Transaction Costs, Institutional Arrangements and Smallholders Participation: Tomato Marketing by Small Producers in India

by Kedar Vishnu, Parmod Kumar, and Pratibha Neharkar

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July 1, 2021

Kedar Vishnu[1], Parmod Kumar [2] & Pratibha Neharkar [3]

Abstract:

The paper analyses the impacts of transaction costs on tomato farmers participation in different institutional arrangements of Modern food retail chains (MFRCs) using primary survey data collected from farmers in India. Primary survey data was carried out in 2017 in the Kolar district in Karnataka, the Southern part of India. The analysis focuses on the impacts of transaction costs differentiated as information, negotiation and monitoring costs. The paper attempts to quantify the impact of opportunistic behaviour and asymmetric information on tomato farmers' income. The study uses a non-parametric propensity score matching estimator to measure the asymmetric information and opportunistic behaviour by the MFRCs on Tomato smallholders' profits. The results show that, in addition to production cost, information, negotiation and monitoring costs affect farmers participation in the MFRCs. The study reinforces previous results and sheds light on possible policy options to support smallholders in improving their access to national and global markets. Furthermore, this study would help in implementing policies aimed at reducing TCs.

Key Words: Institutions and Growth, Agricultural Policy, Food Policy, Marketing
JEL Code: O430, Q180, M310

[1] Assistant Professor, Department of Economics, CHRIST (Deemed to be University), Pune Lavasa Campus & Doctoral fellow at Institute for Social and Economic Change (ISEC), Bangalore - 560 072. Email: kedar.vishnu@christuniversity.in

[2] Director, Institute for Social and Economic Change, Bangalore, India

[3] Ph.D Student, Department of Economics, Dr. Babasaheb Ambedkar Marathwada University (BAMU), India

We are grateful to Prof. Ashok Mishra and Dr. Alwin Dsouza from Arizona State University, USA for their valuable comments and discussions at AAEA annual meeting 2019 at Atlanta, USA. The authors are also thankful to the anonymous referees for their suggestions and comments. The usual disclaimer, however, remains.

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I. Introduction:

The existing empirical studies in developing countries have shown varied analyses of contract farming participation and welfare effects (CF). Previous studies finding revealed that CF has increased farmers' net income (e.g., Barrett et al., 2012; Bellemare, 2012). However, to what extent the CF has helped the small and marginal farmers for increase their income is questionable (Barrett et al., 2012). Some of the recent studies, Warning and Key (2002), in Senegal, Wang et al. (2011), in China, Mishra et al. (2016) in India, revealed that smallholders have been included in the emerging CF. Others, studies such as Singh (2007); Gopalakrishna & Sreenivasa (2009), in India, Guo et al. (2005), Key and Runsten (1999), in Latin America, reported the opposite.

The earlier studies findings have revealed that the CF significantly help the farmers for reducing the prices risk, input uncertainty and output uncertainty for the small and marginal farmers from developing countries. However, the participation is associated with asymmetric information and opportunist behaviour by the CF procurement managers (Allen & Lueck, 1993; Escobal & Cavero, 2012). The extend of the opportunist behaviour, and asymmetric information is higher in those countries where the institutional economics framework is missing. It is also higher for those countries where the enforcement mechanism is lacking or associated with transaction costs. The incomplete contract and asymmetric information about the required quality, procurement prices provides enormous scope for the procurement managers of the CF firm for behaving opportunistic with the small and marginal farmers (Kedar & Kumar, 2013). However, the existing studies have not given much attention to capture the details of the transaction costs

resulting from opportunist behaviour, asymmetric information and market imperfections. The lack of attempt is associated with the difficulty for quantifying the transaction costs variables for capturing the opportunistic behavior and asymmetric information on farmers' income as they are not easily accountable (Ning, 2003). This paper attempts to develop the conceptual framework for quantifying the impacts of opportunistic behaviour and asymmetric information on tomato farmers from India. In the present study, we have tried to answer some of the following research questions. To what extent has the opportunistic behavior and asymmetric information reduced the profits for the smallholders for tomato crop associated with CF companies (MFRC)? What factors determine farmers participation in CF for tomato crop? How to reduce opportunistic behaviour and asymmetric information problems with the help of an institutional framework?

II. Objective:

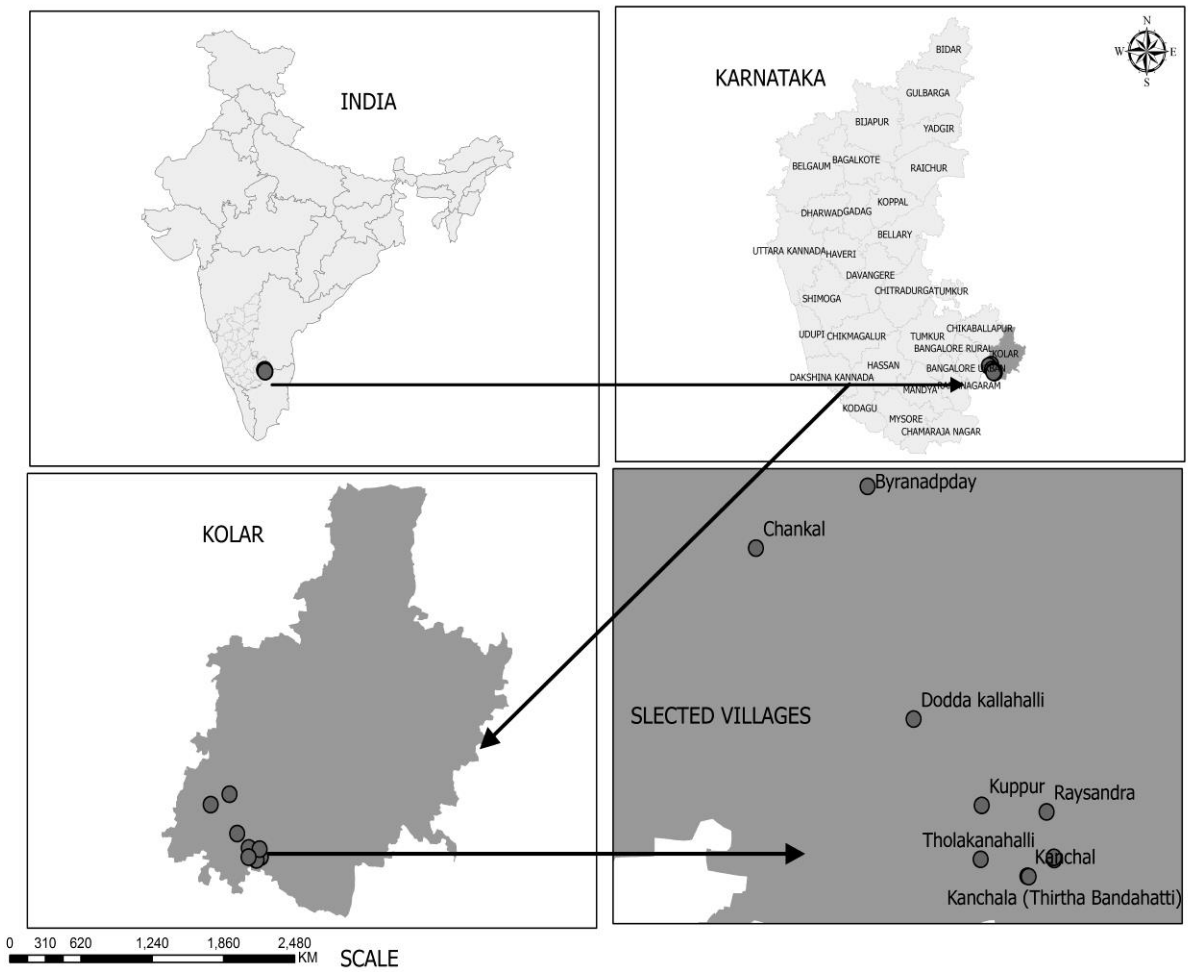
This study attempts to develop a conceptual framework for quantifying the CF firm's asymmetric information and opportunistic behaviour on Tomato smallholders' profits. Additionally, it attempts to propose some policy suggestions for reducing the opportunistic behaviour of CF firms with the help of an institutional framework. This is the first study to measure the CF firms asymmetric information and opportunistic behaviour on smallholders' profit from India.

III. Database:

The present study is based on the primary survey data collected in 2017 from the Kolar district of Karnataka, the Southern part of India. The questionnaire was designed based on the focus group discussion with Independent farmer (IF) spot market agents, CF firm managers and tomato farmers in the selected district. We have used a stratified random sampling method to select the farmers from PCs, MCs MFRCs. A list of farmers was obtained from MFRC, and 100 farmers

were randomly interviewed belonging to each supply chain. In this way, a number of 100 farmers each were interviewed belonging to production contracts (PCs), marketing contracts (MCs) and control groups (traditional spot market farmers/independent farmers) for tomato. At aggregate, a total number of 300 farmer observations are used in our paper.

Figure 1: A selected area for the primary survey



Source: Authors Primary survey (2017)

We have observed two different types of MFRCs for Tomato in the selected area. Our study considers MFRCs with production contracts (PCs) and MFRCs with marketing contracts (MCs) as they are systematically different from each other. PCs provide fixed procurement prices in

advance before sowing the crop and supply the seed and fertilizer to the farmers who agree to deliver the product after harvesting with some kind of written contract. Whereas MCs are characterized by providing technical help on chemical and fertilizer use and higher procurement price compared to the traditional market.

IV. Conceptual and Empirical Framework:

We have used a non-parametric propensity score matching estimator to measure the TCs variables (asymmetric information and opportunistic behavior by CF firms) on Tomato smallholders' profits. Nearest neighbor matching (NNM) and kernel-based matching (KBM) are used in this paper as they are the most common and essential methods used in the literature (Mishra et al. l., 2016; Wooldridge, 2010). The NNM method picks each treated unit (CF farmers) and searches for the control unit (APMC or control group farmers) with the closest propensity matching score. The main attractive feature of NNM is that all the treated units find a match (Mishra et al., 2016). In addition to this, Smith and Todd (2005) argued that matching with replacement involves a trade-off between bias and variance.

Further, an attempt is made here to identify the main determining factors for farmers' participation in CF for tomato crop from India. The empirical analysis is carried out in two stages: In the first stage, the Probit model is used to identify the factors responsible for Tomato farmers' participation in CFs (PCs and MCs MFRC) compared to independent farmers (APMC farmers). In the second stage, propensity score matching (PCM) is used to overcome selection bias. As the dependent variable, we have a binary variable that shows the farmers' choice of market channel (MFRC=1, traditional markets/control group= 0). The regressors in the market channel equation are chosen by the above conceptual. We wanted to analyse the probability of

participation and not the intensity of participation; instead of using the Tobit model, we used the probit model.

Another major issue with our cross-section data is self-section bias. The self-selection bias arises if unobservable factors influence both the error terms of the CF choice. The accuracy of the impact of participation on the outcome variable (like profit per acre), farmers should be assigned randomly between the two groups (CF and IF). But, the farmers self-select themselves into one of the two groups (Stefanides & Tauer, 1999). The adoption decision may depend on some other unobservable variables like skills, innovation, and land fertility, which may correlate with the outcome variables. Several estimation techniques are available for overcoming the selection bias problem. For solving the selection bias, few recent studies (Dehejia & Wahba, 2002; Elizaphan et al., 2012; Fischer and Qaim, 2012) used statistical matching to overcome selection bias. Several existing studies on agricultural economics (Tauer, 2009; Liu and Lynch, 2007) used the Propensity score matching (PSM) to compare the treated vs. non-treated farmers. Hence, we follow Rosenbaum and Rubin's (1985) PCM and focus our analysis on the average treatment effect on treated (ATT). Becker and Ichino (2002) argued that ATT could be considered the main parameter.

The primary purpose of the PSM is to balance the observable distribution of the covariates across the two farmers groups (CF farmers and independent farmers). It is preferred to use the balancing test to ensure that the covariates in the CFs with independent farmers samples have been eliminated. Therefore, the matched comparison group can be considered as a counterfactual. We used STATA statistical packages for empirical analysis. The details of the transaction cost variables used in the present study are shown in Table 1. We have developed the institutional

variables for capturing the impact of asymmetric information and opportunist behaviour by the procurement managers on farmers' net income.

Table 1: Variables used for measuring TCs incurred by farmers

Sl No.	Variable	Individual Transaction costs	Nature of the measurement
01	Information costs -arise prior to an exchange) - incur due to uncertainty and asymmetric information	Search for buyers and reliability of potential buyers	Actual
		Price uncertainty	Actual
		Quality standard/ product quality uncertainty	Actual
		Other information required on (seeds type + Packaging materials etc.)	Actual
02	Bargaining/ Negotiation costs (during exchange)	Lack of control over sale order [a]	Relative
		Unequal Bargaining Power	Relative
		Frequency of sale	Actual
		Cost and time spent on negotiation the prices and quality of the product with the company	Actual
		Monetary value due to opportunist behavior [b]	Actual
03	Monitoring Costs (incurred to ensure that the conditions of an exchange are met)	Product Quality	Actual
		Grade uncertainty	Actual

[a] Possible responses were 1, not a problem; 2, minor problem; 3, a problem; 4, relatively significant problem; 5, major problem.
[b] Mostly applicable for those qualities which would have been accepted by MFRCs.

Source: Authors Primary survey (2017)

V. Preliminary results:

The descriptive statistics for tomato are presented in Table 2 for MFRCs and independent farmers. The data set covers 300 tomato farmers. Table 2 reports sample mean values for PCs' household characteristics, MCs' (treatment group), and independent farmers (APMC farmers /control group) from the same region. There is not much amount of variation in the area under tomato crops among the MFRCs. However, a significant difference was observed with respect to

decision-makers age (in years) where farmers in PCs, and MCs have a higher age than independent farmers. Both PCs and MCs farmers are relatively older than independent farmers. Other existing studies finding shows that CF procurement managers prefer to purchase from the young age farmers. However, our findings for tomato crop has shown the opposite results.

Our study has revealed that the decision-maker experience was higher for MCs' than independent farmers. Our study results have shown that PCs farmers were better educated than other MCs, MFRC, and independent farmers, statistically significant. We observed that MFRC farmers borrowed more loans compared to independent farmers. Further, we calculated the percentage of decision-makers not educated, educated up to primary, secondary, and tertiary education. As expected, we found that decision-makers with primary and secondary education reported a higher percentage of participation in MFRC than independent farmers. Better educated farmers might be more aware of the MFRCs requirement of the products.

There is a general assumption in the existing literature that farmers are risk-averse, and their objective to join MFRCs is mainly to manage output and price risk (Abebe et al. 2013; Michelson et al., 2011). However, our data reveal different results. Our results showed that IF are more risk-averse than MFRCs farmers. Therefore, we argue that MFRCs prefer to source mainly from risk-loving farmers than risk-averse farmers.

Distance from farmers' agricultural fields to input and output markets have played a significant role in farmers' participation. Our finding shows that the farmers supplying to MFRCs have less distance to input markers and near good roads from farmers' fields than independent farmers. Overall, these results suggest that input markers for purchasing seed and other required agricultural equipment for producing particular commodities play a significant role than near

output markets for tomato farmers' participation. Contrary to the expectation, we found significant differences concerning distance to village leader's home and distance to bus stand, where independent farmers have reported less distance than MFRCs farmers.

On average, we found that all MFRCs had more area under tomato compared with independent farmers. Our results show that MCs' MFRC farmers reported the highest area (2.53 acres per Hh) under tomato, followed by PCs farmers (1.75 acres per Hh) as compared to independent farmers (1.61 acres per Hh). We found a significantly higher area under tomato for MCs' MFRCs than PCs MFRCs and independent farmers. Further, we discovered that PCs farmers have reported 30.90 per cent more yield (19.06 ton per acre), followed by 22.57 per cent (17.01 tons per acre) for MCs' than independent farmers (13.17 tons per acre) yield. Thus, MFRC farmers reported significantly higher yields than independent farmers.

Evidence in table 2 suggests that MFRC procurement price was significantly higher than independent framers for tomato. We found that PCs procurement price was 35.88 per cent (12.54 Rs per Kg) higher than independent farmers, followed by 13.52 per cent (9.32 Rs per Kg) for MCs' MFRC farmers. Further, we find significantly higher revenues, profits, and yield for MFRC farmers than the independent farmers for tomato. However, we observed that MFRC farmers reported higher tomato costs per acre than independent farmers (Table 2).

Table 2: Characteristics of contract and independent Tomato producers, India 2017-2018.

Variable	Independent farmers	PCs	MCs
Land area (*acre*)	6.49	6.96	8.72*
Age of head of household (HH, in *years*)	39.80	42.90*	45.92***
Farming experience of HH (*years*)	17.44	13.12	19.87
Household size (*number*)	5.0	8.0***	4.0**
Loan amount (Lakhs Per HH)	1.62	3.14*	2.12
Distance to input market (In Km)	10.7	6.43***	7.1***
Near road distant from agri. field (in kms)	2.0	1.43**	1.14***
Distance of HH agri. field from home (in kms)	0.68	1.17***	1.94***
Near other collection centers (in Kms)	13.84	18.39**	16.22
Near output market distance from agri. field (kms.)	16.70	27.16***	9.84***
HH member, perceiving high risk (*%*)	20.00	41.18	38.00
HH member, perceiving medium risk (*%*)	30.00	58.82	62.0**
HH member, lower medium risk (*%*)	46.00	0.00	26.00
HH member, perceiving no risk (*%*)	4.00	0.00	0.00
HH member, education (in *years*)	6.48	9.61***	7.42
HH member, illiterate (*%*)	12.00	2.00**	6.00
HH member, primary education (*%*)	32.00	16.00**	32.00
HH member, secondary school education (*%*)	22.00	37.25*	30.00
HH member, Tertiary education (*%*)	34.00	45.10	32.00
Area under tomato per acre	1.61	1.75	2.53**
Total labour cost acre (*Rs*)	7,684	9,554**	7096
Total input per acre (*Rs*)	41581.9	66342	56698
Total variable costs[a] per acre (*Rs*)	30828	25784*	26649
Total cost per acre (*Rs*)	80094	101670***	90443
Total revenue per acre (*RS*)	94082	177516***	110655**
Total profit per acre (*Rs*)	13988	75836***	20212*
Procurement Prices (Rs per Kg.)	8.06	12.57***	9.32
Yield (Kg. *per acre*)	13.17	19.06***	17.01***
Total cost per quintal (*Rs*)	608	533	532
Net profit per quintal (*NPR*)	106	398	119
Number of observations	*200*	*200*	*200*

Note: [a] Also known as operation costs, includes seeds, seed treatment, fertiliser (urea, potash, DAP), micronutrients, manure, and pesticides, and miscellaneous.
*Significant at the 10% level; **Significant at the 5%; ***Significant at the 1% level.
Source: Authors Primary survey (2017)

VI. Empirical Results of the Probit model:

Table 3 shows the results of different probit models for PCs, MCs' MFRC vs. independent farmers, where farmers' participation is defined as a binary variable. As mentioned above, we have run two separate probits models to analyse the various determining factors for farmers' participation in MCs' and PCs MFRCs vs IF. Performance and robustness check parameters of the model reveal that Model II performs better and hence is preferred. We observed that Model II satisfies the balancing score property of PCM.

Our empirical results revealed that the procurement price received from MFRCs, other collection centre distance from the agricultural field, loan amount, the distance of the agricultural field from home and decision-makers age were statistically significant and positive factors determining farmers' participation in PCs MFRC for tomato. The supermarket's coefficient of procurement price was positive and significant, indicating that higher prices from supermarkets are more likely to incentivise farmers to participate in PCs. On the other hand, we observed a negative relationship associated with input market distance from the agricultural field (in kms), Hhs heads being illiterate or even with primary school education. Among all the variables, the result of primary school education (dummy variable) was unexpected.

Further, our results revealed that higher risk preference, household size, nearest road distance from farmers' agricultural field and net sown area were positive but insignificant factors responsible for farmers' participation in PCs. The variables viz., fixed price in advance (dummy variable), farmers' awareness about the supermarket, Hhs with secondary school education had negative coefficients. Farmers were unwilling to accept fixed price options in advance, mainly due to supermarkets' lower procurement prices. However, the existing literature shows that

farmers prefer to fix the prices in advance to reduce the price uncertainty in the open markers. In contrast, in our case, farmers did not choose fixed prices in advance.

Table 3: Propensity score for PC MFRC farmers vs IF for Tomato (probit Estimation)

Variable	Model I		Model II	
	Coefficient	Standard error	Coefficient	Standard error
Ln Age (Years)	0.0211	(0.0212)	2.072**	(1.032)
HHs, illiterate [a] (dummy)	-2.456**	(1.072)	-1.870*	(1.439)
HHs, primary education [a] (dummy)	-1.731**	(0.820)	-1.031**	(0.700)
HHs, secondary education [a] (dummy)	-0.207	(0.612)	-	-
High Risk HH [b] (dummy)	0.889	(0.611)	0.902	(0.648)
Ln net sown area (Acre)	0.905	(0.800)	0.0220	(0.115)
Household size (Nos.)	0.142*	(0.0723)	0.592	(0.444)
Ln price received (Rs / kgs)	3.107***	(0.827)	3.053***	(0.842)
Ln plots (Nos.)	-0.103	(0.576)	-0.156	(0.478)
Ln loan borrowed (Rs.)	1.021***	1.021***	0.0493**	(0.0233)
Preference for fixed price [c] (dummy)	0.326	(0.430)	-0.512	(0.568)
Aware of MFRC contractors (dummy)	-1.178*	(0.610)	-0.804	(0.719)
Ln Distance to collection center (Km)	0.120***	(0.0435)	1.118**	(0.439)
Ln Distance of Input Market (Km)	-2.166***	(0.716)	-1.408***	(0.497)
Ln distance of agri. field from home (In kms)	-	-	1.021***	(0.392)
Ln Distance of nearest road from farm (Km)	-	-	0.250	(0.381)
Constant	-7.011***	(2.237)	-14.90***	(4.840)
Pseudo R2	0.5887		0.669	
Number of observations	*200*		*200*	

Note: [a] Base is farmers with primary/ illiterate/ Secondary/ (Tertiary or others education)
[b] Base is farmers with no risk
[c] Base household will not prefer fixed pries in advance
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Source: Authors Primary survey (2017)

The estimation results for the probit models are shown in Table 4 for MC MFRC for tomato crop. It is observed that the coefficients in table 4 mostly confirm the results from our descriptive statistics presented in Table 2. Procurement prices received from the supermarket and decision-maker age positively influenced farmers' participation in MCs' MFRC. We were expecting that

MFRC might prefer younger farmers. As against our expectations, our findings show that higher age decision-maker farmers are more likely to participate in MCs MFRC for tomato. Other collection centers' distance was statistically significant, indicating that increasing other MFRCs collection centres' distance is expected to increase farmers' participation. This suggests that farmers might have been associated with more than one MFRC for selling their products.

Our results show that illiterate Hhs and those with primary school education, input market distance (in kms), and household size (in numbers) were statistically significant and negatively correlated with farmers' participation in MCs' MFRC. Given the importance of distance, it is understandable that farmers close to the input market are more likely to participate in MCs for tomato. Contrary to the expectations, the coefficient of the variable household size was found negative and significant, suggesting that with an increase in household size, farmers are less likely to participate in MFRCs.

Table 4: Propensity score for MC MFRC farmers vs IF for Tomato (probit Estimation)

Variable	Model I		Model II	
	Coefficient	Standard error	Coefficient	Standard error
Ln Age (Years)	1.651**	(0.794)	0.109***	(0.0336)
HHs, illiterate [a] (dummy)	-0.322	(0.738)	-3.359***	(1.147)
HHs, primary education [a] (dummy)	-	-	-2.216***	(0.849)
HHs, secondary education [a] (dummy)	-	-	-0.975	(0.658)
High Risk HH [b] (dummy)	1.111***	(0.380)	0.330	0.330
Ln net sown area (Acre)	-0.653**	(0.317)	0.127	(0.286)
Household size (Nos.)	-0.530	(0.389)	-0.278**	(0.121)
Ln price received (Rs / kgs)	0.817*	(0.429)	0.151**	(0.0718)
Ln plots (Nos.)	0.378	(0.502)	0.139	(0.538)
Ln loan borrowed (Rs.)	-5.0408	(6.7407)	-0.0235	(0.0215)
Preference for fixed price [c] (dummy)	0.546	(0.419)	0.555	(0.552)
Aware of MFRC contractors (dummy)	-0.297	(0.399)	0.702	(0.619)
Ln Distance to collection center (Km)	0.0641**	(0.0252)	0.710*	(0.364)
Ln Distance of Input Market (Km)	-0.634***	(0.240)	-1.379***	(0.470)
Ln distance of agri. field from home (In kms)	-	-	0.0546**	(0.0229)
Ln Distance of nearest road from farm (Km)	-	-	-0.284	(0.473)
Constant	-7.453**	(3.281)	-6.067***	(1.991)
Pseudo R2	0.4148		0.6232	
Number of observations	*200*		*200*	

Note: [a] Base is farmers with primary/ illiterate/ Secondary/ (Tertiary or others education)
[b] Base is farmers with no risk
[c] Base household will not prefer fixed pries in advance
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Source: Authors Primary survey (2017)

VII. Empirical results from Transaction cost;

The estimated propensity scores are used to derive average treatment effects of CF participation on the outcome variables of interest (Net profit and yield etc etc.). We use the NNM methods and impose the common support condition to ensure proper matching. Table 5 presents the average treatment effects estimated by NNM and indicators of matching quality from the matching models. We compared PCs, MCs with independent farmers (IF).

Our study contributed to the existing literature on quantifying the impact of asymmetry information and opportunistic behaviour by CF on tomato farmers income from India, where institutions crucial for supporting contract enforcement are totally missing. India is characterised by a great number of smallholders who are trying to connect with CF firms.

We found that asymmetry information and opportunistic behaviour together reduce the Tomato smallholders profit by 14.5 per cent. The earlier studies have not attempted to capture these important costs associated with CF participation. Further, while looking at the breakup, we found that opportunistic behaviour alone reduce the smallholder's profit by 9.42 per cent and asymmetric information by 5.08 per cent profit. Therefore, we argue that earlier studies have just concentrated on explaining the positive impact and overestimated the benefit of CF.

Furthermore, we observed that opportunistic buyers might underreport quality levels to smallholders to decrease the price that they have to pay. In response, farmers have to spend a lot of time monitoring and negotiating with the CF firm that cut back investment, negatively affecting farm productivity. In addition to this, our study result indicates that smallholders associated with CF reduce their output by 8.0 per cent due to uncertainty associated with

promised price and quantity rejection rate. The reduction in production was mainly due to the delay in applying the inputs on time. The findings of our study may also be transferable to other countries for fruits and vegetable sectors, especially those where competition between CF firms is low, and asymmetry information exists.

Williamson explained the two considerable uncertainty sources include opportunistic behaviour and bounded rationality. Opportunistic behaviour refers to the possibility of agents to act out of self-interest behaviour unconstrained by morality. It includes providing selective and distorted information, making promises that are not intended to be kept, and acting differently when the actual implementation time comes. The procurement managers sometimes behave opportunistically with the farmers during the purchase of the product and prices. There is a huge possibility of opportunistic behaviour by PCs MFRC procurement managers when the contract is incomplete or when the agreement is oral in the case of MCs MFRC. Opportunistic managers may underreport quality levels to farmers to reduce the price they have to pay. In response, farmers may have to monitor the grading activities of the MFRCs continuously, thus creating an environment for emerging TCs.

As a governance structure for reducing transaction costs, contracts become particularly important in governing long-term relationships (Slangen et al., 2008). In F&Vs, arrangements are mainly justified by transaction frequency, which is high because F&Vs are harvested in a concise period, and sales are made every week for selected vegetables. During the low-production season, transaction frequency may drop to one delivery every two weeks. The drop in the frequency might create more trouble for PCs MFRC farmers. As per the contract, the company has promised to send the vehicle to the farmers' field to procure the F&Vs. The PCs procurement

manager might not send the vehicle to the farmers' field during the early stage and last stage of the production. Farmers may have to visit the PCs procurement office more frequently to get the vehicle in the farmers' field. Hence, reducing the transport vehicle frequency might lead to incurring more transaction costs for the farmers.

As explained earlier, TCs included ICs, BCs, and MCs. The details of the TCs incurred by the farmers' TCs are presented in table 5; PCs farmers have incurred Rs 1828 per acre ICs compared with Rs 826 per acre for Independent farmers. Our empirical findings have shown that ICs are considerately higher for MFRCs than independent farmers. Information costs are incurred mainly due to uncertainty and asymmetric information on prices and grading standards. The procurement price was fixed before producing the tomato by the PCs (near the beginning of each supply season). However, these amounts are set differently, with ups and downs across seasons, from month to month.

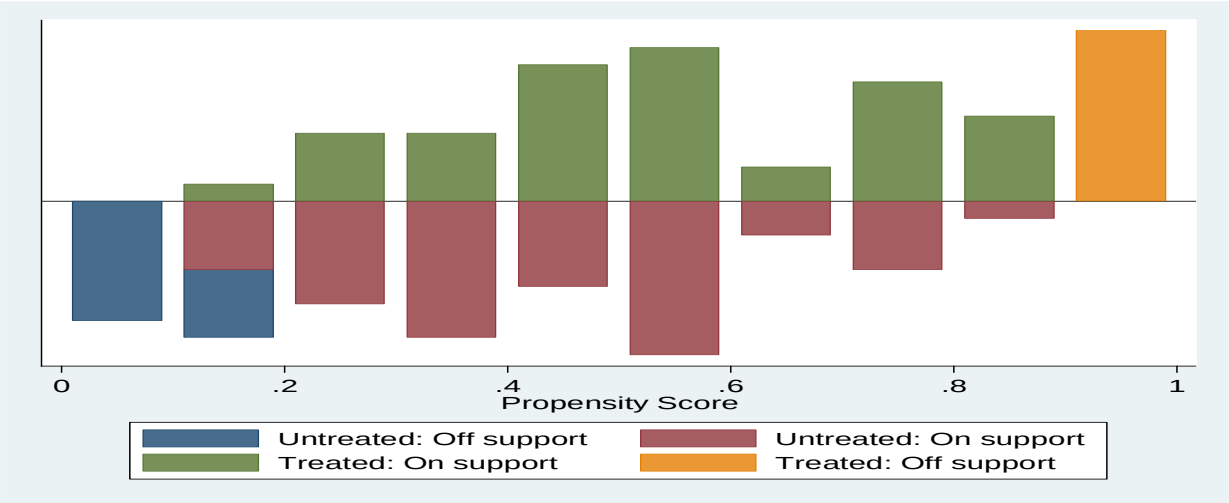
Indian context, the operation of the MFRCs is limit in some areas with limited farmers. When a few MFRCs are operating in the area, the MFRCs may behave as a monopsonist, keeping grower profit just above the point at which growers would switch to an alternative option. In the more competitive environment, where multiple MFRCs are competing for clients or product supply, the farmers' reservation utility will be bid up, and the MFRCs would have less bargaining power. As more MFTC enter a market, farmers gain the ability to choose among contracts, and MFRCs must compete to give the best contract ``package' – including technical guidance, inputs, credit, extension, and product price. Hence, contracts will be relatively less profitable in a more competitive processing market. However, we are still in the very early stage of the expansion, and competition is minimal. As mentioned earlier, bargaining costs incurred once the MFRCs

and the farmers sign the contract. We have identified the following reasons for incurring the higher bargaining costs by the farmers.

Our study result shows that monitoring cost accounted for a second higher share in the TCs for all the MFRCs. Monitoring cost was reported significantly higher for PCs, followed by MCs MFRCs than IF (Table 5). The monitoring costs are incurred to ensure that an exchange's conditions are met. Monitoring costs mainly incur to produce the required quality standards of F&Vs. It includes the farmers' extra effort and time to ensure their product (F&Vs) fulfils the quality standards set by the MFRCs.

We estimated a probit model using the treatment status (participation in MFRCs—Tomato) vs. independent farmers. The result of probit estimation is presented in the earlier section. After running the Probit model, matching in the region of common support was done to impose the common support conditions. Figure 2 presents the region of common support and the distribution of the propensity score.

Fig. 2: Robustness check- PCs MFRC vs IF for Tomato



Propensity score distribution and common support for propensity score estimation. Treated on support indicates the farmers in the MFRCs group who find a suitable match. Treated off support indicates the farmers in the MFRCs group who did not find a right match.

The estimated propensity scores are used to derive average treatment effects of supermarket participation on the outcome variables of interest (like, profit, productivity and revenue etc). We use the NNM methods and impose the common support condition to ensure proper matching.

Table 5 presents the average treatment effects estimated by NNM and indicators of matching quality from the matching models. Results in Table 5 indicate that NNM matching estimator, PCs MFRC exerts a positive and significant impact on farmers' profit, productivity, and total revenue per acre for tomato but reported a significantly higher cost of cultivation and transaction costs per acre. The NNM causal effect of PCs MFRC adoption on profits (Rs. 42023 per acre) suggests that the profits (after including TCs) of MFRC tomato farmers' are higher than the profits of non-contract (independent) farmers by about Rs 42,023 per acre (73.34% higher than IF) and significant at 1% level. The profit was significantly higher, excluding TCs for tomato. Transactions cost (TC) was considerably higher for MFRCs farmers as compared to independent farmers. TCs accounted for 13.51% share in total cost for PCs, whereas for the independent farmers, TCs was less than 5.33%. PCs MFRC farmers enjoy higher yields of 5.48 tons per acre (28.48% higher) than independent farmers. It can be easily observed from Table 5 that PCs farmers reported significantly higher profits due to procurement price premium.

We analyse different components of TCs, i.e., information costs, monitoring costs, and bargaining costs. Among the TCs, monitoring costs constituted the major components for PCs, followed by BC and IC. The information cost was 54.81% higher than IF farmers. Our results revealed that bargaining costs were highest by 79.16% (significant at 1%) followed by

monitoring costs of 70.55% (significant at 1%) higher for PC farmers than IF farmers. Our discussion with the farmers during the primary survey revealed that the monitoring cost was higher due to standard grading uncertainty. Most of the time, products are not appropriately graded by MFRCs managers. As a result, the farmers have to incur cost on monitoring.

Further, the average treatment effects revealed significant impacts on MCs farmer's participation in outcome variables. Participation in MC leads to increased farmers' profit by Rs 5,344 per acre but statistically not significant, higher revenue by Rs 5,349 but not significantly, productivity by 4.00 tons per acre significantly, and higher in-significant productivity procurement price by Rs 1.10 per Kgs than independent farmers for tomato. Similarly, TCs was more elevated and significant for MC farmers by Rs 3,062 per acre (43.33%) higher than independent farmers. Compared with earlier results, we observed that MCs MFRC has significantly helped farmers gain higher tomato productivity per acre while providing continuous technical guidance.

TCs accounted for 8.05% share in total cost for MCs farmers as compared with 4.56% share for independent farmers for tomato. Furthermore, our finding revealed that among all MC accounted highest share (with 47.87%) followed by bargaining cost (with 37.98%) and IC (14.15% share) for MC farmers. Due to higher supervision and monitoring, the MC farmers could also achieve impressive productivity compared with independent farmers for tomato. However, farmers have accounted for higher MC as compared to independent farmers.

As compared to all the MFRCs available for Tomato farmers, our result revealed that PCs MFRC significantly benefited the farmers by Rs 57,299 net profit per acre (statistically significant), followed by Rs 18,758 net profit per acre (statistically insignificant) for MC tomato farmers

(even after including TC in total costs). However, the independent farmers of PCs and MC reported a net profit of Rs 15,255 per acre, Rs 13414 per acre.

As compared to TC across MFRCs for tomato, our study revealed that TC reported significantly higher for PCs farmers with Rs 16,352 per acre (72.49% higher than IF), followed by Rs 7,067 per acre (statistically significant) for MCs (43.33% higher than IF) farmers for tomato. In other words, the proper institutional arrangement can help farmers for raising the profit for PCs and MCs by 13.51%, and 8.05%, respectively. The major problems of TCs were more in PCs MFRC, followed by MCs MFRCs for Tomato.

Table 5: Average treatment effects and results of sensitivity analysis- MFRC, Tomato

Matching algorithm	Outcome (Rs. per acre)	Treated	Controls	Difference	*t*-stats	Critical level of hidden bias Γ	Number of treated	Number of controls
(1) PC vs IF	Information costs per acre	1828	826	1002	2.28	1.65-1.70	100	100
Nearest neighbor matching (NNM)	Monitoring costs per acre	7505	2210	5295	4.91	3.25-3.30	100	100
	Bargaining costs per acre	7020	1463	5557.0	3.1	4.55-4.60	100	100
	Total Transaction costs per acre	16352	4498	11854	4.01	5.00-5.05	100	100
	Price Received (Rs per kgs)	12.50	7.98	4.51	4.03	3.75-3.80	100	100
	Yield (Ton)	19.26	13.78	5.48	3.71	2.25-2.30	100	100
	Cost per acre (C1) (including TCs)	121052	84353	36698	4.58	4.40-4.45	100	100
	Profits per acre (P1) (including TCs)	57299	15277	42023	3.65	1.90-1.95	100	100
	Revenue per acre	178351	99630	78721	5.54	5.00-5.05	100	100
	Cost per acre (C2) (excluding TCs)	104699	79855	24844	3.18	3.40-3.45	100	100
	Profits per acre (P2) (excluding TCs)	76831	22206	54624	5.12	3.15-3.20	100	100
(2) MC vs IF	Information costs per acre	1000	893	107	0.55	1.6-1.65	100	100
Nearest neighbor matching (NNM)	Monitoring costs per acre	3383	1784	1599	3.19	1.65-1.70	100	100
	Bargaining costs per acre	2684	1328	1356	2.61	1.45-1.50	100	100
	Total Transaction costs per acre	7067	4005	3062	3.08	1.40-1.45	100	100
	Price Received (Rs per kgs)	9.49	8.39	1.10	1.18	1.60-1.65	100	100
	Yield (Ton)	17	12	4	2.59	1.90-1.95	100	100
	Cost per acre (C1) (including TCs)	87772	87766	5	0	1.20-1.25	100	100
	Profits per acre (P1) (including TCs)	18758	13414	5344	0.57	2.60-2.65	100	100
	Revenue per acre	106529	101180	5349	0.41	2.40-2.45	100	100
	Cost per acre (C2) (excluding TCs)	71821	78966	-7145	-0.93	1.75-1.80	100	100
	Profits per acre (P2) (excluding TCs)	25867	19886	5981	2	1.65-1.70	100	100

Source: Authors Primary survey (2017).

VIII. Conclusions:

Our result shows that PCs MFRC significantly benefited the farmers by Rs 57,299 net profit per acre (statically significant), followed by Rs 18,758 net profit per acre (statically in-significant) for MC tomato farmers (including TC in total costs for profit calculation). However, the independent farmers of PCs and MC reported the net profit Rs 15,255 per acre and Rs 13,414 per acre. Therefore, we conclude that MFRC has helped the farmers increase the net profit than independent farmers'. Further, our results have also revealed that PCs MFRC farmers reported significantly higher procurement prices Rs 12.50 per Kgs (36.08 % higher than IF) , followed by Rs 9.49 per kgs (11.62 % higher than IF) for MCs. Furthermore, we found that PCs MFRC farmers reported significantly higher productivity, 19.26 tons per kg (28.45 % higher than IF), followed by 17.00 tons per acre (23.53 % higher than IF) for MCs.

As compared with TC across MFRC for tomato, our study revealed that TC reported significantly higher with Rs 16,352 per acre (72.49 % higher than IF) for PC, followed by Rs 7,067 per acre (Statically significant) for MC (43.33 % higher than IF). In other words, the proper institutional arrangement can help the farmers for raising the profit for PCs, MCs by 13.51 % and 8.05 %, respectively. We strongly suggest that NGC needed to promote for connecting small farmers with MFRC. NGO can help for reducing the uncertainty and supervision costs incurred by the farmers. Further, NGO can help build trust between farmers and MFRC and help reduce the TCs. Additionally, we suggest for establishing a proper institutional arrangement with the provision for enforcement of the terms decided in the contract. The availability of enforcement mechanisms might be helpful to overcome the barriers faced by the small and marginal farmers.

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