Transaction Cost Estimation in Vegetable Marketing Involving Modern Food Retail Chains
Impact on Profitability of Chili Growers

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Abstract. This paper is an attempt to empirically measure the Transaction Costs (TCs) incurred by the farmers across different Modern Food Retail Chains (MRFCs). Evidence from existing studies indicate that MFRCs tend to behave opportunistically towards farmers due to an incomplete contract, lack of enforcement and asymmetric information. We estimated the TCs using the primary data collected in the year 2017 through a structured and pre-tested schedule administered to 100 each randomly chosen green Chilli farmers in Kolar district, India. The farmers were categorised into three groups; farmers undertaking production contracts, marketing contracts and traditional farmers selling their produce in spot markets. A non-parametric propensity score matching (PSM) estimator was used for measuring the asymmetric information (AS) and opportunistic behaviour (OB) by MFRCs. Our analysis indicated that AS and OB together reduced the green Chilli profit by 14.5%. A breakup of TCs indicated monitoring cost accounted for 65% followed by negotiation cost (28.7%) and information cost (6.3%). These findings have far-reaching policy implications: as how to reduce TCs and improve the profitability of Chilli growers.

Keywords: Agricultural policy · Modern food retail chains · Transaction cost and asymmetric information

1 Introduction

Economic growth in India is leading to improving living standards and consumer income which eventually raises the demand for high-quality Fruits and Vegetables (F&Vs). Consequently, the Supply Chain (SC) is witnessing a change, particularly with the emergence of MFRCs. The share of F&Vs in MFRCs has been continuously increasing over time [1]. The MFRCs are expanding by employing different business models; consequently are establishing as an important alternative market channel for the farmers to sell their vegetables. In the beginning, the MFRCs used to procure vegetables from traditional wholesalers. Since the early 2000s, transformation is witnessed with most of the MFRCs modernising their supply SC and enforcing strict quality standards [2]. Such transformation of supply chains presents a greater challenge for farmers for producing better quality produce.

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A series of studies in developing countries have undertaken varied analyses relating to the participation and welfare effects of contract farming (CF), a mechanism used by the MFRCs. These studies indicated, MFRCs have significantly helped the farmers for increasing their income [3, 4]. However, to what extent the farmers participate in MFRCs and have benefited in terms of increased income needs an in-depth analysis [5]. A few studies in India [4, 6], and, China [7] have empirically shown that smallholders are not excluded from the business model of MFRCs. While, other studies, such as [8, 9], in India, [10] in China, and [11], in Latin America, have reported the opposite.

Many empirical studies have revealed that MFRCs have benefited the farmers by reducing their price risk, input and output risk and providing access to improved technologies. Interestingly, existing studies also reveal that CF firm tends to behave opportunistically towards farmers [12, 13]. Farmers are exposed to risks through contracts mainly when the buyers are either monopsonists or oligopolists [14]. The risk of an incomplete contract and asymmetric information regarding quality, quantity and price provides the CF firm enough scope for exploiting the farmers [15]. Surprisingly, there is little attention focused on TCs resulting from uncertainty, risk, market imperfections and coordination failures. The studies on CF rarely look at the possibility of opportunistic behaviour by the CF firm and the problem of asymmetric information and its impacts on the farmers' profit and welfare. This is understandable due to the difficulties associated in quantifying the impacts of opportunistic behaviour and asymmetric information on farmers' income that are not easily accountable [16, 17]. This paper is an attempt to empirically measure the TCs incurred by the farmers across different MRFCs for green Chilli growers in India.

2 Objective

The paper attempts to develop a framework for quantifying the opportunistic behavior in procurement by the MFRCs and the impact of asymmetric information on profits of Chilli growers. Additionally, some policy suggestions for reducing the opportunistic behavior of CF firms with the help of an institutional framework is attempted.

3 Analytical Framework and Methodology

The study uses a non-parametric propensity score matching estimator for measuring the TCs (asymmetric information and opportunistic behavior) of MFRCs and its impact on Chilli growers profits. PSM is one of the important methods used to overcome the problem of selection bias. The nearest neighbor matching (NNM) method is used in this paper as it is commonly used in such analysis [18]. The NNM method picks each treated unit (MFRCs farmers) and searches for the control unit (APMC marketing farmers) which has the closest propensity matching score. The key advantage of the NNM is that all the treated units find the match with control group farmers [18]. Further, [4] it is argued that matching with replacement involves a trade-off between bias and variance.

We estimated the TCs using the primary data collected in the year 2017 through a structured and pre-tested schedule administered to 100 each randomly chosen green Chilli farmers in Kolar district, India (Fig. 1). The farmers were categorized into three

Table 1. Variables used for measuring TCs incurred by farmers

No.	Variable	Individual Transaction Costs	measurement	Measurement details
01	Information costs -arise prior to an exchange) -incur due to uncertainty and asymmetric information	Search for buyers and reliability of potential buyers	Actual	1. Opportunity cost of time (Rs/per acre[a]) 2.Travel expenses (Rs/per acre) 3. Phone call charges (Rs/per acre)
		Price uncertainty (search cost associated with incurring the offered prices by MFRCs and price uncertainly	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	Relative	Is the lack of control over the sale order which products is sold at MFRCs[b]
		Unequal Bargaining Power	Relative	Do you have to take whatever prices is offered by the MFRCs[b]
		Frequency of sale	Actual	No of sale in week
		Cost and time spent on negotiation the prices and quality of the product with the company	Actual	1. Opportunity cost of time (Rs/per acre) 2.Travel expenses in (Rs/per acre) 3. Phone call charges (Rs/per acre)

(*continued*)

Table 1. (*continued*)

No.	Variable	Individual Transaction Costs	measurement	Measurement details
		Monetary value due to opportunist behavior	Actual	1. Transportation costs associated with sale of rejected product by MFRCs into other market (Rs per acre) 2. Monetary value of the wastage (Rs/per acre[c]) If the rejected product is not sold
03	Monitoring Costs (incurred to ensure that the conditions of an exchange are met)	Product Quality (supervision cost to fulfill the MFRCs quality, extra effort spent by the farmers)	Actual	1. Opportunity cost of time (Rs/per acre) 2.Travel expenses in (Rs/per acre) 3. Phone call charges (Rs/per acre)
		Grade uncertainty (Ensuring that the product is graded as per contract at field as well as collection centers	Actual	

Source: Authors Primary survey (2017)

[a] (No of visit* Average time spent per visit in hrs * Wage rate per hrs)

[b] Possible responses were 1, not a problem; 2, minor problem; 3, a problem; 4, relatively a significant problem; 5, major problem.

[c] Mostly applicable for that quality which would have been accepted by MFRC

distinct groups; farmers undertaking production contracts (PC), marketing contracts (MC) and traditional independent (IP) farmers selling their produce in spot markets. At aggregate, the sample comprised of a total number of 300 farmers growing Chilli in the selected area. The Variables used for measuring TCs incurred by farmers are presented in Table 1.

The descriptive statistics for selected MFRCs farmers and independent farmers are presented in Table 2. The independent farmers had a higher average age and land area, lower educational level and smaller loan amounts as compared to the MFRCs farmers. It is expected that the farmers having advantages in the above variables would have a higher probability to participate in the MFRCs. The results in Table 2 corraborated that the household heads having higher farming experience entered to production contracts *vis a vis* independent farmers. It was observed that MFRCs farmers had shorter distances to input markets ($p < 0.01\%$) and shorter distances between their houses and their fields ($p < 0.01\%$) compared to independent farmers. The infrastructure variables indicate that

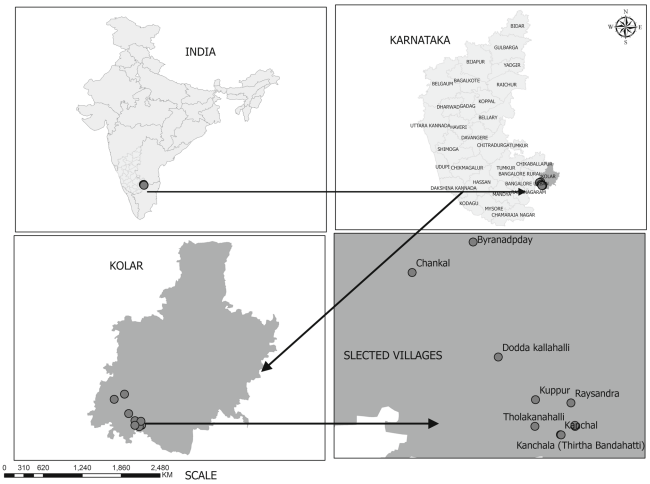

Fig. 1. Selected area for conducting the primary survey (Source: Authors Primary survey (2017)).

farmers associated with MFRCs were in an advantage as compared with the independent farmers.

We assessed the extent of risk the farmers were willing to take while participating with the MFRCs. Both production-contract and marketing-contract farmers' perceived higher production risk (significance $p < 0.01\%$) as compared with the independent farmers. This indicates that Chilli farmers associated with the MFRCs were willing to take more risks than independent farmers [16].

Regarding the perception of production risk and financial risk (related to loosing produce, reduction of the output due to pests and disease attacks, and being willing to make more investment in agricultural equipment), our findings show that PCs and MCs growers perceived significantly higher production risk. This gives us an indication that MFRCs farmers are willing to undertake bigger risks as compared to independent farmers. Due to their risk-taking abilities, they are better positioned to meet the higher quality standards of MFRCs.

The education level of independent farmers were lower as compared to farmers in production and marketing contracts. Indicating that MFRCs preferred more of educated farmers so that they can be trained to produce better-quality produce. Similar findings have been recorded in other studies in India [19, 20].

Comparison of procurement prices (Table 2) indicate that Chilli farmers who entered into production contracts received significantly higher prices at Rs 21.41 per kg ($p < 0.01\%$) as compared to Rs 18.38 per kg, received by the independent farmers, This translates in to 16.49% higher price than independent farmers. Further, the farmers with marketing contracts received a significantly higher ($p < 0.1\%$) price of Rs 20.20 per kg, compared to independent farmers. Clearly, under the scheme of the production contract followed by MFRCs the procurement prices were higher than the prices under the marketing contract and independent farmers selling in spot markets. As A result, farmers preferring production contracts in MFRCs secured more income. Further, farmers undertaking production and marketing contracts in Chilli crop realised significantly

Table 2. Socio-Economic Characteristics of MFRC and independent Chili farmers (2017–2018).

Variable	IF	PCs	MCs
Land area (*acre*)	3.84	4.76	3.44
Age of head of household (HH), in *years*)	48.12	41.45**	44.32**
Farming experience of HH (*years*)	*13.86*	*16.08*	*14.08*
Household size (*number*)	4.00	5.00	4.00**
Loan amount (Lakhs Per HH)	0.77	3.09**	1.78***
Distance to input market (in Km)	12.80	6.98***	7.00***
Nearest road distant from agri. Field (in kms)	1.06	1.11	0.93***
Distance of HH agri. Field from home (in kms)	1.01	0.81*	0.9***
Distance to other collection centers (in Kms)	13.52	16.82**	10.44*
HH member, perceiving high risk (%)	10.00	23.00*	32.00***
HH member, perceiving medium risk (%)	48.00	73.00***	36
HH member, low risk (%)	34.00	4.0***	14.00**
HH member, perceiving no risk (%)	8.00	4.00	18.00
HH member, education (in *years*)	2.66	9.12***	7.7***
HH member, illiterate (%)	26.00	1.00***	4.00***
HH member, primary education (%)	48.00	26.00***	44.00
HH member, secondary school education (%)	26.00	43.0**	26.00
HH member, Tertiary education (%)	0.00	30.0***	26.00***
Total cost per acre (*Rs*)	48,454	77918***	82,925***
Total gross revenue per acre (*RS*)	82,810	1,35,228**	1,23,328***
Total profit per hectare (*Rs*)	34288	57310**	40403*
Yield (Kg. *per hectare*)	4.92	7.95***	7.39***
Total cost per quintal (*Rs*)	985	980	1122
Net profit per quintal (*Rs*)	698	721	547
Number of observations	*100*	*100*	*100*

Source: Authors Primary survey (2017)
* Significant at 10% level; ** Significant at 5%; *** Significant at the 1% level

higher yields, higher revenue and higher total costs ($p < 0.01\%$). The procurement prices of MFRCs were higher as the contract farmers were providing better quality vegetables which in turn increased their production costs [17].

It is relevant to note that both production and marketing-contract farmers reported a significantly lower area under Chilli cultivation than independent farmers. Those PCs prefer mostly one acre under Chilli. It is indicative of the fact MFRCs entered in to contracts with small farmers so that they can utilize their labour resources for producing quality vegetables by following good production practices, harvesting at right time and

enforcing grading standards at farm level. Interestingly, production-contract farmers realised higher ($p < 0.05\%$) profit (Rs 57,310 per acre), followed by marketing-contract farmers (Rs 40,403 per acre); both being higher as compared to independent farmers (Rs 34,288 per acre). Thus, the profit earned by the production-contract farmers were higher by 67.14% than independent farmers. Similarly, the profits of marketing-contract farmers were higher by 83% than independent farmers. In conclusion, the MFRC farmers realised significantly higher profit mainly due to higher yield and procurement prices offered by the retail chains. However, participating in these models is associated with higher TCs which we shall discuss in the next section.

Due to incomplete agreement or contract and asymmetric information regarding quality, quantity, and price, there is scope for exploiting small farmers by the contracting firms [15]. This obviously impacts production costs in general and TCs in particular. These costs are associated with uncertainty, asymmetric information and asset specificity [16]. In literature, these costs are referred to as TCs. Broadly, TCs consist of three components; (1) information costs, (2) monitoring costs, and (3) bargaining costs. The paper attempts to quantify the impact of opportunistic behaviour of MFRCs and asymmetric information on Chilli farmers' net profit. We measure the magnitude of TCs and their components across PCs and MCs, as compared to independent farmers. PCs and MCs are systematically different. PCs are characterized by fixed prices and provision of input supply. In contrast, MCs are characterized by providing technical guidance on plant protection chemicals and fertilizers use and generally pay higher prices in comparison to independent farmers (traditional market).

One of the major problems associated with TCs Economics pertains to the fact that theoretical development has hardly been accomplished with empirical analysis mainly due to measurement problems. Based on available literature, interaction with farmers associated with MFRCs contracts, experts on TCs, we have developed proxy variables for quantifying the TCs incurred (Table 1).

We estimated a Probit model using the treatment status (participation in MFRCs—Chilli) vs. independent farmers. The first step is to run the probit model and the second step is to estimate the PSM. The primary purpose of PSM is to balance the observable distribution of covariates across the two farmer groups (MFRCs farmers and independent farmers). The balancing test is done to ensure that the differences in the covariates between the MFRCs and independent farmers are eliminated. Thereafter, the matched comparison group are considered a counterfactual.

The estimates of TCs for PC, MC and IF for Chili growers presented in Table 3 indicates that TCs were significantly higher for farmers in MFRCs as compared to independent farmers. Such costs accounted for 14.5% of total costs for PC farmers and 9.6% for MC farmers. The TCs was lower (6% of total costs) for the independent farmers. This shows that MFRCs farmers have incurred significantly higher TCs as compared with independent farmers indicating opportunistic behaviour and asymmetric information as the contributing factors. The total TCs worked was higher by Rs 9,178 ($p < 0.01\%$) for PC farmers and Rs 5,394 ($p < 0.01\%$) for MC farmers than for independent farmers (Table 3).

In this section, we have tried to analyze the different components of TCs. Our study findings reveal that monitoring costs constituted the major share in the total TCs for all

Table 3. Average treatment effects and results of sensitivity analysis- MFRC, Chili (Cost per acre).

Matching algorithm	Outcome (Rs. Per acre)	Treated	Controls	Difference	t-stats	Number of treated	Number of control
(1) PC vs IF	Information costs	819	668	151	0.6	100	100
Nearest neighbor matching (NNMa)	Monitoring costs	8,465	1,335	7,131	6.6	100	100
	Bargaining costs	3,740	1,844	1,896	3.4	100	100
	Total TCs	13,025	3,846	9,178	6.0	100	100
	Total Cost (including TCs)	89,820	63,070	26,750	3.9	100	100
	Total Profits (including TCs)	40,331	17,649	22,682	2.5	100	100
	Total Revenue	1,30,151	80,719	49,432	4.4	100	100
	Total Cost (excluding TCs)	76,453	60,522	15,930	2.4	100	100
	Net Profits (excluding TCs)	53,699	20,346	33,353	3.7	100	100
(2) MC VS IF	Information costs	1,228	684	545	2.9	100	100
Nearest neighbor matching (NNMa)	Monitoring costs	4,784	1,336	3,447	4.7	100	100
	Bargaining costs	2,364	963	1,402	4.5	100	100
	Total TCs	8,376	2,982	5,394	5.1	100	100
	Total Cost (including TCs)	87,498	49,846	37,652	4.4	100	100

(*continued*)

Table 3. (*continued*)

Matching algorithm	Outcome (Rs. Per acre)	Treated	Controls	Difference	t-stats	Number of treated	Number of control
	Total Profits (including TCs)	31,197	31,901	−704	−0.8	100	100
	Total Revenue	1,18,695	81,747	36,948	2.8	100	100
	Total Cost (excluding TCs)	79,122	46,864	32,258	3.9	100	100
	Total Profits (excluding TCs)	39,573	35,357	4,216	0.5	100	100

Source: Authors Primary survey (2017)

categories of the farmers. Information cost was quite insignificant and was higher by 22.6% for PC farmers when compared to independent farmers. Similarly, information cost was higher by 79.5% ($p < 0.01\%$) for MC farmers than for independent farmers. The higher information cost is attributed to uncertainty associated with price instability and frequent changes in the quality standards prescribed by the management of the MFRCs.

MFRCs give farmers a flexible price option. As such price volatility and uncertainty about quality of Chilli will affect to a large extent Chilli growers decisions on whether to participate in the MFRCs model. Our study results revealed that monitoring costs were higher by 5.3% ($p < 0.01\%$) for PC farmers and 2.6% ($p < 0.01\%$) for MC farmers compared to independent farmers. This is attributed to the fact that MFRCs supervise the production process of the Chilli to maintain high quality and grade standards. Our discussion with farmers during the primary survey revealed that monitoring costs were higher as there was uncertainty about standards in grading. It was indicated that the procurement managers do not grade the Chilli properly, hence the farmers prefer to be present during the grading of their product. MFRCs expect contractor farmers to provide better quality than independent farmers which necessitates farmers to put extra efforts in proper monitoring at various stages of Chilli production. Similar observations on monitoring costs were reported by other studies [21, 22].

Bargaining costs were estimated by considering the cost of time spent by the farmers in negotiating the price and quality of Chilli with the procurement managers of MFRCs. Bargaining costs were twice as high ($p < 0.01\%$) for PC farmers and 1.5 times higher ($p < 0.01\%$) for MC farmers relative to independent farmers. As observed from Table 3, the bargaining costs accounted for the second-highest share of total TCs for MFRCs farmers. The bargaining cost was mainly higher due to opportunistic behaviour by the procurement managers of the MFRCs. Hence, it is necessary that collective

efforts are made by the farmers to increase their bargaining power for negotiating the procurement price and the grading standards with MFRCs.

The share of information cost in total TCs was relatively lower as compared with monitoring and bargaining cost for Chilli farmers. The farmers incurred information costs mainly for obtaining the information on price, product quality and grading standards before the sale of their produce. Our findings show that Information cost was higher for MC than PC and independent farmers. The information cost was lower for PC due to the fixed procurement price contract set by the MFRCs before producing the Chilli. Due to incomplete contracts used by MFRCs, the farmers face price uncertainty for Chilli. The price is differently set with ups and downs across seasons; from month to month. This mechanism causes price uncertainty to the farmers, who respond opportunistically and by defaulting on contracts. Hence, farmers always try to get sufficient information about the procurement price offered by the MFRCs in the beginning. The same thing is also true with the grading standards set by the MFRCs.

A comparison of costs and profits on per acre basis before and after including TCs has been attempted. As expected the inclusion of TCs increased total cost per acre by 14.5%, and lowered profits by 24.9% for PC farmers. Similarly, the total cost was higher by 9.6% and profits lower by 21% for MC farmers when the TCs was included in arriving at the estimate.

However, even with the inclusion of TCs, PC farmers earned significantly higher profits (more than twice) ($p < 0.01\%$) than independent farmers. On the other hand, MC farmers' profits were lower by 2% (statistically insignificant) in relation to independent farmers. This indicates that when we include the TCs in the calculation of total cost, the profitability of Chilli production reduces to a great extent. Therefore, in reality, TCs should be incorporated in estimation of total cost and in arriving at profit.

4 Results and Discussion

The paper attempts to develop a framework for quantifying the opportunistic behavior in procurement by the MFRCs and the impact of asymmetric information on profits of Chilli growers. The study uses a non-parametric propensity score matching estimator for measuring the TCs (asymmetric information and opportunistic behavior) of MFRCs and its impact on Chilli growers' profits.

Our empirical finding shows that Chilli farmers who entered into production contracts received significantly higher prices at Rs 21.41 per kg ($p < 0.01\%$) as compared to Rs 18.38 per kg, received by the independent farmers, this translates in to 16.49% higher price than independent farmers. Further, the farmers with marketing contracts received a significantly higher ($p < 0.1\%$) price of Rs 20.20 per kg, compared to independent farmers. Further, farmers undertaking production and marketing contracts in Chilli crop realised significantly higher yields, higher revenue and higher total costs ($p < 0.01\%$).

Our results shows that TCs were significantly higher for farmers in MFRCs as compared to independent farmers. Such costs accounted for 14.5% of total costs for PC farmers and 9.6% for MC farmers. The TCs was lower (6% of total costs) for the independent farmers. The total TCs worked was higher by Rs 9,178 ($p < 0.01\%$) for PC farmers and Rs 5,394 ($p < 0.01\%$) for MC farmers than for independent farmers.

5 Major Finding and Policy Suggestion

Our study indicated that opportunistic behavior and asymmetric information enabled the MFRCs to impose significant TCs on Chilli farmers. The farmers incurred bargaining and monitoring costs due to opportunistic behavior by the MFRCs. Asymmetric information on Chilli price and grading uncertainty significantly increased farmers' TCs. This has implications for farmers' participation in MFRCs model. We suggest, introducing a proper institutional mechanism to ensure that written contracts are made obligatory between MFRCs and contracting farmers to safeguard the interest of farmers. The institutional structure should focus first on controlling MFRCs chains' opportunistic behavior, which is the best and effective way to reduce TCs incurred by the farmers.

We also suggest a strict enforcement mechanism, which would make the cost associated with opportunistic behavior less critical for farmers. In fact, ensuring transparent contract is to the advantage of MFRC as it will increase farmers' participation in the model adopted by them. The problem of asymmetric information can be tackled with cooperation and collective efforts mooted by farmers to get updated information on prices and quality standards. We strongly feel that farmers' collectives has the potential to reduce uncertainty about prices by better understanding of the markets and price movements. Similarly, the product quality standards can be tackled through collective bargaining efforts. The study concluded that the MFRCs model of entering in to contracts with farmers has the high potential to emerge as a viable alternate channel for marketing vegetable crops like Chilli as the MRFC practice vertical integration focusing on scientific product quality.

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