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Abstract

This paper examines the idea that contract farming arrangements in developing countries even while offering farmers insurance against certain kinds of risks could simultaneously exacerbate other risks or entail new risks of their own. If correct, farmer perceptions of risks and returns would vary systematically across farmers with different contracting status and also across schemes. Using survey data that elicits subjective distributions of returns and psychometric mapping of risk perceptions from farmers, the study finds that contract farming, not unlike its alternatives, is associated with multiple dimensions of uncertainty and sources of risk, in ways that likely influence participation.

Keywords: contract farming, subjective distributions, risk perceptions, stochastic dominance, elicitation methods

JEL Code: Q12, Q13, D84.

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Safe Gambles? Farmer perceptions of transactional certainty and risk-return tradeoffs in contract farming schemes in southern India

This paper examines the idea that contract farming arrangements in developing countries even while offering farmers insurance against certain kinds of risks could simultaneously exacerbate other risks or entail new risks of their own. If correct, farmer perceptions of risks and returns would vary systematically across farmers with different contracting status and also across schemes. Using survey data that elicits subjective distributions of returns and psychometric mapping of risk perceptions from farmers, the study finds that contract farming, not unlike its alternatives, is associated with multiple dimensions of uncertainty and sources of risk, in ways that likely influence participation.

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Introduction

Contract farming, an institutional arrangement between farmer and firm to produce and transact agricultural commodities on predetermined terms, is often regarded as possessing multiple advantages for farmers in resource-poor developing countries. Specifically, when such an arrangement involves production support from the firm through the supply of inputs, credit, technical advice, etc., it can potentially solve at once many missing market problems for participating farmers. In addition, when buyback commitments are at pre-agreed prices, this implicitly protects farmers from price risk. Contracting can thus bring about greater transactional certainty and reduced transactions costs in many agrarian settings. Even as these are valid, anecdotal evidence suggests that contracting in developing countries is sometimes also associated with high risks and uncertainties for farmers involved in such arrangements. In particular, it could potentially leave a contracting farmer exposed to certain catastrophic risks, even while simultaneously insuring farmers against certain other kinds of risk. A firm could, for instance, offer a fixed price for the produce but renege on the commitment

to buyback produce. This acquires special importance when public enforcement of firms' contractual commitments is weak so that farmers are rendered vulnerable within the contractual relationship.

The motivation for this paper stems from this latter counterpremise, that a contract farming arrangement in a developing country context, rather than being an insurance mechanism for the farmer that increases transactional certainty, is instead akin to a new technology that comes with its own attendant risks.[1] This study suggests then that if contract farming arrangements mitigate many risks but bring others in their wake, farmers must make more complex assessments and subjective evaluations of multidimensional attributes involving multiple sources of risk and uncertainty.

From a policy perspective, this view implies that the degree to which contract farming can take root depends significantly on farmer perceptions of contract farming arrangements relative to the alternatives available. Viewed simplistically, revealed preference theory suggests that farmers only ever agree to participate in a contracting scheme if they expect, on an average, to benefit from the arrangement. A chief theoretical result that underwrites this viewpoint presumes that risk-neutral firms, possessing a greater capacity for risk-bearing, are able to insure risk averse farmers through contracts, thus generating gains from transacting. Explanations for difficulties in scaling up contracting arrangements or uptake are then assessed within this frame of reference.

The high mortality rate of contract farming schemes and farmer exit from schemes in developing countries suggests a more complex phenomenon. In particular, it indicates that these contractual arrangements perhaps themselves carry elements that trigger disadoption or prevent uptake, despite perceived higher average returns, which could influence the trajectory of institutional evolution in important ways.[2] If this is true, it would reflect in farmer perceptions and would differ by a farmer's contracting status.

A central goal of this paper is to examine if the claims implied by this viewpoint hold: Can contracting in a developing country setting itself be a gamble pretty much like the alternative spot market? If this is correct, to what extent is it a safe gamble relative to the alternatives available to a farmer? How does the heterogeneity of farmer perceptions of relative risks between contracting and its alternatives associate with contracting status (or their revealed preference)? Relatedly, can high mean returns associated with contract farming coexist with a high risk associated with such returns,

[1] For a more general view of markets themselves as technologies, see Barrett (2008).

[2] Empirical literature on technology adoption often assumes that a given new technology is beneficial (Foster and Rosenzweig 1996). Disadoption is less frequently studied. Theoretical work aligned to the property rights approach offers greater scope for incorporating technologies with ambivalent impacts, but there have been few empirical applications in the area of contract farming. Barrett et al. (2012) cite instances of such farmer exit from modern supply chains, other instances of churning are reviewed in Reardon et al. (2009) and Reardon and Timmer (2005).

either in terms of price variance and skewness or other risks difficult to monetize? This paper uses unique data from a survey of 822 farmers across five contract farming schemes in the southern Indian state of Tamil Nadu to examine these questions, covering gherkins, papaya, marigold, cotton and broiler. In the context of contract farming in developing countries, this is one of the first efforts to measure directly individual farmer perceptions of net returns and risks associated with contract farming relative to its next best alternative across multiple dimensions to demonstrate that contract farming might be associated with ambivalent normative implications.

Following this introduction, I explore the rationale for investigating farmer expectations and perceptions of risk. I then elaborate on the multidimensional aspects of risk with contracting in general and discuss the structure of risks for the five schemes that form the basis of this study. Thereafter, I describe the methods used in the field survey for eliciting farmer perceptions before analyzing farmers' perceptions of returns and other risks associated with contracting and the next best alternative, illustrating that contracting is no more an insurance mechanism than the alternative arrangements it seeks to replace.

The Structure of Risks and Metrics

Traditionally, risk in agrarian contexts has been articulated in terms of risk preferences and objective risk, with differences in decisions across farmers being attributed to difference in risk aversion or attitudes toward risk (Binswanger 1980; Dillon and Scandizzo 1978; Moscardi 1977). More recently, there is increasing recognition that perceptions of risk matter a great deal, so that economic decisions involving uncertainty are shaped not just by risk preferences but by interpersonal and intertemporal variation in subjective assessments of conditional distributions of relevant outcomes (De Weerdt 2005; Delavande, Gine, and McKenzie 2009; Gine, Townsend, and Vickery 2008; Slovic 1987; Weber and Milliman 1997).

An old but relatively brief tradition of this in agricultural economics finds that farmers' cropping decisions and land allocation patterns are consistent with their yield and returns expectation (Grisley and Kellogg 1983; Goodwin, Sanders, and de Hollanda 1980; Herath, Hardaker, and Anderson 1982; Smith and Mandac 1995; Botha and Meiring 1999).Norris and Kramer (1990) provide a comprehensive review of this tradition. There is now resurgent interest in collecting subjective probabilities and elicitation of expectations in surveys, partly prompted by recent advances in behavioral economics.

Manski (2004) demonstrates that preferences and expectations are often consistent with observed data for a whole range of applications. Nyarko and Schotter (2002) report, using experimental techniques, that the beliefs they elicit from participants do a better job of explaining choices that those that come from three common belief formation models.

To the extent that perceived risk and not actual risk determines economic behavior, risk perceptions obtained through surveys have important informational content for data analysis, notwithstanding methodological caveats (Delavande, Gine, and McKenzie 2009; De Weerdt 2005; Anderson, Dillon, and Hardaker 1977; Dominitz and Manski 1996b,a). As Smith, Barrett, and Box (2001) explain, subjective risk perceptions are valuable since they incorporate multiple factors, including the individual's understanding of the objective risks, the individual's expectations about his or her own exposure to risks, and his or her ability to mitigate (ex ante) or cope (ex post) with the adverse events if they occur and indeed also incorporative of experience and influence, say, of social networks, for example. Recent studies have used measures of risk perceptions both as explanatory factors to analyze economic decisions and as dependent variables to investigate the formation of these perceptions. A number of them use subjective expectations in the context of agriculture and livestock (Bellemare 2009; De Mel, McKenzie, and Woodruff 2008; Delavande 2005; Delavande, Gine, and McKenzie 2009; Doss, McPeak, and Barrett 2008; Gine and Klonner 2005; Gine, Townsend, and Vickery 2008; Lybbert and Barrett 2007; Smith, Barrett, and Box 2001, 2000).

Assessing Risk and Uncertainty

This study draws on the tradition of eliciting subjective probabilities, claiming that expectations regarding uncertain events can contribute to explaining economic decisions, although this study does not seek to explain farmer participation in contract farming schemes per se. The formation of these perceptions or explaining how farmers come to make these subjective assessments is not within the scope of this study and is hence not addressed.

Since Knight (1921), it is common to treat risk as random events to which mathematical probabilities of occurrences can be assigned and uncertainty as pertaining to random events to which mathematical probabilities cannot be assigned, with the latter, known as Knightian uncertainty. I assume that agents who make decisions are able to assign subjective probabilities to all random events when making decisions or declare their inability to do so based on their lack of knowledge that might form the basis of these assessments. The study's focus is on a collection of attributes

that represents aspects of uncertainty associated with contracting and not contracting. Since these attributes are associated with uncertainties, they contribute to value assessments that farmers make for these choices depending on whether they have a negative impact or a positive impact on their well-being. Like Smith, Barrett, and Box (2001), this study then sees risk as denoting a conjunction of uncertainty and adversity. In other words, these attributes, representing different source of uncertainty, can be either risk exacerbating or risk mitigating.

I now lay out the architecture of these attributes of uncertainty and their potential influence on risk exposure as perceived by the farmers and describe the method used in the field survey to measure farmer perceptions of these.

What contract farming insures and what it does not

In general, elements of contract farming practice can contribute either to reducing risks associated with production and marketing or to increasing them relative to the farmer's alternative to contracting. It is not unusual for both phenomena to coexist, so that a contract farming arrangement might reduce risks with respect to some aspects while simultaneously introducing or exacerbating those on other fronts. Empirical work on contract farming demonstrate this amply.

A number of studies show that participation in these schemes holds a number of advantages for the farmer, such as availability of inputs in a timely manner of reliable quality and technical advice that contributes to increased and more stable yields (da Silva 2005; Eaton and Shepherd 2001; Minot 2008). Farmgate collection of produce and delivery of essential inputs reduce transactions costs and time significantly, which can otherwise be substantial in developing countries. Having an assured buyer who will pick the produce at a pre-agreed price simplifies selling decisions, obviating the need to negotiate a transaction. Contract farming schemes are known to have protected farmers, with a large part of the price risk being transferred to the firm that might possess a greater capacity to bear such risks (Knoeber and Thurman 1995; Bellemare 2012; Ramaswami, Birthal, and Joshi 2005; Michelson 2010, for example). Each of these aspects is typically rendered variable if the farmer chooses to produce for the open market, although in traditional settings, the farmer might be able to rely on a network of known traders and input dealers.

Emerging empirical evidence suggests, on the other hand, that while contracting with a firm for inputs/outputs mitigates some risks for the farmer, it entails its own set of risks (da Silva 2005). From the point of view of the farmer, moral hazard arises primarily from the fact that the firm

could reject their delivery on grounds of poor quality, timing, etc., attributes that are typically left unspecified in the contract or arbitrarily enforced. This is particularly the case when the firm, which needs a minimum procurement volume (say, to run a processing plant to its desired capacity) might also contract more quantity than they need, as a buffer against production risk or farmer default. This rejection at the factory or farm gate has been cited as one of the most contentious aspects of the farm-firm relationship (Echanove and Steffen 2005; Glover 1987; Mannon 2005). There have been documented instances of firms setting quality standards arbitrarily, becoming inexplicably stringent if spot market prices collapsed, indicating ample supply available from alternate suppliers. Sometimes, farmers have also had to bear the brunt of poor technical assistance, even plain cheating and deliberate default (Glover 1987; Ramaswami, Birthal, and Joshi 2005). Additionally, the farmer might also evaluate the risk that the firm might not return the next season to contract. This is important, for instance, when the farmer would not want to sever the long-term relationship (s)he has with the village broker or trader. There could be other perhaps longer term risks as well, such as ecological damage or adverse health impacts on account of particular production processes and so forth (da Silva 2005; Pomareda 2006). There is also the oft-neglected issue of catastrophic risk, when exogenous events trigger an implosion of existing schemes. These could emanate from discrete changes in downstream markets that force contracting firms to alter procurement practices or production processes dramatically and often suddenly.[3] Despite its enormous implications, this aspect has been largely left out of rigorous empirical work on contract farming.

Which risks are mitigated for the farmer and which ones are exacerbated depends crucially on the precise nature of the contract farming arrangement and is hence essentially an empirical question.[4]

The data for this study come from a survey of 822 farmers covering five commodity sectors - cotton, gherkins, marigold, papaya, and broiler chickens - conducted in two phases between 2008 and 2010. The study area includes nine administrative districts in the southern Indian state of Tamil Nadu and is heterogeneous in its agro-ecological conditions, physical features, and levels of socioeconomic development. The list of contracting farmers for the year of the survey was obtained

[3] For example, Fold and Gough (2008) discuss how varietal preferences of consumers in Europe impacted pineapple contract arrangements in Ghana. Ashraf, Gine, and Karlan (2009) documents a breakdown of a contracting scheme in Kenya.

[4] The theoretical literature on contracting offers ways of understanding how existing risks are distributed in different ways across contracting parties, along the lines of Eswaran and Kotwal (1985), for example. There is less theoretical work admitting the possibility of new risks that might be borne exclusively by one party.

from one contracting firm (or 'subject' firm) in each of the commodities studied. [5] Based on this list, all the hamlets in the sample area were divided into contracting and non-contracting hamlets and their corresponding villages into contracting villages or non-contracting villages. A similar exercise was carried out for the larger administrative units called blocks and then districts. Starting from the largest administrative unit for the study area, contracting districts were sampled, within which contract and non-contract blocks were randomly sampled and then further on, within sampled blocks, contract and non-contract villages were sampled and so too with hamlets. In the hamlets sampled, a census of all households identified four key types of farmers: those currently contracting; those who were growing the contract crop but for the open market or contracting for other firms; those who had given up contracting with the subject firm; and those who had never contracted. The sample respondents were randomly selected from each type. If a farmer grew the contract crop for some other firm and quit, they were not sampled.

The schemes operate in rainfed agricultural areas and have diverse arrangements with farmers. Gherkins are a non-traditional export crop with no domestic market. The crop is procured from farmers and processed at small-scale plants by washing, rinsing and preserving in brine, acetic acid or vinegar. These are either bottled and labeled for international clients or shipped out in barrels for bottling. Cotton is a traditional cash crop in parts of the study area, with established local markets and networks. Recent years have seen mills coordinating and integrating along the garment chain, extending backward to contract with farmers for good quality, long staple cotton for milling. Papaya was introduced in the region in the 1990s for extracting papain, which has wideranging industrial uses. The variety is appropriate, but not ideal, for table consumption, and the fruit is a by-product that is used to make candied fruit or for pureeing. Marigold contracting was initiated by firms for oleoresin extraction for export, mainly as coloring agent for poultry feed. Marigold has a thriving local market, however, for fresh cut flowers that are used for a number of occasions, religious and otherwise. The broiler industry in the study region is almost completely vertically coordinated, a process that began in the mid-1990s. Day-old chicks are provided by the firm and bought back by the contracting firm. The firm acts as an aggregrator-intermediary, but also has its own brand of chicken in various processed forms.

[5] All firms were approached, who were contracting for the particular commodity in the study area. The firms selected as the subject or sample firms were those that were contracting that year and were willing to share the complete list of contract farmers. The study firms were the first to share these lists.

All contract commodities are cash crops and involve production processes that require farmers to respond continuously to the need to maintain quality. Firms engaged in contract farming thus engage actively in the production process, not only providing critical inputs but also maintaining close supervision from sowing through to harvest and post-harvest handling. The commodities and firms selected for study represent varying degrees of involvement by the firm in the production process or intensity of contractual relationship. The cotton firm brings in a third-party input manufacturer to monitor and advise farmers, arranging for credit from a nationalized bank and providing materials to store the harvested cotton. The mill's role is confined to coordination and oversight of operations. The gherkins firm provides farm inputs (seeds, fertilizers and pesticides) on credit; this is later recovered from the farmers at the time of harvest, when farmers are paid for the produce, net of input costs. Field officers on the company's rolls monitor crop health and advise farmers periodically. Broiler represents even higher relationship intensity with the firm's officials visiting contract growers every day to monitor health and status of the birds. These firms provide day old chicks to the farm and have detailed protocols for feed mix and vaccination schedules. For papaya, the involvement of the firm varies over the life cycle of the crop. In the nursery stage, field officials monitor the crop closely with daily visits and once the plant matures into the flowering stage, there is limited oversight, unless the situation demands it. In papaya, an interesting feature is that labor for latex extraction is organized and trained by the firm, with the wages being borne by the farmer. Latex extraction requires great skill and the firm believes it can ensure quality and supply of latex for the plant by maintaining a pool of trained workers, who extract latex on contract farms. Marigold represents the least participation of the firm in the production process, related partly to fewer quality requirements that need only modest supervision. In fact, the marigold firm suggests that monitoring is required more for contract enforcement rather than for production under contract. The marigold firm thus restricts itself to providing high quality seeds at subsidized prices and training new contract farmers in the cultivation practice for marigold. Its field officials advise farmers periodically on pest and disease control. Across the schemes there is heterogeneity in the way risks are distributed between firm and farmers, although they do share many features, such as provision of some critical inputs, technical advice and an agreement to buy back at the end of the season.

There is a priori reason to believe that the revenue for the farmer from contracting is, by design, a stochastic variable. This arises both from yield variability and on account of price structures.

A shared feature across the commodities in the study is the firms' practice of contracting for acreage rather than quantities, implying that the firm takes on yield risk.[6] Interviews with agribusinesses suggest that contracting acreage is more acceptable to the farmer partly because the crop is unfamiliar to farmers (like gherkins) but mostly on account of a widespread perception is that exposing farmers to yield risk, in the absence of easy access to crop insurance, would undermine the relationship the firm has with farmers. Once contract acreage is agreed upon, contracting firms then provide farmers with as many seeds as is technically recommended for optimal yields on the contracted area. The understanding then is that farmers sell the entire crop from the contracted area to the firm. While this implies that the firm faces uncertain contractual delivery volumes from a given contractee, equally, it implies that for farmers, revenues from contracting a particular acreage could vary with yields. The yield is both naturally variable and related to the effort and ability of the individual farmer. So this introduces some stochasticity in the revenue stream from contracting. Further, contracted produce is accepted by the firms only if it meets certain established though not necessarily measurable standards. For a farmer accustomed to a less discerning buyer in the traditional channel, this could compound the uncertainty associated with delivered volumes.

As far as the price is concerned, the belief that contract farming, by fixing a price, reduces price risk is valid only in a limited sense. The contract price is sometimes a mark up on a reference wholesale market price and hence fluctuates along with the market price. It is also not unusual for price to be tied to some measure of quality or benchmark. This implies that price is rendered dependent on farmer effort or on factors beyond his or her control.

While returns to contracting are potentially stochastic, there are other risks farmers might associate with contracting. Some are pre-existing risks (or risks shared across modes of operation, contracting and not contracting) that continue to be borne by the farmer. Others are new risks that come with contracting. Some risks are somewhat long-term, for example, the effects of contract inputs on human health and soil quality, whereas others are immediate. Further, risks could be one-off, like losing title to land, or they could be recurring risks, risks that occur each season the farmer contracts. For instance, in each contracting season there is a perceived possibility that the firm does not turn up to collect the harvest. This is potentially a critical risk when there exists no alternative domestic market for the contract commodity. If the firm does evacuate contracted

[6] For broiler, the size of the shed sets the scale of contracting and firms allot birds so that there is one bird for one or 1.2 square feet of shed space.

produce, there is always a chance that the product is downgraded on the basis of quality checks that are not always transparent, price might be discounted, and so on.

In the balance, only a subset of these risks is reflected in the farmers' subjective distributions of returns. Other risks that are more difficult to translate into monetary terms also figure prominently in the farmers' 'mental model' of contract farming and could potentially exert a powerful influence on decision to contract. Quite apart from this, for farmers, contract farming is part of a larger set of decisions that are made as part of the farmer's livelihood strategy, for instance, how much exposure to have to markets and how much to provide for one's food needs.[7] There are also other dimensions that are not easily monetized, like the notion of self-respect and independence that drives farmer decisions (Key 2005).

To be able to address the particular concerns of this work I use a combination of two approaches to record farmers' subjective assessments of these risks. The first involves elicitation of entire subjective distributions of net returns associated with contracting and not contracting and the second comprises a psychometric mapping and measurement of other uncertainties or risks to which farmers might find it difficult to assign monetary values and hence might not incorporate in thier assessment of returns distributions.

Eliciting Subjective Distributions

The first approach entails eliciting the subjective distributions of the farmer with respect to yield, price and net profit, wherever possible, under contracting and for an appropriate alternative. The appropriate alternative refers to the farmer's articulation of what (s)he considered as the next best alternative course of action, were the contracting option not available to them. This is characterized as either growing the contract crop for another firm or the open market or switching to a competing crop. For example, a contract farmer for gherkins might have a next best option that involves contracting with a competing firm or not growing gherkins at all to grow tomato instead. In the former situation, the farmer is asked to name the competing firm that seems the next best alternative ask about the specific expectations with that firm. In the lattter situation, subjective distributions are measured for tomato. [8] For those farmers not currently contracting with the sample or subject

[7] Echanove Huacuja (2003); Echanove and Steffen (2005), for instance, provide instances where farmers in Mexico try to minimize their risks by planting vegetables for two different companies and, on occasion, cultivating produce for the national fresh market.

[8] In the survey, almost all farmers named a single crop as the alternative to the contract crop. Where there were multiple competing crops, they were able to pick one that they considered the closest substitute for the contract crop.

firm (whether they grow for the open market or contract with some other firm), the alternative was predetermined as contracting with the sample or subject firm.[9]

Farmers were therefore asked about the benefits associated with their actual choice and the benefits from the alternative the farmer did not choose. The aim is to compare the benefits from the farmer's choice (of contracting or not contracting) relative to the other option, had it been available. This was asked of four classes of farmers, those currently contracting with the subject firm, former contract farmers with the subject firm, those currently contracting for other firms or cultivating for open market, and those who have never contracted with any firm and are currently not producing the contract commodity.

For each farmer there are six subjective distributions : yield, price and net returns, each for the contract crop under contracting and the alternative option as chosen by the farmer. The returns here refer to net profit per acre per season (net profit per cycle for broiler) of the contract or alternate crop and refer to the income earned minus all paid out costs. Unpaid inputs are not factored in and fixed costs were not apportioned. Farmers were simply asked for the net income they were left with per unit area of production at the end of the season, after paying out all production and transactions costs for the entire season, including multiple harvests. This seemed to be a reasonable, though admittedly not the only, basis for assessing farmers' evaluations of alternatives. Farmers typically clarified that these net profit assessments factored in a subset of risks associated with the marketing channel like price discounts and rejection of quality, etc., so that there is some overlap of the attributes accounted for in the two approaches. The subjective distributions were obtained with specific reference to the particular firm sampled or the trader or firm they were transacting with at that time and not any representative firm or abstract notion of contracting. This is essential if it is to relate to participation and contracting status, given the heterogeneity of firms and practices.[10]

In general, the minimum, modal and maximum value of expected outcomes were elicited through the survey and the farmers were then asked to assign 20 stones as weights to each of these three

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Only in a couple of cases, the farmers suggested that they would leave the land fallow, in which case there exists no alternative distribution. The returns distribution associated with the alternative was treated as being degenerate at zero. Given the typically small size of contracted acreage, the possibility of the contract acreage being assigned to multiple crops contemporaneously did not arise.

[9] It is possible that contracting with a firm other than the subject firm might be the next best alternative for the farmer who grows for the market, but this would rule out consistent comparisons across farmer categories and was hence not considered.

[10] This is to suggest that a farmer's perception of contracting with firm A need not be identical to the farmer's perception of contracting with firm B even if the salient aspects of contracting, price and quality are exactly alike, that there might be non-contractual elements that drive farmers to prefer contracting with one firm rather than the other.

points, reflecting the expected relative frequencies of the outcomes. These serve as the subjective probabilities at the minimum, mode and maximum values.[11]

Despite the usefulness of such elicitation techniques, these are not without problems, being very sensitive to the way questions are posed and also the context of heuristic biases, among other things (De Weerdt 2005; Delavande, Gine, and McKenzie 2009). To illustrate, all three subjective distributions (price, yield and net returns) were not possible for all cases. For gherkins, for instance, because contract pricing is a schedule of prices related to size of the gherkins, farmers had difficulties in articulating a single (average, effective) price. Similarly, the heuristic of availability, or rather the lack of it, was at work for farmers who had never contracted. Having never experienced contracting themselves, and having little vicarious knowledge of this option, the idea of contracting seemed too remote to be able to articulate their expectations regarding returns, yield and price. This data 'gap' however itself yields insight in the sense that lack of information of options (and the related absence of subjective assessments) might influence farmer choices.

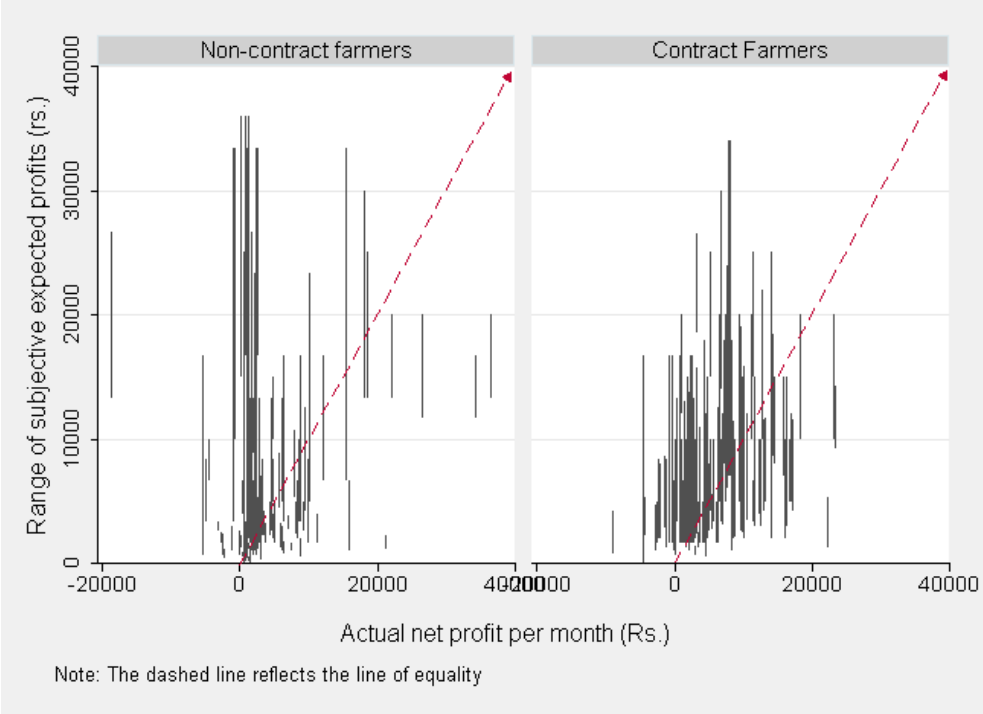
Another potentially important problem is the self-confirmation bias, where farmers articulate expectations that affirm the choices they have made because affirmation is desired for its own sake. In this study, since the farmer makes repeated decisions on whether to contract or not, the issue of self-confirmation bias is reduced to the extent that farmers get repeated opportunities to reassess their choice afresh at each decision point. Indeed, if we admit that farmers learn in a dynamic setting, the problem of self-confirmation bias seems less of a concern. Another way I try to deal with this is to frame the question in terms of a longer time horizon, implicitly urging farmers to 'span out' before revealing their expectations.[12] Figure 1 plots the range of expectations of net profits elicited against the actual net profit for the most recent season and it is apparent that the most recent outcome does not exert a disproportionate influence on the subjective expectiations.

I did not ask ex post about a choice they made ex ante, which would make it hard to distinguish between regret over a stochastic outcome and regret for a poor decision. I also place this set of

[11] In practice, it was not easy to implement this procedure literally and farmers frequently preferred to assign frequencies verbally. Some even expressed their desire to assign fractions of points which the number of stones would not allow them to do.

[12] The question, translated from the Tamil, reads: "If you were to follow the same set of procedures, with the same firm and field officer, under the same contractual terms and assuming the general conditions in your family, village and weather are unchanged, out of 20 seasons growing the contract crop in a plot of your choice, which has the same qualities, what is the number of occasions you would attain the minimum/ the most likely / the maximum price/yield/net income per acre of the commodity?"

Figure 1. Comparing expectations and outcome



questions before discussing their recent experience or the immediate plans so as not to anchor their responses in time.[13]

For analysis, I use mainly the subjective distributions of returns or the net profit per acre. Given that both price and yield are stochastic, the focus on the measure for net returns that have been directly elicited presumably accounts for any potential covariance between price and yield, making it a more reliable indicator. Data on subjective returns to contracting versus the next best alternative for each respondent enables me to compare, at the farmer level, the moments of these distributions as well as the comparison of the entire distribution using stochastic dominance techniques, again for each farmer. In general, it makes more sense to compare these distributions for each farmer rather than across farmer categories. This is owing to the significant differences in alternatives available

[13] I necessarily assume that these subjective distributions are somewhat stable over time. This is necessary to be able to relate the data on subjective distributions to contracting status in the most recent season. If the subjective distribution is influenced disproportionately by the most recent experience, then these expectations might be more closely related to contracting status for the season that follows rather than the season just passed. To an extent this problem is addressed by the question's time horizon.

to farmers both across regions and schemes so that the moments, say, the mean net return for alternatives, averaged over farmers, requires careful interpretation.[14]

Mapping of Risks

The second component of elicitation is mapping a comprehensive list of attributes that can either contribute to increasing or decreasing risk exposure, i.e., the risk associated with a contracting or the farmer-defined next best alternative. This roster of attributes was assembled in the course of the pilot survey as the collection of all possible attributes listed or mentioned by farmers in a series of open-ended questions about the relative merits and demerits they saw in contracting versus not contracting. These attributes are listed in Table 1. Each attribute could be associated with either increasing risk exposure or decreasing it. For example, a field official could work well for one farmer and not the other, so that the attribute that the field official is available at hand could work as a risk mitigator for the former and as a risk enhancer for the latter. Further, some of these risks could be accounted for in farmers' articulation of subjective distributions of price, yield or returns. Attempts to focus on only those risks that are unlikely to be factored into the farmer's calculation of subjective net returns were difficult. For example, a farmer who felt the firm's poor quality of inputs often ended up factoring this into his or her response on subjective yield and net returns distributions while also mentioning it as a valid concern in the open-ended listing of risks. In practice, therefore it was not possible to account for these overlaps. So these are necessarily coarse measures. However, the farmer was asked to state his/her expectations under 'regular' conditions, so that catastrophic occurrences are likely not incorporated in the net returns distributions.[15]

The superset of attributes formed the basis for the final survey of farmers in the form of a list of risk-attenuating and risk-enhancing attributes that farmers associate with contracting and its next-best alternative.The questions themselves were open ended, however, so that the relevant attribute

[14] In general, the units and crop duration of the alternatives varies from those of the contract commodity. In the survey, these have been harmonized over units and time frame for each scheme to make them comparable. For example, for papaya, the return to contracting was expressed as income per month since it is from a crop which lasts for three years, whereas the alternative crop would be a three month crop - the net return for which is converted to the equivalent for a month. In general, the gestation period for crops was not considered. Effectively, the comparison is only for a window when the contract crop or its alternative is generating a return. The yield can in fact vary over the life of a crop and these subjective returns are not adjusted for the age of tree crops. This is less of a concern because these returns were elicited from farmers for conditions that were held similar across the 20 'times'.

[15] For example, some risks such as the firm not showing up to collect the produce or a complete loss of crop on account of pest were not incorporated in the expectations of net returns. For instance, the minimum expected net return was rarely close to zero and never negative.

Table 1: Risk Enhancing and Risk Attenuating Attributes

Contracting		**Not Contracting**	
14	22	10	13
Risk attenuating factors associated with contracting	Risk exacerbating factors associated with contracting	Risk attenuating factors associated with next best alternative	Risk exacerbating factors associated with next best alternative
P_c	R_c	P_{nc}	R_{nc}
Yield fluctuations	Yield fluctuations	Yield fluctuations	Yield fluctuations
Cash advance for input purchase	Yield fluctuations on account of weather	Transactions time and cost	Yield fluctuations on account of weather
Credit availability	Yield fluctuation on account of pest and disease	Food self-sufficiency	Yield fluctuation on account of pest and disease
Availability of inputs (Seed, fertilizers, pesticides)	Initial investment	Credit availability	Rejection or downgrading quality of produce
Quality of inputs	Rejection or downgrading quality of produce	Can sell anytime, flexibility	Price fluctuations
Availability of technical advice	Firm might not return to contract in the future	Rejection or downgrading quality of produce	Availability of inputs (Seed, fertilizers, pesticides)
Crop duration	Group default	Availability of buyer / known trader	Quality of inputs
Transactions time and cost	Firm may not show up	Self respect	Availability of technical advice
Farmgate collection	Field officials are not trustworthy	Lumspum payments	Quality of technical advice
Availability of buyer/Assured buyer	Impact on health	Timely payments	Transactions time and cost
Price premia	Impact on soil quality		Cash advance for input purchase
Lumspum payments	Fear of losing land		Credit availability
Timely payments	Availability of labor		Payment delays
Sure income	Labor intensity		
Firm bears losses	Input costs		
Administer vaccines	Labor costs		
	Transactions time and cost		
	Quality of technical advice		
	Delayed payments		

[1] These are assembled from the responses of all the farmers.

is checked off on the list based on the farmer's unprompted listing of these. The roster was meant merely to assist investigators clarify or code the responses. [16]

Given the multiple nature of risks and their varying impact, the relative importance of several sources of risk is not clear. This poses a significant challenge for measurement. One way to measure

[16] Occasional prompting was required for reticent farmers, who took time to be persuaded that we were not sent by the contracting firm. In most cases, however, no such prompting was required. Whenever the listing of these relevant attributes was sparse, investigators prompted the farmer to ensure that these attributes were truly irrelevant and not a result of a farmer's reluctance to share such information. This was necessary especially for farmers interviewed first in a village. Prompting, as a rule, implied offering a set of attributes from the roster as examples and only in the case of soil fertility and health implications did prompting entail mentioning the risk specifically. In general, farmers in the study area were candid about deeming the prompted risks as irrelevant, if that were indeed the case. For example, in the gherkins area since many farmers voiced a perception that gherkins cultivation affected health, when other farmers who did not mention this risk were prompted, often the response was 'we do not think this is a problem, though in the village many women have experienced difficulties after working on the gherkins fields'. That said, it is difficult to gauge precisely the effect of prompting on the nature of responses and detailed information on which risk was obtained after or before prompting for each farmer was not recorded as part of the survey.

risk perception is to ask people an intensity measure with regard to a specific risk (Kohler, Behrman, and Watkins 2007); another is to get a ranking of the relative importance of different risks(Doss, McPeak, and Barrett 2008; Smith, Barrett, and Box 2001). Aggregating these measures into reliable indices can however be tricky especially when one wishes to compare measures across individuals (Smith, Barrett, and Box 2001).

To avoid this problem, the survey uses psychometric measures of perceptions on cardinal scales. Once a farmer identifies a particular attribute as either risk mitigating or risk enhancing, the farmer is asked the frequency of occurrence (that is, the probability of the risk) out of ten occasions and the importance of the risk to their personal sense of well-being on a scale of 0 to 10 (these are akin to weights attached to the risk). These weights were meant to proxy the monetary value of loss that farmers associate with the risk in order to capture the distinction between low probability of high loss versus high probability of low loss.[17]

This approach to collecting perceptions of risk allows me to construct risk scores for individual farmers that factor in their perceptions of the benefits of risk reducing attributes and costs of risk enhancing attributes of contracting and not contracting. The primary motive for this is to be able to see how contracting does relative to not contracting from an individual farmer's perspective and to see if these scores relate in expected ways to contracting status. To do this, all attributes are partitioned into four sets, each representing attributes that increase risks associated with contracting, R^c, increase risk exposure when not contracting, R^{nc}, reduce risk exposure under contracting,P^c, or when not contracting, P^{nc}. An attribute can appear both as a risk reducing and risk enhancing factor even for the same farmer. For example, when availability of inputs appears as an attribute, contracting can imply assured availability, so that it would be counted as an attribute in P^c, and it could also be the case that under not contracting, farmers face the risk of not having access to inputs, so that it falls under R^{nc}. A list of these attributes is presented in Table 1 and detailed discussion of that is reserved for section 3 of this paper. Here, I outline the method for constructing a simple metric to represent the collection of attributes.

I compute three scores for each farmer, a risk frequency score (R_i^f), a risk criticality score (R_i^g) and a combined risk score (R_i^{fg}). The frequency score weighs the relevant attribute with the frequency of occurrence as stated by the farmer. The criticality score weighs each relevant attribute

[17] The pilot survey tested the possibility of eliciting monetary values of losses associated with these risks, but owing to sparse and often imprecise data, this was not retained for the final survey.

by a cardinal response of how important the attribute is to the farmers indicated as relevant to farmer i. The combined score weighs each relevant attribute with both the frequency and criticality scale. In this case, a high frequency, low loss risk is treated as equivalent to a low probability, high loss risk.

Denoting $I(r)$ as an indicator variable taking the value one if the attribute r is relevant to the individual farmer i and zero if not, the collection of all attributes r represent the universe of such attributes, i.e., all the possible attributes listed by sample farmers as either contributing to increasing risks or decreasing risks associated with contracting and its alternative. The score is summed within each set of attributes to yield the following structure of scores.

$$(1) \qquad R_i^g = (\overbrace{\sum_{r\in R^c} I(r)g_i}^{\text{Risk enhancing}} - \overbrace{\sum_{r\in P^c} I(r)g_i}^{\text{Risk attenuating}}) - (\sum_{r\in R^{nc}} I(r)g_i - \sum_{r\in P^{nc}} I(r)g_i)$$

$$(2) \qquad R_i^f = (\sum_{r\in R^c} I(r)f_i - \sum_{r\in P^c} I(r)f_i) - (\sum_{r\in R^{nc}} I(r)f_i - \sum_{r\in P^{nc}} I(r)f_i)$$

$$(3) \qquad R_i^{fg} = \underbrace{(\sum_{r\in R^c} I(r)f_ig_i - \sum_{r\in P^c} I(r)f_ig_i)}_{\text{Net risk score from contracting}} - \underbrace{(\sum_{r\in R^{nc}} I(r)f_ig_i - \sum_{r\in P^{nc}} I(r)f_ig_i)}_{\text{Net risk score from not contracting}}$$

$R_i^g, R_i^f R_i^{fg}$ are interpreted as the net incremental risk the farmer associates with contracting. The greater the score, the greater the risks farmers believe they are taking on with contracting, relative to their next best alternative and after factoring in the benefits they associate with contracting. This score does not reflect monetary values though some of the component attributes affect incomes directly.

The score is an absolute measure but is best interpreted in its broader context. The survey identified 22 attributes as belonging to R^c, 14 factors in P^c 13 in R^{nc} and 10 in P^{nc}. A farmer treating every attribute in every set as valid ends up with a risk score of 5. In other words, when a farmer believes that each of the attributes in each set is relevant, that each of it is extremely important to his or her sense of well-being (and hence carry the maximum score 10) and occurs every time the farmer chooses to contract or not contract (with a frequency of 10 out of 10), that farmer would have component scores of 22, 14, 13 and 10 yielding a combined risk score of 5. A farmer who sees none of these attributes as relevant has 0 for each component score and hence a

combined net risk score of 0.[18] The greatest incremental risk comes when a farmer associates all 22 risk enhancing attributes with contracting and believes that all 10 risk mitigating attributes from not contracting as valid. Should the farmer choose contracting the net incremental risk would be 32. This is the maximum risk farmers take on, given the set of risks defined by the sample. The least incremental risk from contracting is associated with a farmer who treats all positive attributes with contracting as relevant and the alternative option is associated only with risk increasing attributes and all the risk increasing attributes. In this case, the net incremental risk a farmer takes on would be -27. This defines the range of possible frequency and risk mitigating scores. The combined net risk score is higher whenever a farmer associates a particular option with either a larger number of risks, a greater criticality of risks or a greater frequency of risks, or combinations of these, *ceteris paribus*.

These risk scores are coarse measures but offer useful tools to make select comparisons across farmer groups distinguished by contracting status. It also offers a tool to map the heterogeneity in the distribution of attributes that operate on risks and uncertainties across different contracting schemes. [19]

The Stochasticity of Contract Prices and Net Returns from Contracting

With the combination of tools described above, it is now possible to map farmer perceptions of relative risks and returns associated with contracting. For the purpose of this analysis the sample farmers are treated as either contract farmers (implying they could either contract with not just the sample or subject firm but for any other firm) or as non-contract farmers (denoting those who do not currently contract at all).

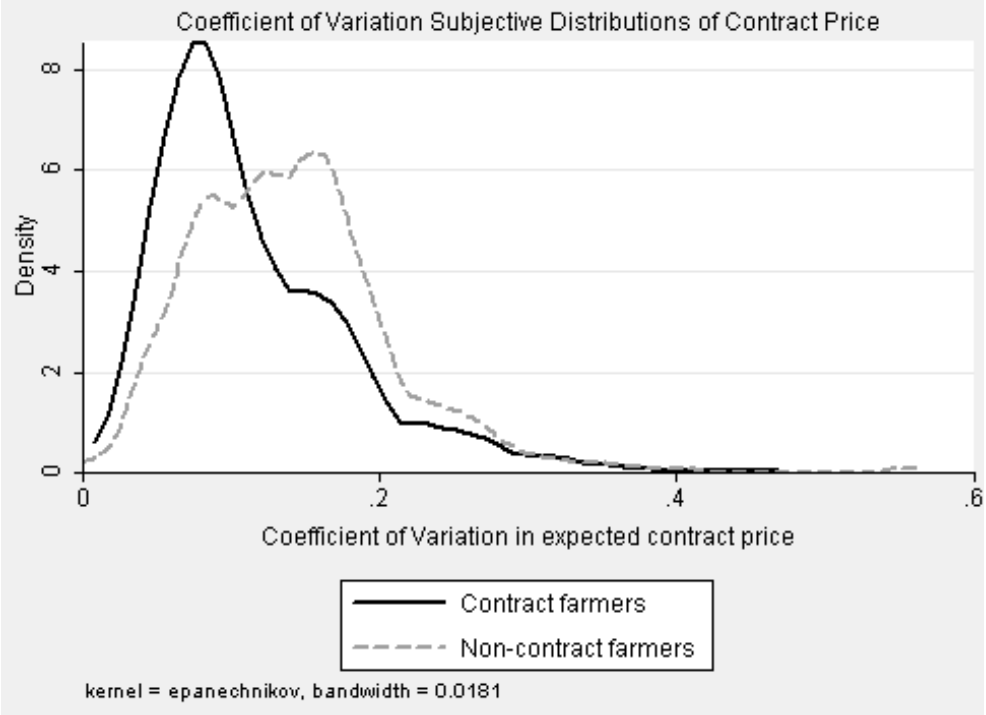
Subjective distributions of net returns from contracting across farmers and commodity sectors suggest that contracting is indeed a gamble. This is an outcome of the perceived stochasticity of both price and yield by farmers.

As far as price goes, elicitations of subjective distributions of contract price that farmers expect confirm that the notion of fixity of contract prices is only approximately correct. Figure 2 plots

[18] The risk scores are cast as differences and not as ratios in order to avoid instances of component scores being 0.
[19] Given that a great deal of debate on smallholder participation centers on their ability to take risks, it would be of interest to understand if farmers with small landholdings tend to have higher risk scores than the larger farmers. This is however beyond the scope of this paper.

the coefficient of variation of subjective distributions of contract prices for all the farmers in the survey illustrating the extent of variation in the contract price that farmers expect.[20] It is evident from the kernel density function that far from being a degenerate distribution which would imply zero variation in price, farmers expect to get different contract prices, on account of factors that might be related to quality or due to complex structures of pricing linked to commodity attributes or market price anchors to contract pricing or farmer productivity. The figure suggests too that non-contract farmers are more likely to expect higher variation in contract prices than contract farmers.[21] Contract farmers thus associate contracting with reduced price volatility than non-contract farmers.

Figure 2. The Stochasticity of Subjective Contract Prices of Contract and Non-contract farmers



Note: The Kolomogorov-Smirnov test for equality of distributions suggests that with a D-statistic of 0.25, and an associated p-value of 0.00 the null that the two distributions are equal can be rejected at 1% level of significance.
Contract farmers refer to those who contract with any firm, i.e., either the subject or sample firm or any other firm. Non-contract farmers refer to those who do not contract with any firm, these are either farmers who grow for the spot market or are attrition farmers or those who have never contracted.

[20] The coefficient of variation is presented since this enables pooling of data for all commodities. The data on subjective distribution of contract price are computed only for non-missing observations. Close to eight percent of the respondents across both phases were unable to give complete and consistent distributions for the contract price.

[21] Non-contract farmers here include farmers who have never contracted, those who have ceased contracting and those growing for the open market. Contract farmers include farmers contracting for either the subject firm or for any other firm.

In general, it makes sense to think of contract prices as representing an objective price and a subjective price, where the objective price is agreed upon as part of the contract and is conditioned on certain parameters for delivery. The subjective price, meanwhile, is the contract price that farmers expect to get. These are however distinct from what might be called the actual realized contract prices.

While individual farmers' subjective contract price suggest that they may be stochastic, it is instructive that the subjective modal contract price that farmers expect varies widely, despite the fact that these farmers work with the contracting firm on the same contractual terms. In other words, farmers have similar contracts but very different expectations of modal price, perhaps reflecting an assessment of their own abilities and idiosyncratic experiences with the subject firm. Figures 3 and 4 show the distribution farmers who contract with only the subject firms in the respective commodity sectors.

Figure 3 for gherkins contract farmers in the two phases shows for instance that the distribution of expected subjective contract price varies widely over the range of contract prices established by the firm for different size categories, the latter indicated by the vertical lines.

In the case of cotton (Figure 4), the contractual price is a mark up on the three-day average of the price prevailing in the wholesale market preceding the time of delivery. Farmers' expectation of the modal expected contract price varies widely, reflecting perhaps their perception of the variability in market prices that anchor the contract price.[22]

The case of papaya and marigold (not shown here) present a contrast in that the distribution is virtually degenerate, since for these two, the objective contract price, as specified in the contract, and the subjective modal contract prices expected by farmers vary only marginally and coincides for all farmers.

Figure 5 shows the distribution of prices contract broiler growers actually received at the most recent contractual delivery ; this is the distribution of contractual prices received across broiler growers. [23] The distribution of realized contract prices on delivery lies to the left of the distribution of subjective modal contract prices. This implies that farmers are either optimistic so that their expectations of the contract price run higher or that this was a disappointing season.

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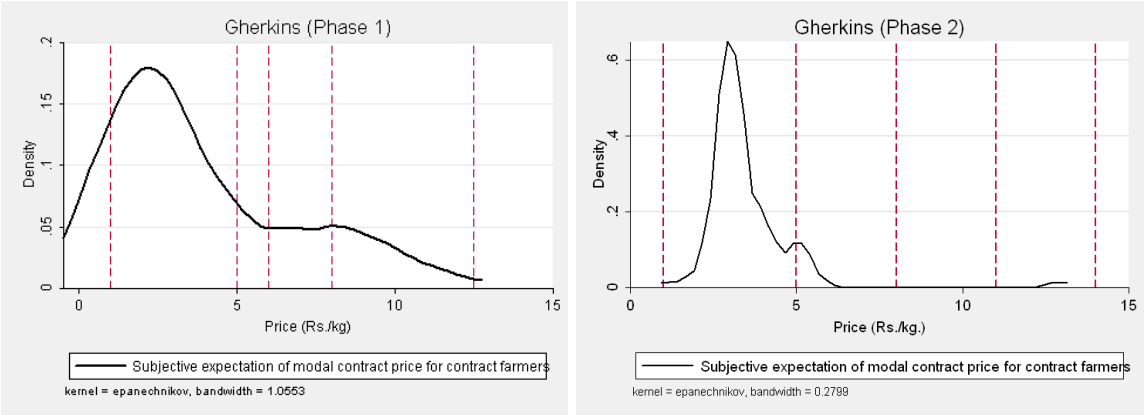
[22] These objective prices are Rs.34/kg. and Rs.37/kg at the time of the survey and were obtained from the firms according to the contract.

[23] The vertical line in the figure represents a benchmark price per kilogram of live weight broiler for a feed conversion ratio (FCR) that the firm considers optimal.

Figure 3. Subjective Modal and Objective Contract Prices of Gherkins Subject Contract farmers



Note:The contract farmers refers to those who contract with the subject firm. Vertical dashed lines represents the objective price obtained from the contracting firms. For gherkins, there are five sizes, each with an associated price with the smallest commanding the highest price.

These comparisons reveal that the objective contract price need not necessarily coincide with the subjective prices that farmers expect to receive in reality, and that this is an important source of variation in expected net returns from contracting that differs across farmers and potentially over time. Moreover, both objective and subject expected prices may differ from actual realized prices, allowing the possibility of disappointment and regret over contracting decisions.

The actual price a farmer earns for a given contractual delivery, or realized price, can therefore be regarded as a draw from a distribution, be it from a farmer specific distribution of prices or from a distribution of prices across farmers. In short, price under contracting need not necessarily be a degenerate distribution, much less the farmers' subjective expectations of these prices, although the more transparent and rigorous the measures of quality employed, the more certain the price offered for produce. [24]

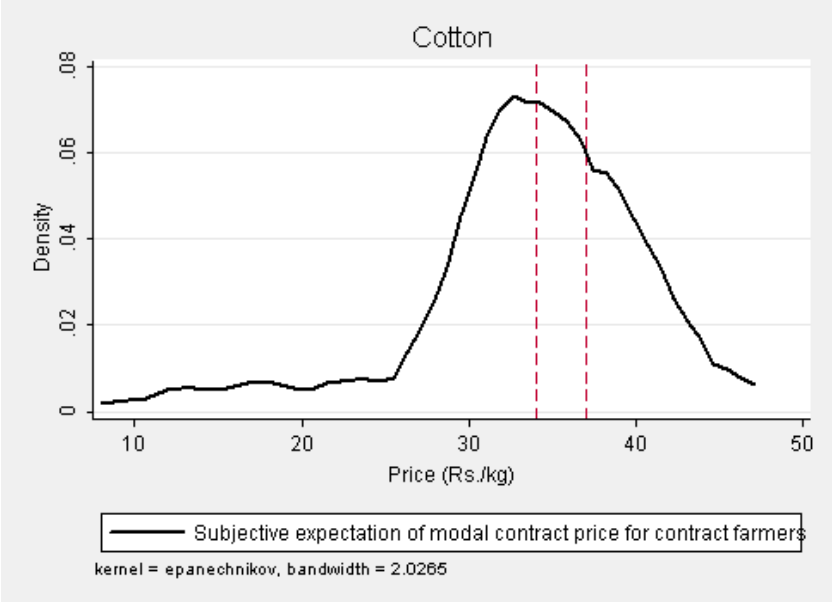
The stochasticity in farmers' perception of prices combined with yield fluctuations renders the expected net returns from contracting stochastic as well.[25]

In essence, if contracting is associated with some sort of certainty, it is not in an absolute sense, and not in the realm of net returns. The question is then, if contracting is a gamble, how safe a gamble

[24] For papaya, the latex price is related to the level of papain activity as measured by the Brix meter. Contract deliveries by farmers invite a price discount or premium for an acceptable range of parameters. In the case of papaya, the survey revealed that the modal price for farmers was exactly Rs.90/kg, and the minimum and maxiumum were defined at Rs.80 and Rs.110/kg. For marigold, the price is scaled according to volumes delivered, primarily to offer an incentive to honor the contract and prevent sidesale. The base price offered was Rs.2.85/kg for each ton delivered, with a premium of Rs.0.50 per kg. on the entire delivery, for each extra ton delivered.

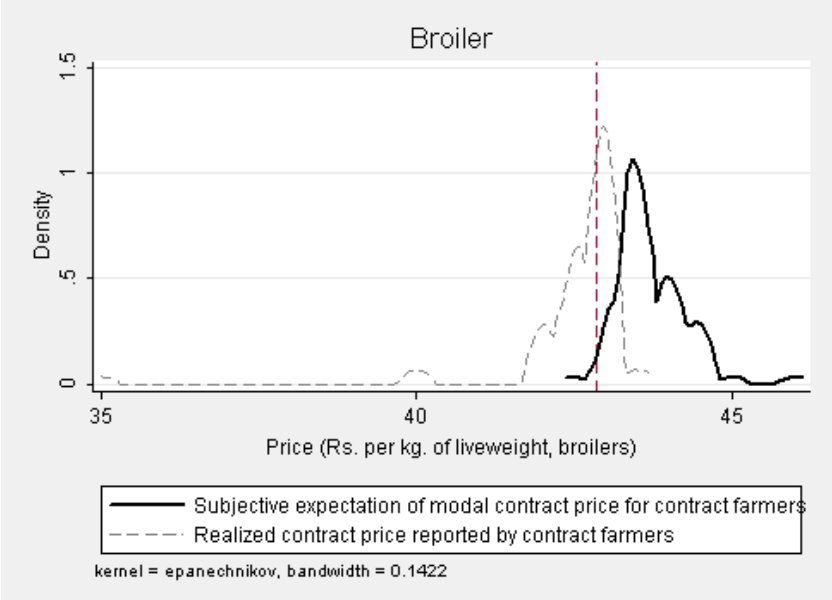
[25] The issue of yield fluctuation is not addressed here since not contracting is often associated with not growing the contract commodity making yield comparisons difficult.

Figure 4. Subjective Modal and Objective Contract Prices for Cotton Subject Contract farmers



Note:The contract farmers include farmers who contract with the subject firm. Vertical dashed lines represents the objective price of (Rs.34/kg/. and Rs.37/kg. at the time of the survey, obtained from the contracting firm.

Figure 5. Realized Prices, Subjective Modal and Objective Contract Prices compared for Broiler Subject Contract farmers



Note: The contract farmers include farmers who contract with the sample firm. Vertical dashed lines represents the objective price obtained from the contracting firms.

Table 2: Description of Indicators of Relative Moments for an Individual Farmer

Variable	Computation
Ratio of mean subjective net returns from contracting and next best alternative	$\left[\frac{\mu_c}{\mu_{nc}}\right]_i$ for each farmer i
Ratio of coefficient of variation of subjective net returns	$\left[\frac{\sigma_c}{X_c} / \frac{\sigma_{nc}}{X_{nc}}\right]_i$ for each farmer i
Difference in skewness in subjective net returns between contracting and next best alternative	$\left[Sk_c - Sk_{nc}\right]_i$ for each farmer i
Difference in kurtosis in subjective net returns between contracting and next best alternative	$\left[K_c - K_{nc}\right]_i$ for each farmer i

[1] These are computed using the elicited returns distributions for each farmer. These are then averaged across farmer types or groups to make intergroup comparisons.

is it? One way to explore this aspect is to compare, for an individual farmer, the farmer-specific moments of the subjective distributions of net profit per unit area across possible choices. These include mean, coefficient of variation, skewness, kurtosis measures for the subjective distribution from contracting as well as that for the next best alternative. These are expressed in relative terms, i.e., as farmer-specific relative moments to represent the relative attractiveness between contracting and a farmer selected next best alternative. Table 2 gives details of these measures as a prelude to subsequent tables.

Table 3 shows measures reflecting the farmer-specific relative moments of the subjective distributions of contracting versus the next best alternative averaged over farmers for the different contracting schemes and farmer types distinguished by contracting status.[26]

The raw measures of the ratio of relative subjective returns between contracting and the next best alternative suggest that contracting in gherkins, cotton and papaya is associated with higher mean returns, irrespective of farmer type, i.e., whether they are currently contracting, have exited the arrangement or have never contracted. Tellingly, however, farmers tend to associate contracting not only with a higher mean, but also with higher coefficient of variation, barring cotton farmers who do not contract. This is evident from the ratio of the coefficient of variation in subjective returns between contracting and the next best alternative.

[26] For this part of the analysis, the farmer types are disaggregated so that there are Subject Contract Farmers (who contract with the subject firm), Other Contract Farmers (who contract with any other firm), Attrition Farmers and Never Contract Farmers.

In the case of marigold and broiler, the reverse is true, so that the subjective mean returns from contracting are lower relative to not contracting, except for marigold farmers who do not contract with the sample firm. Marigold farmers however associate contracting with a higher coefficient of variation. Only with broiler are clear indications of contract farming serving as an insurance against risky returns, with contracting associated with a low mean and also a low coefficient of variation relative to the alternative.

Furthermore, higher variability in returns to contracting relative to its alternative, which Table 3 suggests is comparable across farmers, might not in itself be a significant factor. Critical is the skewness of the distribution. Contracting protects the farmer from downside price risk by fixing a price. However, this also prevent farmers from exploiting high prices in the next best alternative. Table 3 shows the difference in skewness between the expressed returns distribution of contracting and not contracting. Whenever this figure is positive, not contracting allows a greater possibility of higher returns the contracting. In the Farmer Survey, many farmers who choose not to contract suggest that the advantages with the open market is that when prices sometimes shoot up in the open market and by opting to go for a contract crop one loses the opportunity to take advantage of these price spikes, even if they were infrequent occurrences. Marigold farmers, for instance, associate the spot market net profit distributions with a negative skewness, which renders the difference in skewness between contracting and not contracting positive (Table 3) indicating relatively larger opportunities of a higher return in the spot market than when contracting. The t-test of difference in means across farmer groups is however not significant for any comparison across farmer groups for marigold. One reason could be the porosity of contracts; owing to weak enforcement, the farmers were often able to divert part of the contract produce on a few festival days when prices for fresh marigold flowers spiked. This muddies the comparison of relative skewness across the farmer categories. For gherkins (Phase 2) and papaya, the difference in skewness for each group of non-contracting farmers is positive and the figure is statistically significantly less than for contract farmers, in most cases.

Similarly, the difference in kurtosis of subjective distributions of contracting and the next best alternative imply that a positive figure indicates fatter tails associated with contracting relative as compared with not contracting. In the case of broiler and papaya, the contract farmers, with both the sample firm and other firms, associate contracting with a relatively thinner tail, whereas for those not contracting the opposite is true. This pattern is evident in the gherkins sample from Phase 2.

Table 3: Relative Moments of Subjective Distributions of Net returns for Contracting relative to the Next Best Alternative

Commodity and Farmer type	Average of the ratio of mean subjective net returns	t-statistic for equality of means across groups	Average of the ratio of coefficient of variation of subjective returns	t-statistic for equality of means across groups	Average difference in skewness of subjective returns distributions	t-statistic for equality of means across groups	Average difference in kurtosis of subjective returns distribution	t-statistic for equality of means across groups	N
Gherkins:Phase 1									
Subject Contract Farmers	2.11		1.49		0.01		0.01		40
Other Contract Farmers	1.33	2.96 ***	1.35	0.64	0.12	-0.61	-0.13	0.67	58
Attrition Farmers	1.76	1.04	1.53	-0.17	0.04	-0.11	0.48	-1.85 **	40
Never Contract Farmers	3.61	-0.99	1.12	2.06 **	-0.03	0.2	-0.03	0.16	60
Cotton									
Subject Contract Farmers	1.44		1.20		-0.07		0.01		60
Other Contract Farmers	1.33	0.32	0.65	2.26**	0.12	-0.9	0.25	-0.57	6
Attrition Farmers	1.10	1.29 *	1.37	-0.41	-0.49	1.68 **	-0.64	1.24	32
Never Contract Farmers	1.33	0.28	1.18	0.11	-0.16	0.43	-0.30	0.65	52
Gherkins:Phase 2									
Subject Contract Farmers	3.39		1.46		-0.11		-0.03		54
Other Contract Farmers	2.64	0.88	1.24	1.23	0.09	-1.45 *	0.07	-2.03 **	23
Attrition Farmers	2.83	0.56	1.70	-0.9	0.06	-0.88	0.20	-1.32	18
Never Contract Farmers	3.68	-0.21	1.16	1.74**	0.26	-2.96***	0.08	-1.9 **	21
Marigold									
Subject Contract Farmers	0.85		1.75		0.32		-0.25		59
Other Contract Farmers	1.90	-2.69***	0.90	4.34 ***	0.12	0.73	0.15	-1.1	24
Attrition Farmers	0.76	0.52	1.61	0.55	0.50	-0.61	-0.63	0.91	18
Never Contract Farmers	0.66	1.25	1.59	0.58	0.45	-0.63	-0.36	0.35	20
Papaya									
Subject Contract Farmers	1.33		1.07		-0.06		-0.04		72
Never Contract Farmers	2.72	-2.69 ***	1.35	-1.55 *	0.24	-1.38 *	0.31	-1.37 *	27
Broiler									
Subject Contract Farmers	0.30		0.76		0.13		-0.24		61
Other Contract Farmers	0.26	0.98	0.79	-0.25	0.08	0.38	-0.13	-0.65	10
Attrition Farmers	0.30	0.07	0.92	-1.24	-0.28	2.05 **	0.10	-1.14	10
Never Contract Farmers	0.34	-2.12 **	0.89	-1.96 **	-0.11	3.19 ***	0.01	-1.63*	57

Significance levels : * : 10% ** : 5% *** : 1%

[1] Farmer Survey, Phase 1 and 2,2007-10.

[2] Computations include only those observations for which farmer responses were complete.

[3] The relative moments in ratios pertain to those associated with contracting over the next best alternative. The differences in skewness and kurtosis are those for contracting minus the next best alternative.

[4] The t-statistics are for comparisons of relative moments between contract farmers and each of the other farmer types. Hence, there is no corresponding statistic for contract farmers. The null is that the difference in mean between contract farmers and the other farmer group is zero.

[5] All figures are rounded off to two decimal places.

Inter-group comparisons of the means of these relative moments corroborate this pattern. For gherkins and cotton, there is a statistically significant difference between contract and a subset of non-contract farmers for both mean and coefficient of variation, emphasizing that contract farmers see contracting as a high variance option, but also one that has a higher mean return relative to not contracting. For broiler and papaya, the difference between contract and non-contract farmers for the relative mean and coefficient of variation is statistically significant. This signifies that contract farmers for papaya and broilers might be willing to settle for a lower mean return if it is also associated with a lower variance.

Table 4 shows, groupwise, the percentage of farmers for whom the subjective returns distribution from contracting stochastically dominates that from the next best alternative. Oddly enough, the tests for a significant difference in proportion indicates that contracting stochastically dominates not contracting for a significantly greater proportion of non-contract farmers than for contract farmers. Where this difference is with respect to the Never Contract Farmers group, as it is for gherkins and papaya, it is plausible that a large proportion of those who have never experienced contracting tend to associate it with a returns distribution that is unambiguously better than not contracting, in part due possibly to inaccurate perceptions in the absence of experience to contract. The weak correspondence of contracting status and stochastic dominance also points to other possible sources of exclusion, either by virtue of having been rationed out by the firm or on account of other concerns that do not readily reflect in returns distributions. The table shows for instance that for those farmers who do not contract but believe that returns from contracting stochastically dominates not contracting, an overwhelming majority stated in the survey that they were unlikely to want to contract at any time in the next three years, 72%, 90% and 93% for gherkins (Phase 1), marigold and papaya, respectively. The relationship between contracting decisions and farmer assessments of risk-return tradeoffs is tested for robustness using regression methods (Appendix 1)

The data on farmers' subjective returns points to two broad issues. First, farmers are attentive to mean returns from contracting but are likely take into consideration the entire distribution of returns including other higher order moments. Second, other attributes that enhance or mitigate risks can perhaps exert a reinforcing or countervailing influence on the decision to contract.

If non-contract farmers too associate contracting with higher relative mean returns, and indeed, where subjective returns from contracting first order stochastic dominates not contracting, the question arises as to why many farmers opt not to participate. While one explanation is that they were

Table 4: Stochastic Dominanace of Net returns for Contracting and the Next Best Alternative for Different Farmer Types

Commodity and Farmer type	Proportion of farmers for whom contracting first-order stochastic dominates the next best alternative	Proportion of these who do not want to contract	Z-statistic for equality of proportion for contract farmers with each farmer type	Proportion of farmers for whom contracting second-order stochastic dominates the next best alternative	Z-statistic for equality of proportion for contract farmers with each farmer type	N
Gherkins:Phase 1						
Subject Contract Farmers	35			45		40
Other Contract Farmers	26	29%	0.97	33	1.23	58
Attrition Farmers	40	31%	-0.46	45	0	40
Never Contract Farmers	60	72%	-2.45 ***	63	-1.8 **	60
Cotton						
Subject Contract Farmers	28			30		60
Other Contract Farmers	50	100 %	-1.01	50	-1	6
Attrition Farmers	22	57%	0.67	25	0.51	32
Never Contract Farmers	31	81%	-0.28	35	-0.52	52
Gherkins:Phase 2						
Subject Contract Farmers	56			59		54
Other Contract Farmers	65	7%	-0.79	70	-0.85	23
Attrition Farmers	56	50%	0	56	0.28	18
Never Contract Farmers	62	50%	-0.5	71	-0.98	21
Marigold						
Subject Contract Farmers	14			19		59
Other Contract Farmers	42	90%	-2.82***	42	-2.19 ***	24
Attrition Farmers	17	100%	-0.33	17	0.19	18
Never Contract Farmers	5	0%	1.04	10	0.9	20
Papaya						
Subject Contract Farmers	32			36		72
Never Contract Farmers	52	93%	- 1.82**	56	-1.75**	27

Significance levels : * : 10% ** : 5% *** : 1%

[1] Farmer Survey, Phase 1 and 2,2007-10.
[2] The computations include only observations for which the responses of farmers regarding subjective distributions is complete.
[3] Broiler farmers are excluded since the proportion of farmers for whom contracting first order stochastically dominates not contracting is zero for all farmer groups.

rationed out by the contracting firm, this is not always the case. Indeed, when those who had never contracted were asked whether the firm excluded them or they opted out, the percentage of farmers who had never wanted to contract despite an opportunity to do so was 48% for gherkins, 50% for marigold, 55% and 30% for broiler and papaya respectively. Evidence from the survey bears out the premise that there might exist other overriding concerns for non-participation.

To see this, it is useful to superpose risk scores with subjective returns distributions. Figure 6 compares the distributions of relative mean returns of contract farmers (irrespective of which firm they contract with) and non-contract farmers, wherein the distribution of the latter is only marginally more heavily concentrated below one than that of the non-contract farmers. Whereas, the risk scores computed for attributes indicates that non-contract farmers believe they are taking on significantly greater incremental risks with contracting than do contract farmers. Kolomogorov-Smirnov test for equality of distributions suggests that contract and non-contract farmers do not differ overall in their perceptions of relative returns from contracting versus its next best alternative, but do differ significantly in the perceptions of the relative risks they associate with contracting (Figure 7).

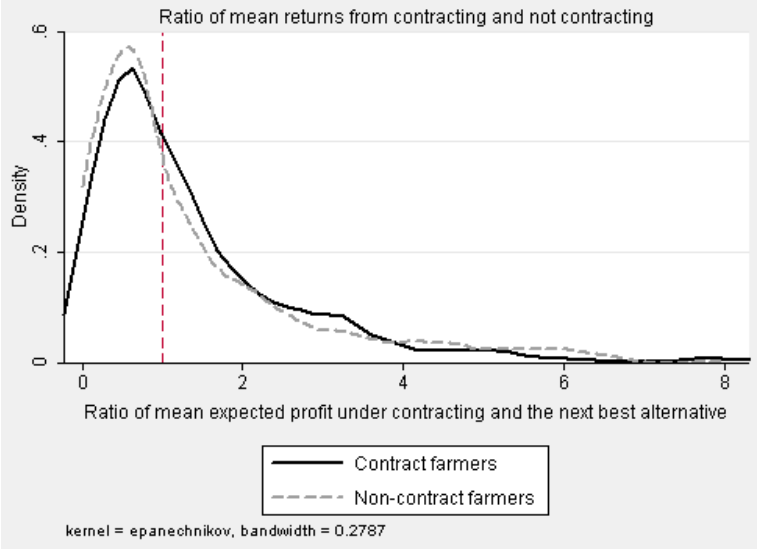
In order to test the robustness of the association between perceptions and contracting status, a set of commodity-wise and pooled regression equations were estimated, where contracting status is the dependent variable and explanatory variables represent relative moments of these distributions, stochastic dominance as well as other risk perceptions, among others. These are presented as supplementary materials. All of them show that at least a subset of these variables are statistically significant

Mapping Sources of Risk across Attributes

Anecdotal evidence suggests that regardless of farmer perception of the variation in returns to contracting or in the skewness of these distributions, contracting decisions are often driven by the perception of possibilities of catastrophic risk.

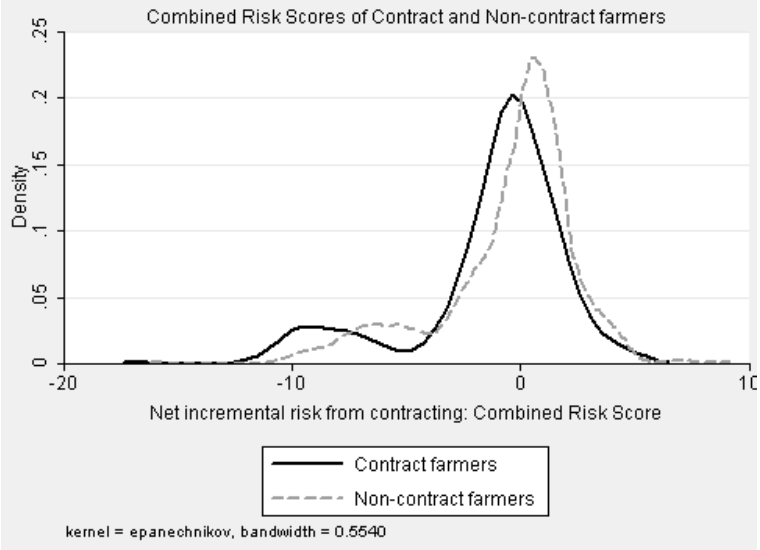
In general, there is much variation across commodities. Table 5 shows the average scores by commodity and farmer type for the three measures - the Combined Risk Score, Criticality Risk Score and the Frequency Risk Score. These three measures appear equivalent. Hence, the Combined Risk Score is used as the main indicator of the net incremental risk associated with contracting. Figure 8 shows the distribution of the Combined Risk Scores according to commodity and farmer type. It is clear that of the commodities studied, marigold contracting is generally associated very

Figure 6. Contracting and its Alternative: Comparison of Relative Returns



Note: The Kolomogorov-Smirnov test for equality of distributions suggests that with a D-statistic of 0.254, and an associated p-value of 0.20 the null that the two distributions are equal cannot be rejected at even 10% level of significance.

Figure 7. Net Incremental Risk from Contracting: Combined Risk Scores for Contract and Non-contract Farmers, 2008-10



Note: The Kolomogorov-Smirnov test for equality of distributions suggests that with a D-statistic of 0.17, and an associated p-value of 0.00 the null that the two distributions are equal can be rejected at 1% level of significance.

low incremental net risk exposure. Papaya and broiler contracting are associated with relatively moderate net additional risk exposure, with gherkins and cotton occupying the higher end of the combined risk score scale.

This is consistent with the qualitative information collected from the field survey. Even as gherkin is regarded as lucrative and despite the decade long embrace of gherkin, it continues to be an exotic crop grown for the 'factories'. No local market exists for gherkin and it does not figure in local diets. Many farmers had visited the factories as part of the company's efforts to build confidence of farmers in this new crop. To most farmers the rapid growth of the gherkins crop was a wonder, attributed to the high level of inputs. In fact, across the survey region, the Tamil name for the crop was *visha vellri*, or poison cucumber, a reference to the relatively high level of chemical inputs it required.

It is also clear that gherkin is a highly demanding crop in terms of labor inputs, especially during harvesting. Timely harvesting of produce is critical. This has something to do with the structure of the contract, where small gherkins command a premium over larger ones. Since the gherkins grow rapidly in size, from day to day, in order to get the maximum returns, the farmers need to harvest gherkins "on the day that matters".[27] Any delay could cause a profound dent in the revenues a farmer can get. Farmers opined, for instance, that "even if there is a death in the house at harvest time, we have to put the body aside until we finish with the gherkins".[28] Many who chose not to contract cite small families and lack of family labor or lack of availability of labor as reasons for not doing so.

Also, women tend not to work on gherkins plots. There is a popular perception among the farming families that the pesticide use in gherkins fields is detrimental to women's reproductive health and causes workers (especially women) to faint. While this is largely unsubstantiated in the sense that there is no independently available scientific evidence on the link between morbidity and pesticide use in the specific context of gherkins cultivation in the study area, the higher incidence of women's health issues in the villages has been enough to keep the women away from working on gherkins fields. This appears to have an impact on the willingness to contract as well.

Another impression that was shared across villages in one part of the study area is that gherkins cultivation led to deterioration is soil quality. Some farmers claimed that paddy, when it followed

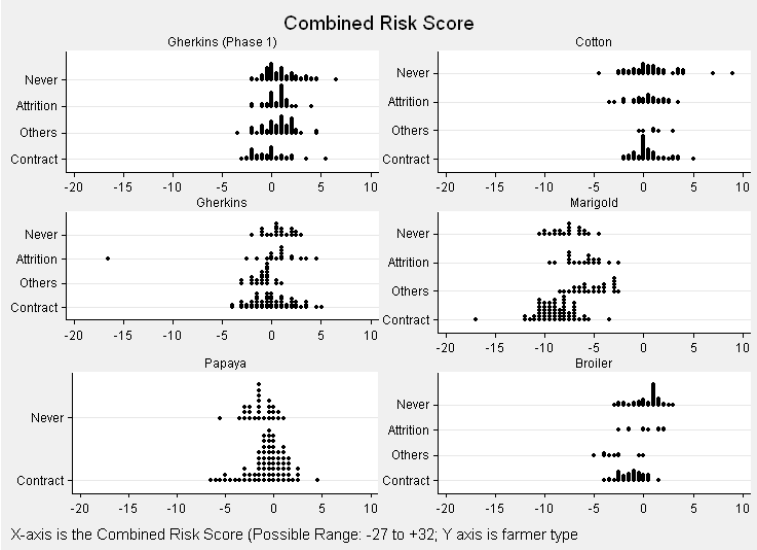
[27] Farmer Survey, Phase 1, 2008, Reddiarchatram block, Dindigul district.
[28] Farmer Survey, Phase 1, 2008, Natham block, Dindigul district.

gherkins on the same plot, yielded half of what it would otherwise. Some others claimed they changed the top soil layer, when they switched from gherkins to another crop, in order to restore soil quality. As a consequence of soil quality concerns, some farmers participate in episodes, growing gherkin every other year, but not more frequently. Indeed, field officers recommend switching plots and rotating crops to maintain soil fertility.

The riskiness associated with cotton contract farming is quite different in complexion. Cotton is a traditional cash crop in the region, and the firm contracting is well known. Farmers associated cotton contracting with significant benefits. For example, a positive externality from contracting for both cotton (and gherkins, in fact) is the advice farmers got for plant protection for other crops. This has obvious value, against the background of a collapse in state agricultural extension programs. According to most farmers, the field officers advised them against the indiscriminate use of pesticides and that fertilizer application needs to take into account the type of soil. This seemed to be a revelation for the farmers. But this advice also seemed very dependent on who the field officer was. Despite this, the pricing in the cotton contracting scheme, which is a mark-up on the market price, exposed farmers to the market price fluctuations the same way as the alternatives for the farmer. The quality requirements of the firm for staple length and cotton free from external impurities was considered a problem. Most of all, however, many farmers believed that the firm did not pay on time and discounted prices somewhat arbitrarily. Collectively these rendered cotton contracting a risky proposition relative to the alternative. Most cotton contract farmers suggested that they would opt to grow a competing crop like tomato or chilies, or cotton for the open market. Interestingly, the year of the survey was the last season the cotton firm contracted. It seems that the high risk scores reflected farmer discontent, an important ingredient of the failure of cotton contracting in the region.

In the case of papaya, Table 5 suggests that farmers who do not contract associate papaya contract farming with lower risks than do contract farmers. This is likely owing to the particular turn of events during the time of the survey. Papaya contracting had been growing popular across swathes of the study area. Despite requiring a long gestation period, since the trees bear fruit only in the eighth month or so, farmers were content with the arrangement. However, in June 2009, the worldwide epidemic of papaya mealybug reached southern India and the contract papaya fields and farmers in the area lost entire plantations to the pest. Consequently during the survey, virtually

Figure 8. Net Incremental Risk from Contracting by Commodity and Contracting Status, 2008-09



all contract farmers expressed risks of pest and consequent yield loss as the most important risk associated with contracting.

Marigold is viewed as bringing on less incremental risk for several reasons. This crop needs low initial investment, it is not too labor demanding and in a region that is fairly remote up in the hills, firms collect produce at the farmgate while delivering all the inputs to the farmer. The firm has been around for over two decades. In addition, unlike gherkins or papaya, there is a vibrant alternate domestic market. In the case of marigold, therefore, the fixed price offered by the firm and the relative indifference to quality makes it a reliable insurance mechanism for the farmer. Indeed, the spot market offers a lucrative sideselling option during festive occasions when the marigold price spikes. For the farmer, the alternative of growing for the spot market and growing on contract are not mutually exclusive owing to weak contract enforcement.

For broiler, there are no substantial perceived risks and those that exist have to do with the placement of birds, administration of vaccines, quality of feed and timely lifting of birds. In general, the broiler contracting firms exert substantial control over wholesale market prices of live birds by regulating the volume traded. Each growing cycle spans six weeks and firms calibrate the volume of chicks placed with contract farmers based on projections of market prices six weeks ahead. This implies that whenever the firm wants to curtail supply in the upcoming months, it cuts back on placements of chicks with contract farmers. Alternatively, farmers who are promised five or six

Table 5: Mapping Farmer Perceptions of Net Additional Risk Exposure from Contracting with the Subject Firm

Commodity and Farmer Type	Risk Scores			N
	Combined Risk Score	Criticality Risk Score	Frequency Risk Score	
	Range: -270 to +320			
All commodities				
Subject Contract Farmers	-1.57	-1.85	-1.92	347
Other Contract Farmers	-1.24	-1.30	-1.48	122
Attrition Farmers	-0.65	-0.91	-0.84	118
Never Contract Farmers	-0.61	-0.81	-0.83	241
Gherkins				
Subject Contract Farmers	-2.93	-0.42	-15.40	95
Other Contract Farmers	-24.30	-3.64	-19.41	82
Attrition Farmers	58.91	35.19	61.29	58
Never Contract Farmers	65.85	92.15	55.51	81
Cotton				
Subject Contract Farmers	0.28	0.55	0.40	60
Other Contract Farmers	0.53	1.20	0.68	6
Attrition Farmers	0.32	0.36	0.36	32
Never Contract Farmers	0.55	0.94	0.56	52
Marigold				
Subject Contract Farmers	-6.12	-8.71	-7.28	59
Other Contract Farmers	-3.27	-4.88	-3.84	24
Attrition Farmers	-3.82	-5.82	-4.61	18
Never Contract Farmers	-4.61	-7.12	-5.50	21
Broiler				
Subject Contract Farmers	-1.94	-1.07	-2.41	61
Other Contract Farmers	-3.00	-2.73	-3.87	10
Attrition Farmers	-0.95	0.20	-1.17	10
Never Contract Farmers	-0.29	0.30	-0.30	60
Papaya				
Subject Contract Farmers	-0.96	-0.51	-1.21	72
Never Contract Farmers	-1.07	-1.28	-1.27	27

[1] Farmer Survey, Phase 1 and 2,2007-10.
[2] The scores are designed to lie between -270 and +320. The former is for farmers who associate contracting with only positive attributes and not contracting with only negative attributes and list all attributes as relevant, and assign the maximum score of 10 to each of these. The latter is for farmers who associate contracting with only negative attributes and not contracting with only positive attributes, treat all of these attributes as relevant and assign 10 for frequency or criticality or both.
[3] The combined risk score has been divided by 10 so that all the scores have the same range.

poultry batches (or cycles) annually are offered fewer batches.[29] By the same token, firms can also time the picking up of the birds, so as to control supply in the wholesale market. For the broiler grower, this affects the price they get via the weight of the bird at the time of pickup, so that they might end up with a sub-optimal feed conversion ratio.

In general, several risks appear important that have important implications for why contract farming schemes are so fragile in India (Table 6). Noteworthy is the farmer perception of the risk of losing land. Poor land titling often implies that farmers hesitate to sign contracts for fear that it might involve confiscation of their land in case of defaults. Close to 15 % of the sample farmers stated that they associated contracting with a firm with the possibility of losing their land. The qualitative information from the survey suggests that some of these farmers stated a preference for oral contracts on account of this. Attributes that were most often cited as risk attenuating in the context of contracting were availability of inputs, technical advice and the benefits of not having to physically travel to a market to sell produce. An assured buyer who pays lumspum is also viewed as a distinct advantage, with almost 30% valuing this as a relevant benefit with contracting. Labor demands also appear to occupy a big place, as the case of gherkin illustrates.

Throughout the survey villages, it was common to find that farmers who contracted were less sure about the company they were contracting for than the field officer who interacted with them. This is not surprising, since to most of the farmers the field officer was the face of the company and took responsibility for every interaction throughout the cropping cycle. This also meant that where farmers were aware of the identity of the contracting firm, the field officer's competence was projected on to that of the company. The latter did not seem to have an existence independent of its personnel. The trustworthiness of the field officer also finds place in the risk map.

It is evident from the discussion that the motivation to contract is driven by considerations that interact in complex ways. Importantly, it emphasizes that it is not adequate to think of contract participation as being driven exclusively by firm preferences and to accord a substantive role to farmer willingness to participate in these arrangements.

[29] Some farmers are rationed out on the extensive margin by not being offered fewer batches per year, so that their bird sheds are left empty. Many farmers are offered fewer birds per cycle, or are rationed out on the intensive margin.

Table 6: A Mapping of Attributes Influencing Risk Exposure under Contract and its Alternative

	Contracting						Not contracting					
	Risk enhancing			Risk reducing			Risk enhancing			Risk reducing		
	Count	C	F	Count	C	F	Count	C	F	Count	C	F
Production related attributes												
Yield fluctuations	317	7.7	4.9	31	8.0	6.9				70	9.3	7.2
Yield fluctuations on account of weather	18	8.8	6.0									
Yield fluctuation on account of pest and disease	103	9.2	6.5				32	8.8	6.9			
Initial investment										3	8.3	10.0
Cash advance for input purchase	50	7.6	5.0	57	6.6	9.0						
Credit availability	77	7.3	5.1	52	6.4	4.9	223	7.1	2.8			
Availability of inputs (Seed, fertilizers, pesticides)	50	6.9	4.9	320	8.0	7.9	87	6.8	4.8			
Quality of inputs	174	8.0	4.5				131	7.7	5.1			
Availability of labor				62	8.1	7.0	215	8.7	6.7			
Labor intensity				23	8.4	8.5				29	7.7	8.9
Input costs				3	10.0	10.0						
Labor costs							88	7.2	5.3			
Availability of technical advice				190	6.7	6.7	246	8.1	4.3	134	9.0	8.9
Qaulity of technical advice							302	8.9	6.1			
Crop duration				4	7.5	10.0						
Food self-sufficiency										30	8.9	9.8
Marketing Attributes												
Transactions time and cost							14	8.3	8.0	1	5.0	10.0
Farmgate collection				150	8.5	7.4						
Availability of buyer				226	8.9		2	5.5	1.5			
Price fluctuations	150	8.5	7.1	340	8.8	9.2				337	9.4	5.4
Price premia												
Rejection or downgrading quality of produce	162	7.7	5.0				117	8.1	5.3	29	6.9	7.9
Lumspum payments				245	8.7	9.9						
Timely payments	72	7.8	5.1	230	8.8	8.4	60	6.4	4.7			
Firm might not return to contract in the future	7	5.4	4.4									
Group default	12	8.1	3.8	141	7.6	7.2						
Firm may not show up	86	8.6	4.5			8.4						
Field officials are not trustworthy	19	7.1	5.2									
Impacts												
Impact on health	117	8.8	8.5									
Impact on soil quality	54	8.6	7.1									
Fear of losing land	112	7.1	5.2									
Self respect				7	6.4	10.0						
Firm bears losses				10	10.0	7.0						
Administer vaccines	1	5.0	4.0									
Sure income	42	7.9	4.8							6	7.5	7.5
Assured buyer							90	7.2	4.8	201	9.4	7.5

[1] C: Average of responses on a scale of 0 to 10 indicated criticality of the risk. This serves as criticality weights for each farmer in the computation of risk scores. F:Average of responses on a scale of 0 to 10 indicated frequency of the risk. This serves as frequency weights for each farmer in the computation of risk scores.
[2] Farmer Survey, Phase 1 and 2,2007-10.

Concluding Remarks

This paper set out to examine the idea of contract farming as an insurance mechanism for farmers, hypothesizing that such arrangements are rather analogous to new technologies with diverse and hence ambivalent normative implications.

Farmers seem sensitive not just to mean returns or even variance but also higher order moments of the subjective net returns distributions. These could vary across commodities. For example, whereas broiler contracting is associated by contract growers with a low mean for a low variance in contract price, contract farmers for some other commodities are willing to tolerate a higher variance of returns with a higher mean returns. The data suggest too that even farmers who do perceive contract farming returns as being higher than their alternatives, on an average, nevertheless might not participate if they perceive large and catastrophic risks associated with it. Further, whenever the alternative market offers options for an occasional windfall, this might override considerations of mean returns when opting out of contracts.

The evidence from the study affirms that contract farming does mitigate some risks but potentially increases others, a feature not adequately acknowledged in existing contract farming research. Implicitly, the empirical evidence highlights the need for more careful consideration of farmer perceptions of the risks and benefits associated with contract farming when studying participation in contract farming arrangements. In particular, the psychometric mapping of risks points to the presence of a number of attributes that are not easily monetized and are hence difficult to account for through perceptions of profitability expressed in monetary terms. These considerations of perceived risks and benefits collectively define a farmer's individual rationality constraint when a firm presents the farmer with an option to contract.

From a policy perspective, that contracting could be a gamble in itself potentially explains non-adoption. This implies that there could be limits to uptake, which might not be the case were contract farming unambiguously beneficial. This underscores the importance of having realistic expectations about the reach of contract farming in developing countries despite its obvious advantages. It also suggests that with expansion in contract farming arrangements in developing countries, notwithstanding their wideranging benefits, there is a continuing relevance for appropriate instruments for risk mitigation.

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Appendix

This appendix presents robustness checks for the relationship between contract participation on the one hand and perceptions of risk and the relative moments of the subjective distributions of contracting and its alternatives. It contains results from a pooled regression model of contracting status with fixed effects for commodities followed by commodity specific regressions.

The dependent variable is contracting status, which takes unit value if the farmer contracts with the subject firm and zero otherwise, including those who may contract with other firms, grow the contract commodity for the spot market or not grow the contract commodity at all. Explanatory variables capture farmer and farm characteristics, locational attributes, firm presence in the region indicated by the number of contract villages in the block in which the farmer is located. The regression model is run for only those blocks where the firm contracts. This implies that this regression model estimates the probability that a farmer contracts with the subject firm conditional on the subject firm operating in the block. The rationale for this is to net out spatial selection effects, so that firms might be choosing based on geographic attributes rather than farmer attributes.

Central to this model is a set of variables pertaining to a farmer's subjective perceptions of contract farming including the relative moments of contracting versus the next best alternative represented by relative mean, cooeficient of variation, difference in skewness and kurtosis. A binary variable for first order and second order stochastic dominance of net returns from contracting and the next best alernative are included and it takes unit value when there is dominance. Further, the Combine Risk Score is included to represent the overall net risk associated contracting with the subject firm. In addition, the model includes the farmers risk aversion coefficient and a binary variable that takes the value one if the farmer is ambiguity averse. [30] An explanatory variable that interacts farmer risk aversion coefficient with the coefficient of variation in spot market prices

[30] These were elicited through three sets of experiments. To see if farmers were risk averse, each was offered a choice of accepting Rs. 150 for sure or alternatively, opt for a coin toss, such that if it is heads (s)he would get Rs.210 and if it is tails, Rs.90. The sure amount was set equal to the daily wage for a male skilled agricultural laborer prevailing at that time. For ambiguity aversion, the opportunity to win Rs.150 was offered. Each farmer was presented with two bags. Bag 1 contained four white balls and six black balls. If the ball the farmer picked was white, (s)he would get Rs.150. Bag 2 contained 10 balls (also with four white and six black balls). In this case, the farmer was told that some are white and some are black but how many of each there are not known. They would choose a color and would win Rs.150 if they picked a ball of that color. Farmers who chose to go with the former game were considered ambiguity averse. Finally, to elicit a lottery price, farmers were asked (translated from Tamil) "Supposing you were offered a lottery ticket, where the prize is decided by a coin flip. You win Rs. 300 if Heads and 150 if Tails. What is the maximum you would be willing to pay for the lottery ticket?" This was used to compute the Arrow-Pratt coefficient of risk aversion

is included to capture preference for some degree of price insurance with contracting. All of these constitute elements of the farmers participation and incentive compatibility constraint.

Farmer characteristics are represented by age, education status, family size, proxies for wealth status, including the field investigators' assessment of the relative poverty of the household in the sample village. Farm size that is often a critical factor is assessing whether contract farming schemes are inclusive of smallhodler is represented both by land owned and land leased in. Irrigation facilites are also accounted for in the model both in terms of whether the land is irrigated or not and the proportion of land that has irrigation. Distance of the farmer residence from the nearest road and the nearest market representing the firms costs of contracting with the farmer are also included. Sunk costs and debt are included. These are codetermined with contracting status since for example being able to contract for broiler necessarily means a one time investment in sheds. Debt might be related to the need to make large scale investments. The coefficients are however robust to the exclusion of these variables.

Commodity specific dummies account for significant differences across schemes. These conflate a large number of important attributes that deserve closer attention. For example, the degree to which social contact plays a role in farmer identificiation, the differences in the nature of contract and what the firm brings to the relationship and different market structures associated with both the industry and the specific alternate markets available to the farmer, etc. [31] For these reasons, the results of the regression have limited interpretative value in terms of understanding the heterogeneity of contract farming arrangements. Similar regression models are run separately for the different contract commodities and are presented separately.

Table 7 presents summary statistics and regressions are run for the two phases separately owing to a difference in the variables available. The standard errors are clustered at the village level for Phase 1.Table 8 presents results separately for Phase 1 and Phase 2. In both models, some combination of attributes representing farmer perceptions emerge statistically significant in explaining the variation in contracting status. Notably the combined risk score is statistically significant, so that higher the net risk the farmer perceives he or she is taking on with contracting, the lower the probability that the farmer currently contracts.

[31] For both papaya and poultry, the identification of farmers is primarily through social networks and contacts; 57% of papaya contract farmers and 95% of broiler growers entered into contracts based on preexisting social relationships with the firm's employees. For marigold and gherkins, the firms tend to identify a small region and then canvass in the villages within that region for farmers who might be willing to contract. Only 8% of all gherkins contract farmers and about 12% of marigold contract farmers were selected based on social networks.

This is borne out strongly by regressions run separately for the different contracting schemes (Appendix Tables 9 to 14). These affirm that farmers care about entire distributions and certainly of higher order moments and not just mean and variance and that these matter in a relative sense depending on the specific alternatives to contracting with the subject firm that are available to the farmer. Farmer perceptions of the risk attenuating and exacerbating factors are also associated with contracting status, underscoring the importance of not treating farmer decisions as coming from an expected utility framwork.

The following are tables that present results from commodity specific regression models of contracting status on a set of explanatory variables including farmer risk perceptions, farmer and farm characteristics, etc. These are meant as robustness checks for the statistical significance of the relative moments of subjective net returns distributions and the combined risk score after controlling for other relevant characteristics. All regressions are run for a commodity specific sample and regress contract participation with reference to the subject firm, conditioned on the subject firm contracting in the given block.

Table 7: Summary Statistics of Dependent and Explanatory Variables

Explanatory Variable	Phase 1 (N=348)				Phase 2 (N=474)			
	Mean or Proportion	Std. Dev.	Min	Max	Mean or Proportion	Std. Dev.	Min	Max
(D) Contracting status (1=Currently contracting with Subject firm, 0=Not currently contracting with Subject firm)	51.9%	NA	0	1	28.74%	NA	0	1
Land owned (acres)	3.9	4.3	0	37.8	5.7	8.3	0	106
Land leased (acres)	0.2	1.3	0	14	0.4	3.8	0	80
Percentage of operated land irrigated	52.0	36.1	0	100	76.7	30.3	0	100
(D) Rainfed farm	67.93%		0	1	94.54%		0	1
Age (years)	42.9	12.0	18	83	44.9	11.1	22	80
Household size	5.1	1.7	1	12	4.4	1.5	2	12
Distance from nearest surfaced road (kms)	1.23	1.65	0	18	1.39	4.64	0	50
Distance from the nearest wholesale market (kms)	7.43	9.6	0	75	1.65	16.53	0	150
Debt (Rs.'000)	42.8	78.3	0	700	98.98	179.94	0	2000
Percentage of food purchased in the past 365 days	58.4	26.4	0	100	88.2	15.7	0	100
Sunk Cost (Rs. '000)	0.40	2.15	0	30	16.88	38.34	0	275
(D) Family belongs to the bottom 40% of households in the village	30.75%	NA	0	1	31.22%	NA	0	1
(D) Piped Water	46.09%	NA	-	-	-	-	0	1
Livestock (Cows and buffaloes)	1.9	2.4	0	30	-	-	-	-
Livestock (Goats)	0.9	2.8	0	40	-	-	-	-
(D) Heat source is LPG	55.27%	NA	-	-	-	-	0	1
(D) Electricity for light	92.36%	-	-	-	-	-	0	1
(D) Scheduled Castes and Tribes (SC/STs)	19.83%	NA	0	1	4.64%	NA	0	1
(D) Other Backward Castes	79.6%	NA	0	1	93.88%	NA	0	1
(D) The most educated member of the family is illiterate	2.87%	NA	0	1	6.75%	NA	0	1
(D) Farmer has post-secondary education	2.59%	NA	0	1	8.65%	NA	0	1
Risk aversion to open market prices	-	-	-	-	3.3	2.3	0	13
Combined Risk Score	42.1	100	-195	400	-184	248	-1297	455
Ratio of coefficient of variation	1.3	1.3	0.1	11.8	0.2	0.1	0	1
Ratio of mean returns	1.7	3.2	0.01	50	1.6	2.8	0	27
Difference in skewness	-0.1	1.0	-4.9	2.7	0.1	0.8	-3	3
Ratio of kurtosis	1.1	0.5	0.1	5.2	1.0	0.3	0	4
(D) FOSD	35.63%	NA	0	1	26.7%	NA	0	1
(D) SOSD	40.23%	NA	0	1	29.54%	NA	0	1
Risk Aversion Coefficient	0.2	0.0	0.08	0.24	0.2	0.0	0	0
(D) Ambiguity Aversion	-	-	-	-	56.54%	NA	0	1
(D) Gherkins	-	-	-	-	24.47%	NA	0	1
(D) Marigold	-	-	-	-	25.53%	NA	0	1
(D) Broiler	-	-	-	-	29.11%	NA	0	1
(D) Cotton	43.20%	NA	0	1	-	-	-	
Number of marigold contract hamlets	-	-	-	-	4	6	0	16
Number of gherkins contract hamlets	8	9	0	22	6	12	0	33
Number of broiler contract hamlets	-	-	-	-	3	6	0	20
Number of papaya contract hamlets	-	-	-	-	1	2	0	7
Number of cotton contract hamlets	3	5	0	11	-	-	-	

Significance levels : * : 10% ** : 5% *** : 1%

[1] AME refers to Average Marginal Effects.
[2] (D) refers to dummy variables that equal 1 if the description is valid and 0 otherwise.
[3] For details on computation of combined risk scores see text in the paper.
[4] FOSD is a dummy variable that equals 1 if the subjective net returns from contracting first order stochastically dominates not contracting; SOSD is a dummy variable that equals 1 if the subjective net returns from contracting second order stochastically dominates not contracting.
[4] Risk aversion to open market prices denotes the coefficient of risk aversion computed from the bid or asking price of risk elicited in the survey multiplied by the coefficient of variation of the alternative /spot market price of the contract commodity in question.
[5] The dummy on whether or not the household belong to the bottom quintile is an investigator-recorded perception of relative status of the household in the hamlet surveyed.

Table 8: Farmer Perceptions and Contracting Status : Regression Results with Comodity Fixed Effects

	Phase 2	**Phase 1**
Explanatory Variable	Z-statistic	Z-statistic
Land owned (acres)	1.10	-2.21 **
Land leased (acres)	1.19	-0.7
Percentage of operated land irrigated	0.13	1.36
(D) Rainfed farm	0.76	-0.46
Age (years)	-2.35 **	-1.7 *
Household size	0.69	-1.48
Distance from nearest surfaced road (kms)	1.41	1.15
Distance from the nearest wholesale market (kms)	1.52	2.65 ***
Debt ('000 Rs.)	1.64 *	0.68
Percentage of food purchased in the past 365 days	1.30	-0.85
Sunk Cost (Rs. '00,000)	4.89 ***	0.29
(D) Family belongs to the bottom 40% of households in the village	-2.30 **	-1.36
(D) Piped Water	-1.51	-
Livestock (Cows and buffaloes)	-	-1.78 *
Livestock (Goats)	-	0.32
(D) Heat source is LPG	-1.02	-
(D) Electricity for light	-0.11	-
(D) Scheduled Castes and Tribes (SC/STs)	2.54 **	11.75 ***
(D) Other Backward Castes	0.09	12.04 ***
The most educated member of the family is illiterate	0.43	0.11
Farmer has post-secondary education	-1.61 **	-1.24
Risk aversion to open market prices	-2.23 **	-
Combined Risk Score	-1.84 *	-3.54 ***
Ratio of coefficient of variation	0.14	-0.07
Ratio of mean returns	0.98	0.6
Difference in skewness	-0.95	0.58
Ratio of kurtosis	-1.74 *	0.52
(D) FOSD	-1.08	1.14
(D) SOSD	0.04	-0.78
Risk Aversion Coefficient	1.52	-0.61
(D) Ambiguity Aversion	1.18	-
(D) Gherkins	-2.25 **	-
(D) Marigold	-0.37	-
(D) Broiler	-4.20 ***	-
(D) Cotton	-	2.02 **
Number of marigold contract hamlets	-0.67	-
Number of gherkins contract hamlets	-2.25 **	0.09
Number of broiler contract hamlets	-1.2	-
Number of papaya contract hamlets	0	-
Number of cotton contract hamlets	-	1.19
Constant	0.63	-4.33 ***
Log pseudolikelihood	-210	-163.73
N	419	307
Proportion of observations classified correctly	74.23%	72.64%
Likelihood Ratio	$\chi^2_{32} = 156.6$	$\chi^2_{29} = 60.05$
p-value	0.00 ***	0.00 ***
Wald Statistic	$\chi^2_{29} = 444.20$	$\chi^2_{36} = 1095.54$
p-value	0.00 ***	0.00 ***
Pseudo R2	0.155	0.2769
Clusters	54	5

Significance levels : * : 10% ** : 5% *** : 1%

[1] Models are run separately for Phase 1 and 2. Not all variables were collected for both phases, explaining the blanks in the table.
[2] (D) refers to dummy variables that equal 1 if the description is valid and 0 otherwise.
[3] For details on computation of combined risk scores see text in the paper.
[4] FOSD is a dummy variable that equals 1 if the subjective net returns from contracting first order stochastically dominates not contracting; SOSD is a dummy variable that equals 1 if the subjective net returns from contracting second order stochastically dominates not contracting.
[4] Risk aversion to open market prices denotes the coefficient of risk aversion computed from the bid or asking price of risk elicited in the survey multiplied by the coefficient of variation of the alternative /spot market price of the contract commodity in question.
[5] The dummy on whether or not the household belong to the bottom quintile is an investigator-recorded perception of relative status of the household in the hamlet surveyed.
[6] The total numer of observations reflects those for which data was complete.

Table 9: Farmer Perceptions and Contracting Status: Results from Commodity-specific Regression Models

	Marigold		Broiler		Gherkins 2		Gherkins 1		Cotton		Papaya	
Explanatory Variable	Z-stat.	AME	Z-stat.	AME	Z-stat.	AME	Z-stat.	AME	Z-stat.	AME	Z-stat.	AME
Land owned (acres)	2.5	0.024 **	0.1	0	-0.75	0	2.04	0.008 **	-2.28	-0.023 **	0.55	0.002
Distance from nearest surfaced road (kms)	-1.2	-0.005	1.4	0.053	2.18	0.15 **	-3.25	-0.0001 ***	1.62	0	-0.97	-0.006
Distance from the nearest wholesale market (kms)	0.4	0	1.2	0	-0.61	0	2.17	0.004 **	5.48	0.04 ***	-1.42	0
Percentage of operated land irrigated	2	0.001 *	-1.1	-0.001	0.63	0	0.34	0.0002	1.36	0.001	-1.12	-0.001
(D) Rainfed farm	3.7	0.206 ***	-0.5	-0.029	-0.55	-0.06	0.52	0.0313	1.22	0.06		
Age (years)	0.2	0	-0.3	-0.001	-1.51	-0.01	0	0	-4.15	-0.012 ***	-0.64	-0.002
Household size	3.2	0.059 ***	-0.6	-0.02	0.92	0.01	0.67	0.0076	-2.55	-0.051 ***	-1.49	-0.03
Percentage of annual income from cultivation	-3	-0.009 ***	2.6	0.003 ***	1.57	0	2.23	0.0016 **	-1.77	-0.003 *	-0.77	-0.001
Debt ('000 Rs.)	0.2	0.033	1	0.076	-2.36	-0.68 **	1.19	0.0003	-0.04	0	-3.21	-1.966 ***
Percentage of food purchased in the past 365 days	-2	-0.004 **	-2.4	-0.005 **	1.31	0	-1.01	-0.0012	0.74	0.001	3.29	0.007 ***
(D) Family belongs to the bottom 40% of households in the village	-1.5	-0.107			0.87	0.06	-0.35	-0.0241	-1.17	-0.116	-2.12	-0.102 **
(D) Farmer is illiterate	2.1	0.105 **	-2.6	-0.176 **	0.3	0.02	0.7	0.0677	-0.37	-0.049	-1.86	-0.156 *
(D) The most educated member of the family is illiterate	0.7	0.049			2.42	0.12 **	-0.19	-0.0071	1.39	0.314	-1.86	-0.148 *
(D) Scheduled Caste or Tribe	2.6	0.465 ***	1.6	0.171	-	-	-	-	0.95	0.194	2.57	0.227 ***
Risk aversion to open market prices	-0.1	-0.004	-2.5	-0.001 **	2.51	0.58 **	0.68	0.1629	0.37	0.026	-0.9	-0.027
Combined Risk Score (for commodity-specific control farmers)	-7.1	-0.001 ***	0.5	0.091	0.67	0	-2.96	-0.001 ***	-0.31	0	-1.48	0
Ratio of coefficient of variation	-0.1	-0.059	-1.1	-0.422	2.44	0.4 **	0.99	0.0197	-0.2	-0.026	0.89	0.286
Ratio of mean returns	0.5	0.011	3.4	0.242 ***	0.94	0.01	1.71	0.0065 *	1.24	0.022	-	-
Difference in skewness	0.6	0.022	-	-	-2.12	-0.13 **	-0.83	-0.0209	3.11	0.055 ***	-1.98	-0.061 **
(D) FOSD	-3.7	-0.323 ***	-	-	-0.35	-0.07	-0.11	-0.0122	-0.27	-0.037	-	-
(D) SOSD	4.2	0.244 ***	-	-	0.01	0	-0.03	-0.0034	-0.01	-0.002	-	-
Number of contract hamlets in the block	-1.9	-0.044 *	0.8	0.017	-0.21	0	0.16	0.0008	1.72	0.017 *	-0.67	-0.037
Number of contract villages in the block	-	-	-1.2	-0.038	-	-	-	-	-	-	0.27	0.047
Sunk Cost (Rs.'00,000)	-	-	4	0.3 ***	2.01	0.6 **	0.05	0.04	-	-	4.27	0.2 ***
Constant	1		-0.5		-3.88	***	-1.24		1.7	*	0.06	
Log pseudolikelihood	-32.28		-56.2		-59.19		-81.83		-70.24		-59	
N	125		138		120		191		148		170	
Proportion of observations classified correctly	88		88		74		82		76		84	
Likelihood Ratio	LR(15)=108.3		LR(18)=274		LR(6)=46.8		LR(12)=29.7		LR(7)=58.6		LR(20)=110.99	
p-value	0 ***		0 ***		0 ***		0 ***		0 ***		0 ***	
Pseudo R2	0.63		0.40		0.28		0.1536		0.29		0	
Clusters	18		45		8		14		8		30	

Significance levels : * : 10% ** : 5% *** : 1%

[1] AME refers to Average Marginal Effects.
[2] (D) refers to dummy variables that equal 1 if the description is valid and 0 otherwise.
[3] For details on computation of combined risk scores, see Chapter text in tis paper.
[4] FOSD is a dummy variable that equals 1 if the subjective net returns from contracting first order stochastically dominates not contracting; SOSD is a dummy variable that equals 1 if the subjective net returns from contracting second order stochastically dominates not contracting.
[4] Risk aversion to open market prices denotes the coefficient of risk aversion computed from the bid or asking price of risk elicited in the survey multiplied by the coefficient of variation of the alternative /spot market price of the contract commodity in question.
[5] The dummy on whether or not the household belong to the bottom quintile is an investigator-recorded perception of relative status of the household in the hamlet surveyed.

Table 10: Summary Statistics for Farmer Selection:Marigold

	Farmers excl. Subject Contract Farmers (n=62)				Subject Contract farmers (n=59)			
	Mean or Proportion	Standard Deviation	Minimum	Maximum	Mean or Proportion	Standard Deviation	Minimum	Maximum
Explanatory variable								
Land owned (acres)	4.4	2.3	1	15	5.2	3.8	1	25
Distance from the nearest wholesale market	4.1	11.8	0.1	50	1.6	1.8	0	10
Distance from the nearest wholesale market (kms.)	21.81	15.67	0	60	28	21	1	80
Percentage of operated land irrigated(%)	79.8	35.8	0	100	90.2	23.2	0	100
(D) Farmers whose main source of irrigation is rain (%)	65.0	N.A	0	1	53	N.A.	0	1
Age (years)	42.1	9.5	23	70	45.3	12.3	25	80
Household size	4.1	1.1	2	10	4.4	1.8	2	12
Percentage of annual income from cultivation(%)	100.0	0.0	100	100	97	8.7	50	100
Debt (Rs.)	0.2	0.1	0	0.7	0.2	0.3	0	2
Percentage of food purchased (%)	78.5	8.6	60	100	78.1	13.6	0	95
(D) Family belongs to the botton 40% of households in the village(%)	52	N.A	0	1	44	N.A.	0	1
(D) Farmer is illiterate (%)	29.0	N.A	0	1	44	N.A.	0	1
(D) The most educated member of the family has completed primary school (%)	27.0	N.A	0	1	46	N.A.	0	1
(D) The most educated member of the family is illiterate (%)	2.0	N.A	0	0	0	N.A.	0	0
(D) Scheduled Caste or Tribe (%)	2.0	N.A	0	1	27	N.A.	0	1
Risk aversion to open market prices	6.7	0.9	5	8	6.4	1.3	2	13
Combined risk score for commodity-specific control farmers	-393.4	126.9	-668	-72	-601.7	169.1	-1297	0
Ratio of mean returns from contracting over next best alternative	1.2	1.4	0	7	0.8	0.7	0	3
Ratio of coefficient of variation in returns from contracting and next best alternative	0.2	0.1	0	0	0.2	0.1	0	1
Difference in Skewness in returns from contracting and next best alternative	0.3	1.0	-3	3	0.3	1	-2	3
(D) Contracting first order stochastic dominates next best alternative (%)	23	N.A			14	N.A.	0	1
(D) Contracting second order stochastic dominates next best alternative (%)	25	N.A			19	N.A.	0	1
The number of villages in the block the firm contracts in	3.2	1.3	0	5	4.3	1	3	5
The number of hamlets sample firm procures from in the block	13.1	5.0	0	16	12	2.9	10	16
Sunk Cost (Rs.)	0.0	0.0	0	0	719	5402	0	41500

[1] (D) refers to binary variables that take the value of 0 or 1. The percentage of responses are reported for these instead of the mean. N.A. means Not Applicable.
[2] Subject Contract farmers refer to those who contract with the subject firm for a particular commodity. All Farmers excluding Subject Contract Farmers refer to those who were selected from among those who do not contract with the Subject firm and include farmers who contract the same commodity with another, grow the contract commodity for the open market, have ceased contracting with the subject firm and those who never contracted with the subject firm.

Table 11: Summary Statistics for Farmer Selection:Broiler

	Farmers excl. Subject Contract Farmers (n=77)				Subject Contract farmers (n=61)			
	Mean or Proportion	Standard Deviation	Minimum	Maximum	Mean or Proportion	Standard Deviation	Minimum	Maximum
Explanatory variable								
Land owned (acres)	11.5	16.4	0	106	7.4	6.8	0	45
Distance from nearest surfaced road (meters)	0.1	0.4	0	3	0.3	0.8	0	5
Distance from the nearest wholesale market (kms.)	17.20	17.69	2.5	150	20.2	20.6	3	150
Percentage of operated land irrigated(%)	77.9	29.6	0	100	56.4	32.6	0	100
(D) Farmers whose main source of irrigation is rain (%)	0	N.A	0	1	38	N.A.	0	1
Age (years)	50.8	10.5	31	75	46.4	11.7	29	75
Household size	3.6	0.8	2	7	3.6	0.8	2	5
Percentage of annual income from cultivation(%)	88.0	21.3	50	100	93.4	17	25	100
Debt (Rs.)	0.1	0.1	0	0.6	0.2	0.3	0	2
Percentage of food purchased (%)	100.0	0.0	100	100	98	10.9	30	100
(D) Family belongs to the botton 40% of households in the village(%)	0	N.A	0	0	0	N.A.	0	0
(D) Farmer is illiterate (%)	18	N.A	0	1	3	N.A.	0	1
(D) The most educated member of the family has completed primary school (%)	50	N.A	0	1	49	N.A.	0	1
(D) The most educated member of the family is illiterate (%)	0	N.A	0	0	0	N.A.	0	0
(D) Scheduled Caste or Tribe (%)	0	N.A	0	0	2	N.A.	0	1
Risk aversion to open market prices	1.7	0.3	0.7	2.0	1.6	0.4	0	2
Combined risk score for commodity-specific control farmers	-71.6	131.1	-379	175	-193.7	78.4	-367.5	-23
Ratio of mean returns from contracting over next best alternative	0.3	0.2	0	0.8	0.2	0.2	0	0.5
Ratio of coefficient of variation in returns from contracting and next best alternative	0.1	0.1	0	0.4	0.1	0.1	0	0.3
Difference in Skewness in returns from contracting and next best alternative	-0.1	0.3	-1.3	0.7	0.1	0.3	-0.5	1
The number of villages in the block the firm contracts in	6.3	3.4	0	12	6.9	3.9	0	12
The number of hamlets sample firm procures from in the block	9.6	5.4	0	20	10.5	6.1	0	20
Sunk Cost (Rs.)	22184.7	42207.8	0	160800	82700	39411	25500	211580

[1] (D) refers to binary variables that take the value of 0 or 1. The percentage of responses are reported for these instead of the mean. N.A. means Not Applicable.
[2] Subject Contract farmers refer to those who contract with the subject firm for a particular commodity. All Farmers excluding Subject Contract Farmers refer to those who were selected from among those who do not contract with the Subject firm and include farmers who contract the same commodity with another, grow the contract commodity for the open market, have ceased contracting with the subject firm and those who never contracted with the subject firm.

Table 12: Summary Statistics for Farmer Selection: Gherkins Phase 2

	Farmers excl. Subject Contract Farmers (n=62)				Subject Contract farmers (n=54)			
	Mean or Proportion	Standard Deviation	Minimum	Maximum	Mean or Proportion	Standard Deviation	Minimum	Maximum
Explanatory variable								
Land owned (acres)	2.3	1.8	0.3	7.5	2.4	5.4	0	40
Distance from the nearest wholesale market	0.3	0.3	0.02	1.5	0.4	0.6	0	3
Distance from the nearest wholesale market (kms.)	12.3	14.9	0	60	12.4	7.9	0	40
Percentage of operated land irrigated(%)	64.3	29.5	0	100	74.1	28.6	17	100
(D) Farmers whose main source of irrigation is rain (%)	100	N.A.	0	1	98	N.A.	0	1
Age (years)	43.6	10.9	27	79	37.4	8.9	22	70
Household size	5.4	1.6	2	10	5.5	1.9	3	12
Percentage of annual income from cultivation(%)	73.1	28.9	0	100	79.1	20.9	20	100
Debt (Rs.)	0.1	0.1	0	0.6	0	0	0	0
Percentage of food purchased (%)	76.4	17.7	40	100	83.7	17.4	30	100
(D) Family belongs to the botton 40% of households in the village(%)	48.4	N.A.	0	1	57	N.A.	0	1
(D) Farmer is illiterate (%)	22.6	N.A.	0	1	20	N.A.	0	1
(D) The most educated member of the family has completed primary school (%)	33.9	N.A.	0	1	30	N.A.	0	1
(D) The most educated member of the family is illiterate (%)	0.0	N.A.	0	0	0	N.A.	0	0
Scheduled Caste or Tribe (%)	0.0	0.0	0	0	0	0	0	0
Risk aversion to open market prices	1.3	0.1	1.1	1.5	1.3	0.1	1	1
Combined risk score for commodity-specific control farmers	5.6	141.1	-325	337.5	-5.6	182	-400	350
Ratio of mean returns from contracting over next best alternative	3.0	3.8	0.35	26.7	3.4	5.2	0	25
Ratio of coefficient of variation in returns from contracting and next best alternative	0.3	0.1	0.1	0.7	0.3	0.2	0	1
Difference in Skewness in returns from contracting and next best alternative	0.1	0.6	-1.7	1.7	-0.1	0.6	-1	2
(D) Contracting first order stochastic dominates next best alternative (%)	61.3	N.A.	0	1	56	N.A.	0	1
(D) Contracting second order stochastic dominates next best alternative (%)	66.1	N.A.	0	1	59	N.A.	0	1
The number of villages in the block the firm contracts in	8.6	3.8	2	11	7.9	4	2	11
The number of hamlets sample firm procures from in the block	25.2	12.4	6	33	22.5	13.3	6	33
Sunk Cost (Rs.) 2354.8	7292.7	0	28000	10685	38757	0	275000	

[1] (D) refers to binary variables that take the value of 0 or 1. The percentage of responses are reported for these instead of the mean. N.A. means Not Applicable.
[2] Subject Contract farmers refer to those who contract with the subject firm for a particular commodity. All Farmers excluding Subject Contract Farmers refer to those who were selected from among those who do not contract with the Subject firm and include farmers who contract the same commodity with another, grow the contract commodity for the open market, have ceased contracting with the subject firm and those who never contracted with the subject firm.

Table 13: Summary Statistics for Farmer Selection: Gherkins Phase 1

	Farmers excl. Subject Contract Farmers (n=158)				Subject Contract farmers (n=40)			
	Mean or Proportion	Standard Deviation	Minimum	Maximum	Mean or Proportion	Standard Deviation	Minimum	Maximum
Explanatory variable								
Land owned (acres)	2.4	3.2	0	37.8	2.5	2.1	0	10
Distance from nearest surfaced road (meters)	1073.0	1536.6	0	16000	775	735.1	20	3000
Distance from the nearest wholesale market (kms.)	9.36	10.43	0	75	14.3	14.8	0	60
Percentage of operated land irrigated(%)	52.5	33.9	0	100	57.3	40.6	0	100
(D) Farmers whose main source of irrigation is rain (%)	95.0	N.A	0	1	93	N.A	0	1
Age (years)	39.6	12.5	1	83	40.2	11.9	18	60
Household size	5.4	1.7	1	10	5.4	1.6	3	11
Percentage of annual income from cultivation(%)	64.7	28.9	5	100	70.3	27.2	10	100
Debt (Rs.)	40.5	77.8	0	700	55.3	80.7	0	400
Percentage of food purchased (%)	54.3	27.0	0	100	51.7	30.4	0	100
(D) Family belongs to the botton 40% of households in the village(%)	44.0	N.A	0	1	38	N.A	0	1
(D) Farmer is illiterate (%)	15.0	N.A	0	1	18	N.A	0	1
(D) The most educated member of the family has completed primary school (%)	44.0	N.A	0	1	40	N.A	0	1
(D) The most educated member of the family is illiterate (%)	0.0	N.A	0	0	0	N.A	0	0
(D) Scheduled Caste or Tribe (%)	31.0	N.A	0	1	28	N.A	0	1
Risk aversion to open market prices	1.2	0.1	1	2	1.2	0.1	1	1
Combined risk score for commodity-specific control farmers	55.5	99.8	-150	375	-0.4	103.7	-195	289
Ratio of mean returns from contracting over next best alternative	1.7	4.2	0	50	2.1	1.4	0	6
Ratio of coefficient of variation in returns from contracting and next best alternative	1.1	1.1	0	9	1.5	0.9	0	5
Difference in Skewness in returns from contracting and next best alternative	0.0	0.8	-4	2	0	0.9	-3	2
(D) Contracting first order stochastic dominates next best alternative (%)	48.0	N.A	0	1	35	N.A	0	1
(D) Contracting second order stochastic dominates next best alternative (%)	48.0	N.A	0		45	N.A	0	1
The number of villages in the block the firm contracts in	4.8	3.0	1	1	5.1	2.9	1	8
The number of hamlets sample firm procures from in the block	13.3	8.2	2	22	14.1	7.9	2	22
Sunk Cost (Rs.)	512.7	3030.1	0	30000	640	1303	0	5000

[1] (D) refers to binary variables that take the value of 0 or 1. The percentage of responses are reported for these instead of the mean. N.A. means Not Applicable.
[2] Subject Contract farmers refer to those who contract with the subject firm for a particular commodity. All Farmers excluding Subject Contract Farmers refer to those who were selected from among those who do not contract with the Subject firm and include farmers who contract the same commodity with another, grow the contract commodity for the open market, have ceased contracting with the subject firm and those who never contracted with the subject firm.

Table 14: Summary Statistics for Farmer Selection:Cotton

	Farmers excl. Subject Contract Farmers(n=90)				Subject Contract farmers (n=60)			
	Mean or Proportion	Standard Deviation	Minimum	Maximum	Mean or Proportion	Standard Deviation	Minimum	Maximum
Explanatory variable								
Land owned (acres)	6.8	5.9	0	30	4.5	2.4	0	12
Distance from nearest surfaced road (meters)	1304.5	1175.5	1.5	6000	1843.8	2602.2	55	18000
Distance from the nearest wholesale market (kms.)	3.04	2.73	1	12	4.3	3.2	0.2	12
Percentage of operated land irrigated(%)	47.8	39.5	0	100	53.6	33.2	0	100
(D) Farmers whose main source of irrigation is rain (%)	94	N.A	0	1	95	N.A	0	1
Age (years)	49.2	10.2	19	72	43.9	9.1	25	70
Household size	4.9	1.9	2	12	4.2	1.2	2	8
Percentage of annual income from cultivation(%)	72.9	33.6	5	100	62	35.7	10	100
Debt (Rs.)	45.4	86.1	0	500	37	65.4	0	300
Percentage of food purchased (%)	64.3	23.1	5	100	64.9	24.3	0	100
(D) Family belongs to the botton 40% of households in the village(%)	17	N.A	0	1	12	N.A	0	1
(D) Farmer is illiterate (%)	17	N.A	0	1	8	N.A	0	1
(D) The most educated member of the family has completed primary school (%)	49	N.A	0	1	57	N.A	0	1
(D) The most educated member of the family is illiterate (%)	0	N.A	0	1	0	N.A	0	0
(D) Scheduled Caste or Tribe (%)	3	N.A	0	1	10	N.A	0	1
Risk aversion to open market prices	3.2	0.5	1	4	3.2	0.4	1	4
Combined risk score for commodity-specific control farmers	46.5	101.8	-150	309	28.2	84.7	-130	400
Ratio of mean returns from contracting over next best alternative	1.1	1.6	0	13	1.4	1.6	0	8
Ratio of coefficient of variation in returns from contracting and next best alternative	0.2	0.3	0	2	0.2	0.2	0	1
Difference in Skewness in returns from contracting and next best alternative	-0.2	1.1	-5	2	-0.1	1	-3	3
(D) Contracting first order stochastic dominates next best alternative (%)	29.0	N.A			28	N.A		
(D) Contracting second order stochastic dominates next best alternative (%)	32.0	N.A			30	N.A		
The number of villages in the block the firm contracts in	3.1	1.0	2	4	3.3	1	2	4
The number of hamlets sample firm procures from in the block	7.5	4.0	3	11	8.3	3.8	3	11
Sunk Cost (Rs.)	175	672.963	0	4000	303	935	0	5000

[1] (D) refers to binary variables that take the value of 0 or 1. The percentage of responses are reported for these instead of the mean. N.A. means Not Applicable.
[2] Subject Contract farmers refer to those who contract with the subject firm for a particular commodity. All Farmers excluding Subject Contract Farmers refer to those who were selected from among those who do not contract with the Subject firm and include farmers who contract the same commodity with another, grow the contract commodity for the open market, have ceased contracting with the subject firm and those who never contracted with the subject firm.

Table 15: Summary Statistics for Farmer Selection:Papaya

	Farmers excl. Subject Contract Farmers (n=27)				Subject Contract farmers (n=72)			
	Mean or Proportion	Standard Deviation	Minimum	Maximum	Mean or Proportion	Standard Deviation	Minimum	Maximum
Explanatory variable								
Land owned (acres)	3.4	2.2	0	9	5.7	5	0	25
Distance from nearest surfaced road (meters)	0.5	0.4	0.01	1.5	0.8	1.4	0	6
Distance from the nearest wholesale market (kms.)	9.47	5.99	500	20	8.2	6.4	1	30
(D) Percentage of operated land irrigated(%)	84.8	20.6	40	100	88.3	20.1	30	100
Farmers whose main source of irrigation is rain (%)	XX	N.A	1	1	90	N.A.	1	1
Age (years)	48.3	10.3	31	70	45.1	9.5	27	70
Household size	4.6	1.6	2	9	4.3	1	3	7
Percentage of annual income from cultivation(%)	78.1	23.5	30	100	78.8	27.9	10	100
Debt (Rs.)	0.0	0.0	0	0.15	0	0	0	0
Percentage of food purchased (%)	90.9	17.5	30	100	96.3	10.9	50	100
(D) Family belongs to the botton 40% of households in the village(%)	41	N.A	0	1	25	N.A.	0	1
(D) Farmer is illiterate (%)	19	N.A	0	1	7	N.A.	0	1
(D) The most educated member of the family has completed primary school (%)	19	N.A	0	1	39	N.A.	0	1
(D) The most educated member of the family is illiterate (%)	48	N.A	0	0	0	N.A.	0	0
Scheduled Caste or Tribe (%)	0	0.0	0	0	0.1	0.2	0	1
Risk aversion to open market prices	4.4	0.7	2.18	5.68	4.1	1.3	0	6
Combined risk score for commodity-specific control farmers	-106.9	146.7	-490	130	-96.1	186.2	-610	455
Ratio of mean returns from contracting over next best alternative	2.7	2.6	0.18	10.88	1.3	1	0	4
Ratio of coefficient of variation in returns from contracting and next best alternative	0.2	0.1	0.05	0.55	0.2	0.1	0	0
(D) Difference in Skewness in returns from contracting and next best alternative	0.2	0.9	-1.94	2.05	-0.1	1.1	-3	2
(D) Contracting first order stochastic dominates next best alternative (%)	52.0	N.A	0	1	32	N.A.	0	1
Contracting second order stochastic dominates next best alternative (%)	56.0	N.A	0	1	36	N.A.	0	1
The number of villages in the block the firm contracts in	1.4	0.8	0	3	1.6	0.9	1	3
The number of hamlets sample firm procures from in the block	2.4	2.3	1	7	2.9	2.6	1	7
Sunk Cost (Rs.)	0.0	0.0	0	0	6708	27135	0	200000

[1] (D) refers to binary variables that take the value of 0 or 1. The percentage of responses are reported for these instead of the mean. N.A. means Not Applicable.
[2] Subject Contract farmers refer to those who contract with the subject firm for a particular commodity. All Farmers excluding Subject Contract Farmers refer to those who were selected from among those who do not contract with the Subject firm and include farmers who contract the same commodity with another, grow the contract commodity for the open market, have ceased contracting with the subject firm and those who never contracted with the subject firm.