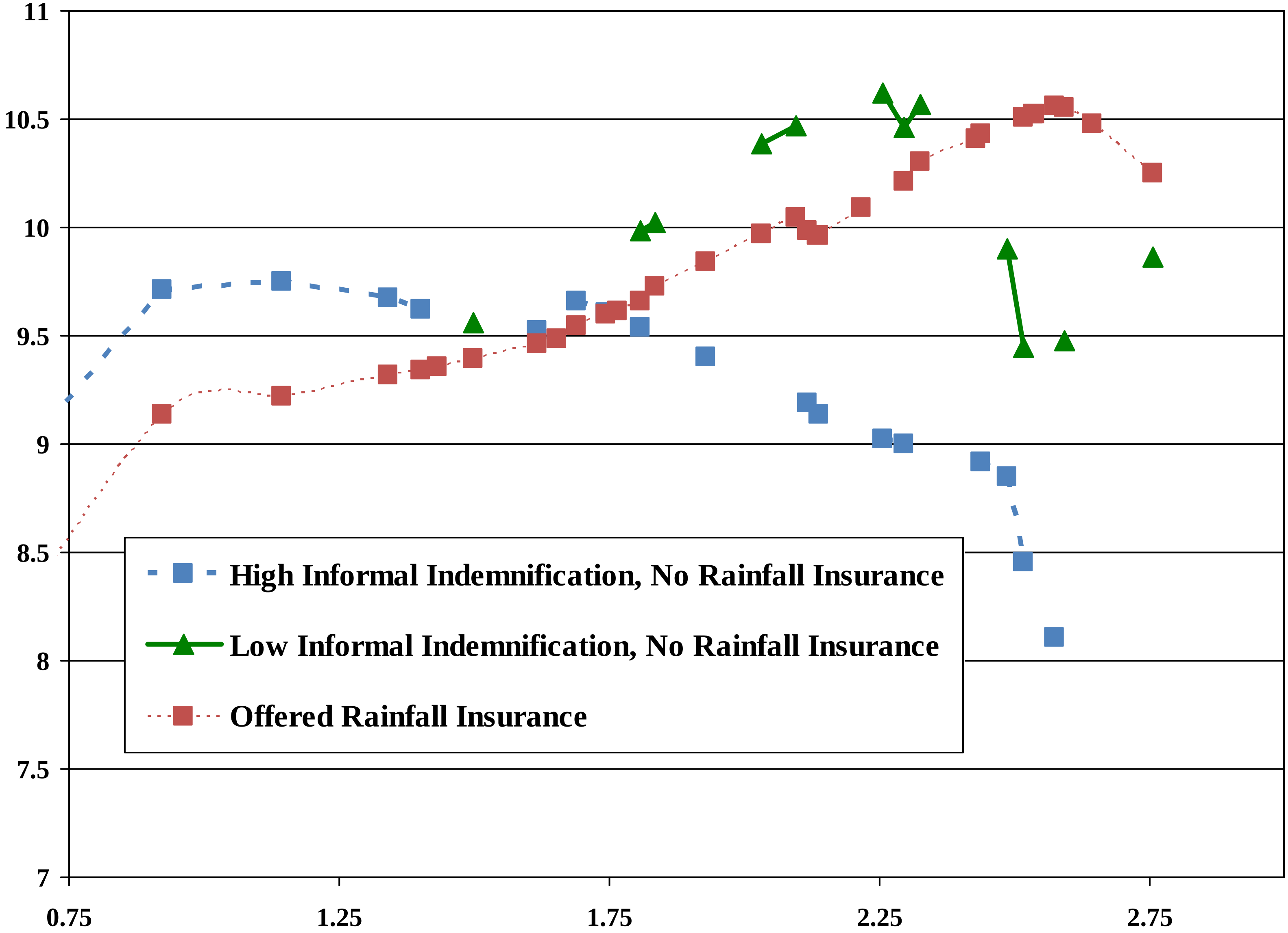

Figure 7: Effects of Insurance Offers on Rice Varieties Planted: Farmers in Tamil Nadu

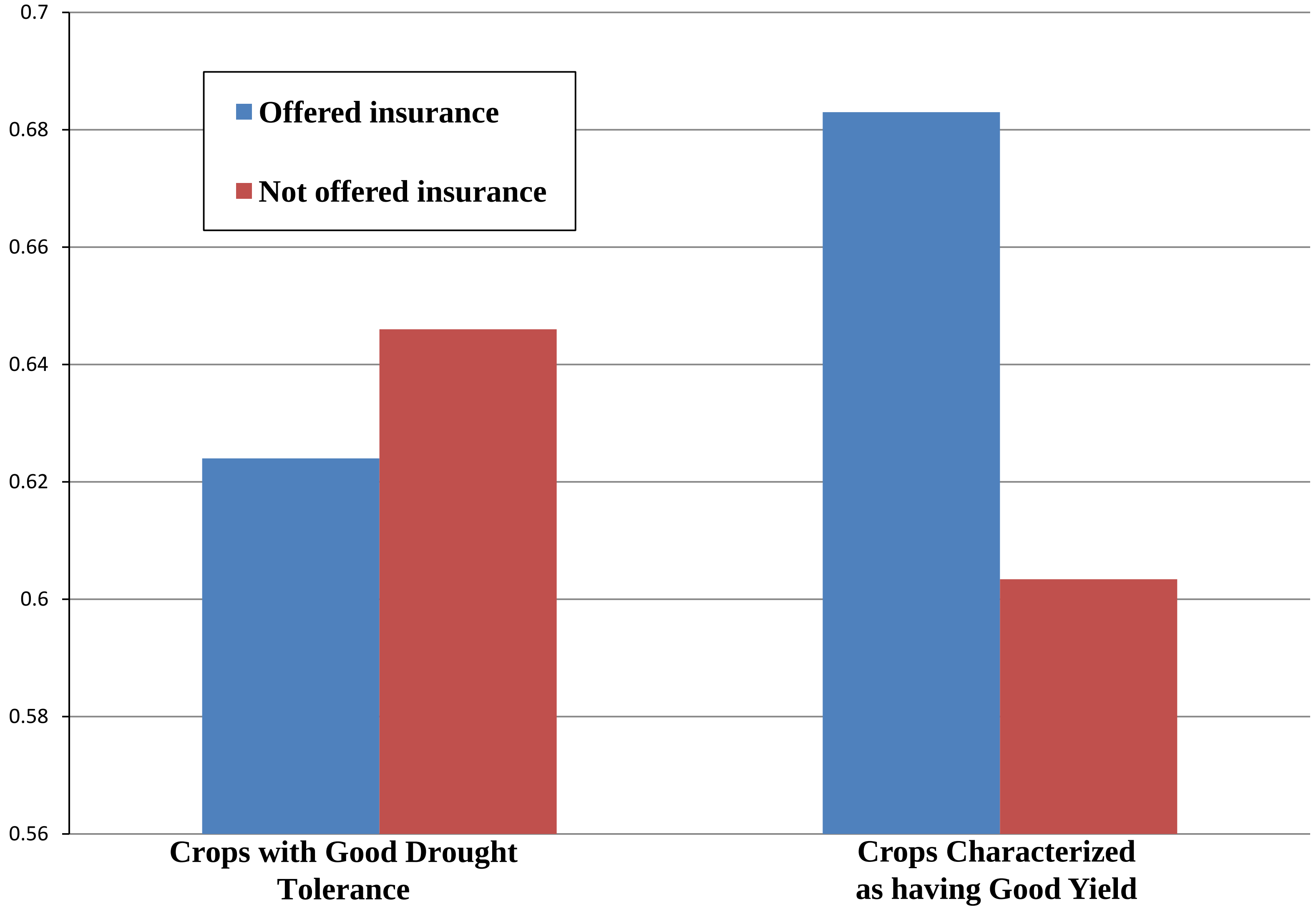

Figure 8: Lowess-Smoothed Relationship Between Days Worked for Agricultural Wages and Rain per Day in the *Kharif* Season Among the Landless, by Insurance Offer

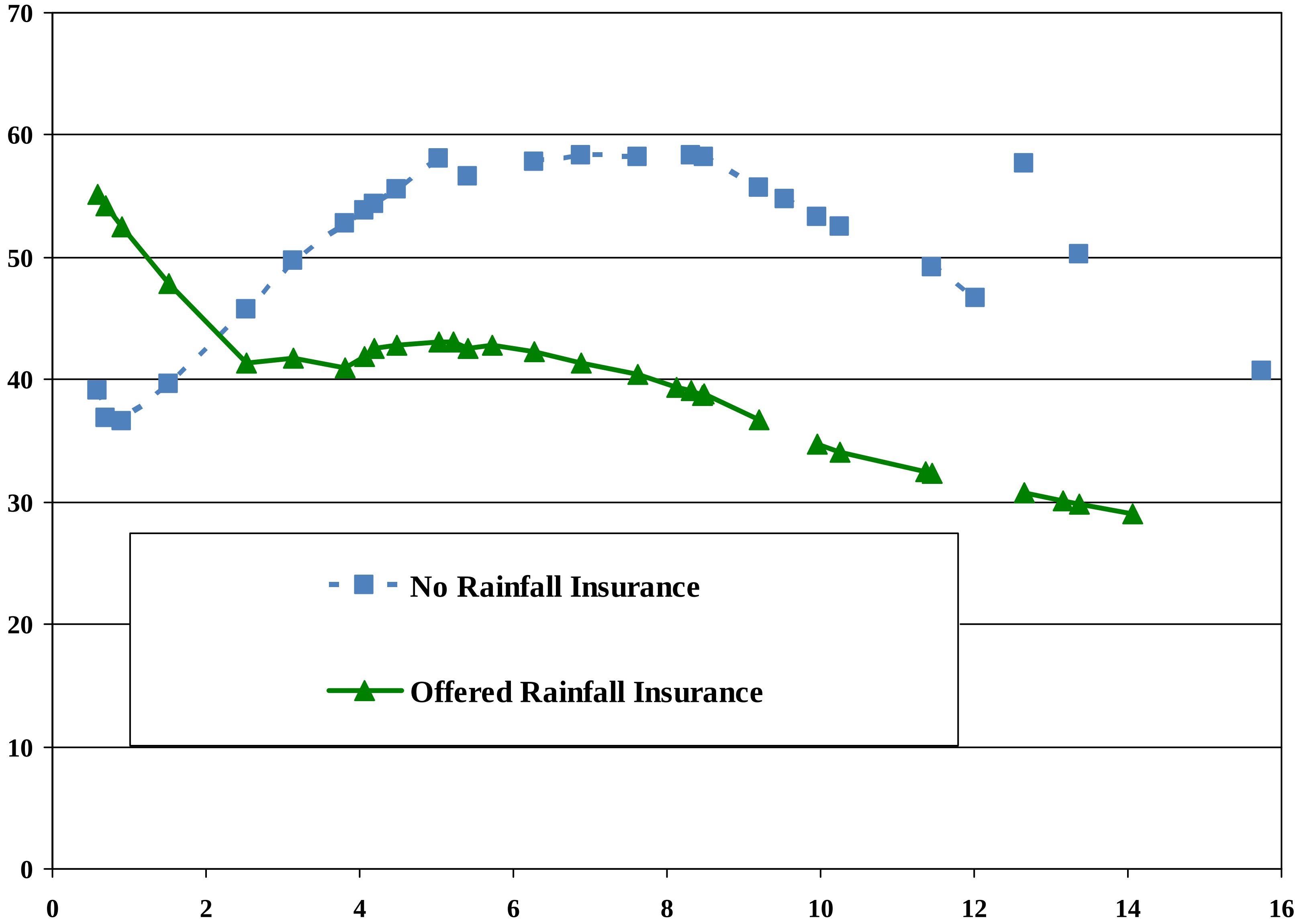

Figure 9: Lowess-Smoothed Relationship Between the Probability of Temporary Out-Migration and Rain per Day in the *Kharif* Season, by Insurance Offer (Males Aged 15-49)

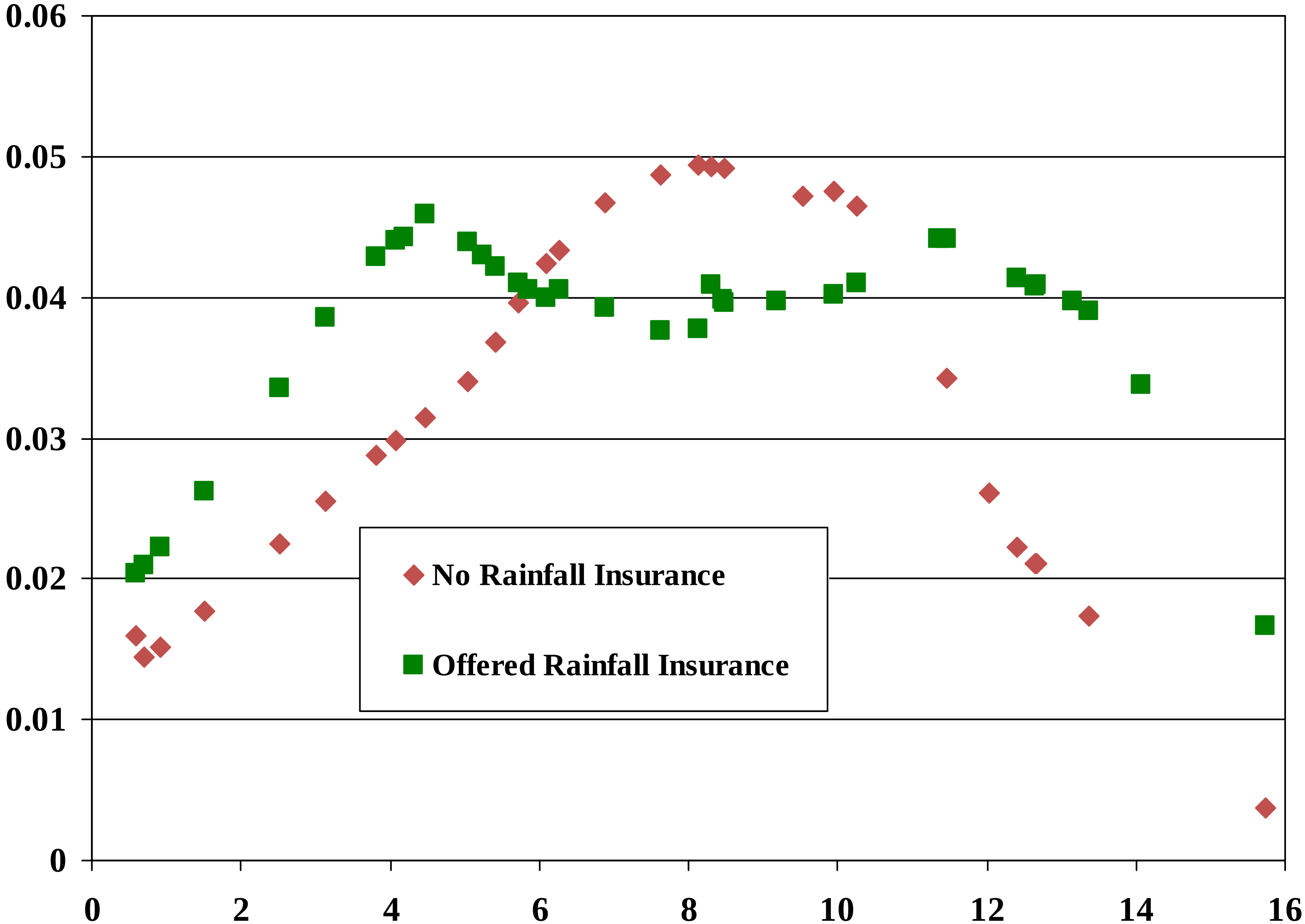

Figure 10: Lowess-Smoothed Relationship Between Hired Male Harvest Labor Use and Rain per Day in the *Kharif* Season among Farmers, by Insurance Offer