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Choice of paddy marketing channel and its impact: evidence from Indian farm households

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Abstract This study uses data from a nationally representative survey to identify the factors that determine farm households' choice of paddy marketing channels and the impact of the choice on the price realized. Small landholders sell their produce predominantly in informal or traditional value chains. Multinomial treatment effect estimates with endogenous market channels indicate that small landholders are less aware of the government-set floor price (minimum support price) and they realize lower prices and earn lower incomes than farmers selling in mandis (regulated markets).

Keywords Paddy, marketing channels, multinomial treatment effects, minimum support price (MSP), impact evaluation, India

JEL codes Q02, Q12, Q13, Q14, Q18, C30

Economic development is both the cause and effect of farmers' participation in markets. Access to markets is an important pathway for ensuring profitability and income and, thereby, reducing poverty (World Bank 2008; Poulton, Kydd, and Doward 2006; Sachs 2005). Improving small farmers' access to markets is of the utmost importance in improving their welfare. If at least one member of a household is self-employed in agriculture in either principal status or subsidiary status, that household can be called an agricultural household. India has about 146.45 million agricultural households, and most (86%) are small and marginal (GoI 2019). Most farmers reside in remote villages, where market infrastructure and connectivity are poor; poor transport and market infrastructure raise transaction costs, reduce the farmers' bargaining power and, ultimately, reduce their income (Bardhan 1991; Clay 2004). The lack of proper connectivity forces farmers to sell their produce to market intermediaries, who use the prevailing information asymmetry to make profits, which ultimately increases the price spread. The literature shows that larger the number of market intermediaries in supply channels, larger the price spread, and lower the farmers' income (Chengappa et al. 2012; GoI 2013).

Farmers rely on several sources for financial assistance because their income is meagre and the time gap between sowing and harvesting is long (Singh and Bhogal 2015). Some intermediaries act as marketing links and also provide credit and inputs. These intermediaries provide easy loans for all purposes, agricultural and non-agricultural, and these loans do not require collateral. But the rate of interest is 15–24%, three times higher than the rate at which formal sources lend, and borrowing from intermediaries worsens the financial condition of farmers and pulls them into a vicious cycle of indebtedness (Kaur 2017; Mitra, Roy, and Mishra 2007; Sidhu and Gill 2006; Singh 2014; Kumar et al. 2015).

To improve the access of farmers to markets, the government has taken several steps: it has instituted market regulation through the Agricultural Produce Market Committee (APMC); announced minimum support prices (MSP); and induced the emergence of

private players and cooperatives in marketing channels that forward produce from farmers to consumers. These steps have improved farmers' access to markets, credit, income, and welfare (Eaton and Shepherd 2001; Patrick 2004; Al-Hassan, Sarpong, and Mensah-Bonsu 2006; Barret 2008). Despite all these steps and benefits, however, farmers, especially smallholders, continue to depend on informal local traders for marketing their product; nearly 80% use marketing channels involving local traders (Abebe, Bijan, and Royer 2016; Jari and Fraser 2009).

Were farmers informed about the interventions started by the government (like MSP) when they chose a marketing channel? How do farmers finance agriculture-related activities? What factors determine their choice of marketing channel? What is the impact of selecting a particular marketing channel on prices? These questions are investigated in this study.

Many studies have been conducted to identify the factors affecting the choice of a marketing channel. According to Jari and Fraser (2009), the factors that determine the choice of a marketing channel are market information, social capital, market infrastructure, group participation, and tradition. In Kenya, the factors responsible for the selection of milk marketing channels are the availability of credit, participation in cooperatives, membership in farmers' groups, and government intervention (Mburu 2007). The factors affecting the selection of dairy value chains in India are family size, farm size, caste, education, training received, food subsidies, unemployment benefits received, and sources of technical information (Kumar et al. 2019). But the literature provides little evidence on the factors that determine paddy farmers' choice of market channels or on the effect of the choice on prices (Lee, Liu, and Chang 2020; Negi et al. 2018).

This study aims to identify the factors that enable farmers' choice of a particular marketing channel and its impact on the price realized. The study contributes to the existing literature in several ways. First, a very large representative sample of paddy farming households (9,304) is used. Second, we use a multinomial treatment effect model to account for endogeneity and selection bias. Third, we deliberate on the potential reasons for the treatment effects. The study also gives insight into the awareness level of farm households involved in marketing channels regarding the MSP of paddy.

Methodology

Data

The study uses the data obtained from the Situation Assessment Survey conducted by the National Sample Survey Office (NSSO) (GoI 2014). The purpose of the survey is to analyse the status of agricultural households in India. The survey covered 4,529 villages and 35,200 farming households. The information was collected for the agricultural year 2012–13. The study followed the stratified multistage sampling technique in which the first stage was the village and the last stage unit was the household. These households were visited twice in 2013, first between January and July and the second between August and December.

This study uses data on the socio-economic, credit, information, and marketing aspects of 9,304 paddy-growing households (out of the 35,200 agricultural households surveyed). The data available from the first visit in 2013 (January to July) and only the first marketing agencies (first agency) selected by farmers was used. That is also the limitation of this study.

Econometric model

From the data obtained from the paddy growers it was found that they sell their paddy mainly to local traders, input dealers, mandis, cooperatives, processors, and others. The impact of a farmer's selection of a particular market channel on their performance can be assessed using the equation

$$y_i = x_i\beta + \theta_{1i}T_{1i} + \theta_{2i}T_{2i} + \theta_{3i}T_{3i} + \vartheta_i \quad \ldots(1)$$

where, y_i represents the price realized, which has been taken as the indicator of efficiency;

x_i represents several characteristics of farmers; and

T_i represents the different marketing channels used by the paddy growers for marketing their produce.

The farmers' selection of market channels is endogenous, and it is jointly estimated along with the determinants of price realization. Paddy growers select a particular marketing channel depending upon their preference (self-selection). On the other hand, a buyer might be interested in a partnership with a particular category of paddy growers. Thus, these choices of farm households are driven by unobservable characteristics: farm management skills, or communication skills, or

acquaintance with certain channels, or others. Therefore, the θ_s obtained in Equation 1 would be biased. To correct this endogeneity, we used, following Deb and Trivedi (2006 a, 2006b), the multinomial treatment effect model.

In this model, the multinomial choice selection equation is estimated at the first stage. As in Equation 1, ϑ_i consists of unobservable characteristics (l_{ji}) common in the selection of the j[th] marketing channel by the i[th] farmer. It can be expressed as

$$\vartheta_i = \Sigma_j \lambda_j l_{ji} + \varepsilon_i \quad (2)$$

where, ε_i represents the error term that is idiosyncratic independently distributed (iid), and

P_{ij} is the latent propensity of the farmer (P_{ij}) for selecting a particular marketing channel j. It can be expressed as

$$P_{ij} = Z_i \alpha_j + \delta_j l_{ji} + \mu_{ji} \quad (3)$$

where, Z_i represents the exogenous covariates and

μ_{ji} represents the random error terms assumed to be independent of e_i.

The l_{ji} is the latent variable that determines both the price realized by the farmer (Equation 1) and the selection of a particular marketing channel (Equation 3). Then the second stage is an ordinary least squares (OLS) regression using the predicted values from the selection equation

$$\Pr(Y_i = y_i, T_{ji} = 1 | X_i, Z_i, l_{ji}) = f(x_i\beta + \theta_{1i}T_{1i} + \theta_{2i}T_{2i} + \theta_{3i}T_{3i} + \Sigma_j \lambda_j l_{ji}) * g(Z_i\alpha_j + \delta_j l_{ji}).$$

The sign of λ_j depicts whether the treatment and outcome are positively or negatively correlated through unobservable characteristics implying positive or negative selection. We follow a normal (Gaussian) distribution function as our outcome variable is continuous.

We use the maximum simulated likelihood procedure to estimate the above multinomial treatment effect model (Deb and Trivedi 2006 a). The 'mtreatreg' Stata routine was used for this study. We follow Birthal et al. (2017), who study the effect of the choice of dairy value chains on the yield and profits of the dairy farm.

The fitted model is identified even without an exclusion restriction. For better identification, we use variables of access to technical advice. We conducted a falsification test to check the admissibility of the instruments, following Di Falco, Veronesi and Yesuf (2010). According to this falsification test, a variable is a valid instrument if it affects the choice of value chain among users, but it will not affect the prices realized by the non-users of the value chain. Except in a few cases, the falsification test indicated that our instruments were valid.

Results and discussion

Distribution across value chain and farm size

Figure 1 presents the distribution of paddy growers across the value chains. The distribution seems skewed towards local traders and mandis (regulated markets). Around 58% of the farmers sold their produce to local traders while 20% sold at mandis. On an average, 73%

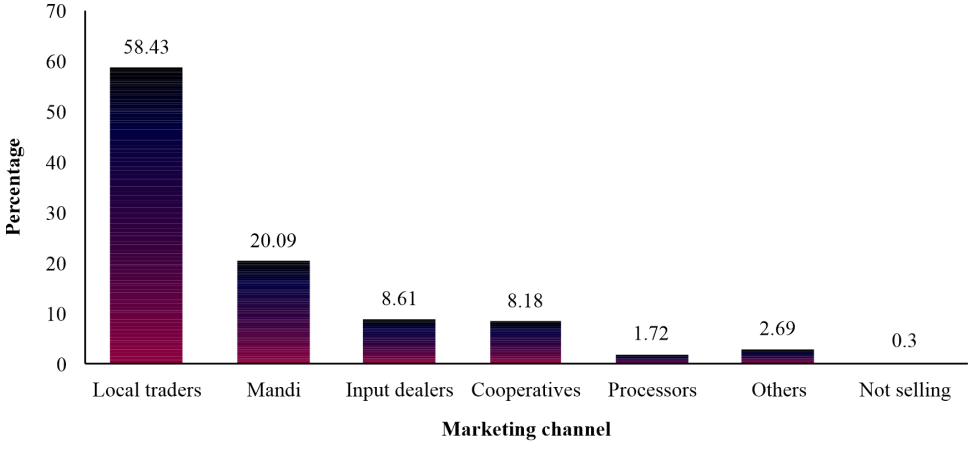

Figure 1 Distribution of users across marketing channel
Source Authors' calculation based on data from GoI (2014)

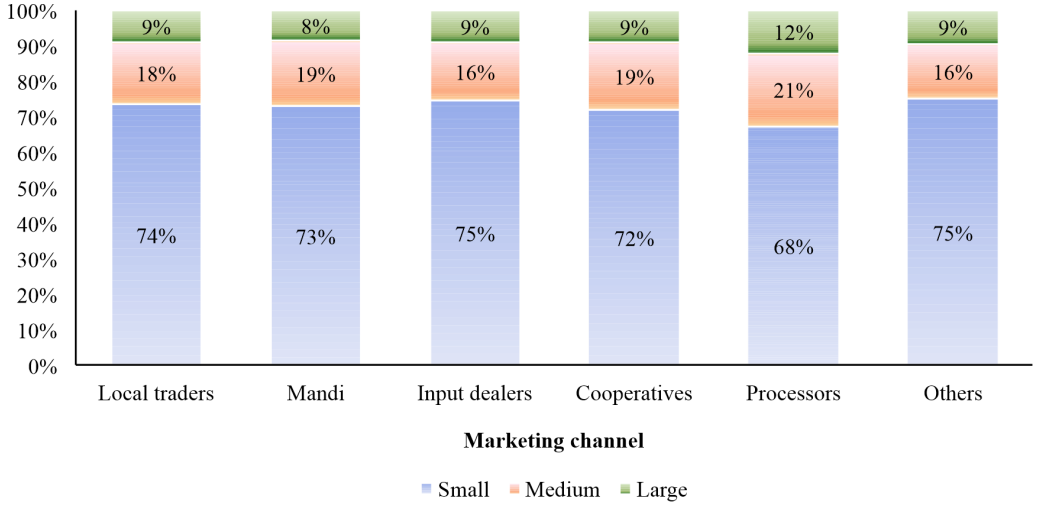

Figure 2 Distribution of users across market channels by farm size

Note Small farmers include both marginal (<1 ha) and small farmers (1–2 ha). Medium and large farmers are who have land of 2–4 ha and >4 ha respectively. The classification is as followed by the Government of India.

Source Authors' calculation based on data from GoI (2014)

of the farmers had less than 2 hectares of land, and the share of small farmers was consistent across different value chains, processors being a slight exception (Figure 2). In other words, 75% of the sample paddy growers were small and marginal, consistent with the all-India figures. The inability of small and marginal farmers to transport their produce to distant formal markets and their inability to bargain (because they sell small quantities) forces them to sell at local markets (Chatterjee and Kapur 2016; Negi et al. 2018). Another plausible explanation for the skewed distribution towards local traders and mandis is that unlike wheat, paddy is cultivated all over India, and in most regions, the formal market is less developed (Negi et al. 2018).

Descriptive statistics

Table 1 displays the descriptive statistics of some key variables. The family size, proportion of male households, and the age of household head was similar across the value chains. The quantity sold and the value of product (including by-product) sold was higher among households that sold at mandis and cooperatives and to processors. The price realized in these three value chains is above the average. The price realized at exceeded even the MSP announced by the government (Table 2). Around 9% of the farm households sold to input dealers (Figure 1).

It is a widely found arrangement in India that farmers either pledge their produce while buying inputs or sell to the same dealers they will buy inputs for the next season. Input dealers also provide farmers credit with their produce as collateral (Negi et al. 2018). Farmers who sell to input dealers have a higher outstanding loan amount and a lower net return. Lesser expenses on inputs and higher monthly household expenditure indicate that farmers use the loans they take from input dealers to finance personal, non-agricultural activities. This reduces the farm output and, thus, the bargaining power of these farmers (75% being small and marginal). This is evident from the lower price received by the farmers selling to input dealers (Table 2). It is well known that moneylenders, input dealers, and other informal sources of credit charge three times higher interest than formal sources like cooperative societies or banks (Kumar et al. 2015). Coupled with lower investment in agricultural activities, evident in lesser expenses on inputs, this poses a serious threat to agricultural development in the country.

Sources of credit

Table 3 presents the sources of credit and Table 4 presents the sources of inputs. Studying the pattern of sources is important because value chain actors play multiple roles: they supply inputs and credit, buy the final produce, and influence farmers' choice of marketing channel (Negi et al. 2018). On an average,

Table 1 Descriptive statistics of key variables

	Local traders	Mandi	Input dealers	Cooperatives	Processors	Others
Family size (number)	5.96 (0.04)	6.05 (0.07)	5.92 (0.11)	6.09 (0.11)	6.71 (0.26)	6.18 (0.18)
Land owned (ha)	1.11 (0.03)	1.06 (0.04)	1.05 (0.06)	1.15 (0.07)	1.35 (0.20)	1.04 (0.12)
Male head of household (1/0)	0.51 (0.01)	0.52 (0.01)	0.50 (0.02)	0.51 (0.02)	0.51 (0.04)	0.51 (0.03)
Age (years)	31.09 (0.28)	31.30 (0.47)	30.87 (0.73)	31.75 (0.76)	30.73 (1.69)	30.06 (1.34)
Quantity sold (kg)	2,733.06 (62.66)	5,488.03 (244.46)	3,089.75 (189.79)	6,919.96 (488.17)	5,050.46 (816.33)	2,469.11 (448.60)
Value of product(including by-product) (INR)	46,642 (2036.10)	65,442 (7,349.57)	53,825 (4,789.18)	51,501 (3,925.97)	42,909 (7,452.48)	37,181 (5,757.24)
Loan outstanding (INR)	116,668.30 (3,522.34)	122,204.50 (7,421.20)	115,211.3 (7,109.16)	103,050.00 (6,751.44)	120,659.4 (15,719.0)	120,786.3 (11,313.60)
Monthly household consumption expenditure (INR)	8,631.30 (120.72)	8,589.83 (334.87)	9,090.46 (506.23)	8,530.95 (222.99)	8,441.91 (480.05)	9,229.66 (875.48)
Expenses on inputs (INR)	1,140.50 (31.13)	1,079.30 (49.20)	1,103.80 (73.11)	1,201.94 (101.95)	1,444.17 (192.23)	1,170.65 (163.33)

Note Standard errors are given in parentheses
Source Authors' calculation based on data from GoI (2014)

Table 2 Price realized across different market channels

	Price realized (INR per quintal)	MSP (2013–14) (INR per quintal)		Difference (%)		Value of product (INR)
		Common	Grade A	Common	Grade A	
Local traders	1,167	1,310	1,345	–12.26	–15.26	46,642.41
Mandi	1,356	1,310	1,345	3.39	0.81	65,442.26
Input dealers	1,141	1,310	1,345	–14.77	–17.84	53,824.67
Cooperatives	1,291	1,310	1,345	–1.44	–4.15	51,501.11
Processors	1,272	1,310	1,345	–3.00	–5.75	42,909.04
Others	1,163	1,310	1,345	–12.62	–15.63	37,180.86
Total	1,215	1,310	1,345	–7.84	–10.72	51,134.56

Source Authors' calculation based on data from FCI (2013) and GoI (2014)

an equal share (50%) of farmers borrows from formal and informal sources. Farmers dealing with processors are an exception, as around 60% borrow from formal sources. Farmers selling to processors are systematically different, as 33% are medium and large farmers (>2 hectares) (Figure 1). Farmers with large farm sizes are more likely to borrow from institutional sources (Kumar et al. (2015). These farmers are more likely to have a higher level, and also extent, of indebtedness (Padmaja and Ali 2019).

Singh and Bhogal (2015) explain that commission agents play an exploitative role. Small farmers are forced to deal with commission agents because these agents provide undocumented credit; essential domestic items, either directly or through other contacts; and agricultural inputs. It was documented

Table 3 Sources of credit for farmers associated with market channels (number of borrowers)

	Govern-ment	Coopera-tives	Bank	Employer/ landlord	Agricultural/ professional moneylender	Shopkeeper/ trader	Relatives/ friends	Total
Local traders	125	476	961	34	691	279	507	3,174
	(4)	(15)	(30)	(1)	(22)	(9)	(16)	(100)
Mandi	57	185	316	11	258	91	186	1,125
	(5)	(16)	(28)	(1)	(23)	(8)	(17)	(100)
Input dealers	16	72	160	3	114	38	77	496
	(3)	(15)	(32)	(1)	(23)	(8)	(16)	(100)
Cooperatives	22	59	125	5	103	37	89	454
	(5)	(13)	(28)	(1)	(23)	(8)	(20)	(100)
Processors	2	11	40	0	22	6	11	93
	(2)	(12)	(43)	(0)	(24)	(7)	(12)	(100)
Others	4	25	46	0	25	12	25	140
	(3)	(18)	(33)	(0)	(18)	(9)	(18)	(100)
Total	226	828	1,648	53	1,213	463	895	5,482
	(4)	(15)	(31)	(1)	(22)	(9)	(16)	(100)

Note Figures in parentheses are percentage to row total
Source Authors' calculations based on data from GoI (2014)

Table 4 Sources of input for farmers associated with different market channels

	Local traders	Mandi	Input dealers	Cooperatives	Processors	Others	Total
a. Number of farmers associated with different sources of inputs and market channels							
Own farm	2,158	725	301	292	61	98	3,650
Local traders	2,449	896	375	340	74	114	4,260
Input dealer	357	111	46	51	12	22	599
Cooperative and government agency	361	103	58	58	9	10	600
Others	107	30	19	18	4	6	184
Total	5,435	1,869	800	760	160	250	9,302
b. Distribution of input source across market channels (%)							
Own farm	59	20	8	8	2	3	100
Local traders	57	21	9	8	2	3	100
Input dealer	60	19	8	9	2	4	100
Cooperative and government agency	60	17	10	10	2	2	100
Others	58	16	10	10	2	3	100
Total	58	20	9	8	2	3	100
c. Distribution of input source within the market channels (%)							
Own farm	40	39	38	38	38	39	39
Local traders	45	48	47	45	46	46	46
Input dealer	7	6	6	7	8	9	6
Cooperative and government agency	7	6	7	8	6	4	6
Others	2	2	2	2	3	2	2
Total	100	100	100	100	100	100	100

Source Authors' calculation based on data from GoI (2014)

that more than 56% of the food for household consumption was purchased from the shops of these agents. These agents trap the small farming households in a vicious cycle of indebtedness. It is not that the farmers do not have a viable alternative; there is a vast network of banks and cooperative societies in India.

Sources of inputs

In the sources of input front (Table 3), 59% of the farmers who use inputs (seeds, manure, etc.) from their own farm sell their produce to local traders, 20% in the regulated markets, and 8% each to input dealers and cooperatives. The distribution of selling is similar across the sources of inputs. However, farmers buying inputs from cooperatives seem to sell through cooperatives. The distribution within the value chain shows that around 83–87% of the farmers across the value chains use inputs from either their own farm or from local traders. There is no visible relationship between factor and product markets at this stage. Local traders dominate both markets, and resource-poor farmers rely heavily on these informal traders. Thus, the penetration of modern value chains could bring sizeable difference in the livelihood of these farmers.

Modern value chains expect higher quality products, and they procure at a monopsonistic price; the effective extent of these modern chains is dependent on the distribution of land (Henderson and Isaac 2017). Eswaran and Kotwal (1986) in their important work implicitly assume this traditional practice of procurement; they derive an inverse relationship between farm size and productivity and predict that egalitarian land distribution could increase farm output and producers welfare. Assuming that the landholding of our sample farmers is uniformly distributed (Table 1), and that most farmers use traditional (informal) means to sell their product, farmers can increase their output and welfare (Eswaran and Kotwal 1986). But Henderson and Isaac (2017) find that introducing a modern value chain can reduce the welfare effect of land redistribution and harm landless agricultural labourers. Despite many years of marketing and price policy, farmers are still dependent on local traders. This calls for rethinking the agricultural marketing and price policies in the country.

MSP and price realized

The government fixes the MSP to protect producers and consumers from price fluctuations. If the market price falls below the MSP, the government is supposed to procure the produce at the MSP (Negi et al. 2018). Thus, awareness of the MSP potentially plays a crucial role in choosing a marketing channel and realizing better prices.

Table 5 shows the awareness of the MSP of sample farmers across the value chains. On average only around 26% of the farmers are aware of the MSP, and participants in the formal value chain are slightly more aware than participants in the informal value chain. This is also reflected in the price realized by farmers. Farmers selling in formal chains earn relatively higher prices (Table 2). For state-wise price realized see Appendix A1. Participants in mandis (regulated markets) get around 3% higher price than the MSP, and farmers using cooperatives are also relatively better off than others. Farmers selling to input dealers and local traders get the lowest prices. This is in line with Baylis, Mallory, and Songsermsawas (2015), which finds that 76% of paddy transactions occur below the MSP.

Thus, to summarize the findings, small farmers who sell their produce predominantly to informal or traditional value chains are less aware of the MSP, realize lesser prices, and earn lower incomes. This

Table 5 Awareness about MSP of farmers using different market channels (in numbers)

	Aware of MSP?		
	Yes	No	Total
Local traders	1,407	3,993	5,400
	(26.06)	(73.94)	(100)
Mandi	508	1,355	1,863
	(27.27)	(72.73)	(100)
Input dealers	204	595	799
	(25.53)	(74.47)	(100)
Cooperatives	212	542	754
	(28.12)	(71.88)	(100)
Processors	36	123	159
	(22.64)	(77.36)	(100)
Others	69	179	248
	(27.82)	(72.18)	(100)
Total	2,436	6,787	9,223
	(26.41)	(73.59)	(100)

Note Figures in parentheses are percentage to row total
Source Authors' calculation based on data from GoI (2014)

might be due to the scale factors at play. Smaller farmers have lesser surplus—thus, less bargaining power—and become price takers, while large farmers with higher surplus have the advantage of bargaining and reap greater benefits of the MSP (Joshi, Birthal, and Minot 2006; Negi et al. 2018).

Choice of value chain

The factors which might influence farmers to choose a particular marketing channel are farm size, source of credit, source of inputs, and awareness of the MSP. The other variables which might drive farmers' choice have been modeled using a multinomial treatment effect model. The results are presented in Tables 6 and 7. Table 6 displays the results of the selection equation, the first stage of the multinomial treatment effect regression. These results are to be interpreted in a relative way. The base category in the multinomial logit model was sale to 'local traders'.

Our hypothesis is that poor households use informal or mostly local traders to sell their produce. The coefficients of the below poverty line (BPL) card across all the value chains are negative (except processors) and significant only in the first case (mandi). This implies that people who possess a BPL card are less likely to sell their produce at mandis; in other words, farmers who are poor are more likely to sell their produce to local traders. Other variables representing farmers' access to social safety nets and covering the poor (Antyodaya) also have predominantly negative coefficient values. Unemployed rural youth who got work through the MGNREGA had a significantly greater chance of selling their produce to cooperatives or government agencies.

The variables age and age squared had positive coefficient values, implying that older households were more likely to sell through the input dealers. Households who were literate without formal schooling were significantly more likely to sell through mandis and input dealers and highly unlikely to sell through cooperatives. However, households where the head had formal schooling below the primary level were more likely to sell through cooperatives and processors.

Further, we hypothesized, and find, that small farming households and landholders were less likely to sell their produce at regulated markets. Medium and large landholders were significantly more probable to sell their produce to the processors and input dealers. The variables which represented the social group (caste) did not influence the households' choice of value chain.

We looked for a relationship between the source of finance and the choice of value chain. The coefficients of dummies for borrowing from banks, shopkeeper/trader, and professional/agricultural moneylenders were positive and significant in the case of input dealers and cooperative value chain. There is no definite pattern of relationship between source of borrowing and the choice of value chain, despite the effects being significant in some cases. Baylis, Mallory, and Songsermsawas (2015) find that credit does not affect price realization in the case of paddy and, therefore, in the choice of value chain.

We find a significant relationship between input and output markets. Farm households using inputs from their own farm were more likely to sell to input dealers. Households who bought their inputs from input dealers were more likely to sell their produce to cooperatives or processors. Households who meet their input demand from the cooperatives are significantly less likely to sell to processors and more likely to sell to input dealers, though not significantly.

Households with access to technical advice from Krishi Vigyan Kendras (KVK) and private commercial agents are more likely to sell at mandis. The coefficient of the MSP is positive for mandis, though not significant, and it is negative and significant for input dealers: farmers who are aware of the MSP are more likely to sell in formal value chains and earn better prices. These results are line with Negi et al. (2018), which finds that access to information has a positive effect on price realization.

Impact of choice of value chain

Table 7 presents the results of the second stage of the multinomial treatment effect regression model with endogenous market channels. The parameter estimates depict the effect of choosing a value chain on the price realized. The inverse Mills ratio (lambda) for processors is positive and significant, indicating the existence of selectivity bias. This might be due to farmers' self-selection into the processor-driven value chain or the preference of processors for a specific kind of farmer. Thus, without controlling for self-selection, the effect of mandi-driven value chains would have been biased upward.

Table 6 Parameter estimates of mixed multinomial selection model of the market channels

	Mandi	SE	Input dealers	SE	Cooperatives	SE	Processors	SE
Age (years)	0.01	0.01	0.03**	0.01	–0.01	0.02	0.03	0.03
Age^2	0.00	0.00	0.00*	0.00	0.00	0.00	0.00	0.00
Education (base: Illiterate)								
Literate without formal schooling (1/0)	1.88**	0.79	2.11***	0.83	–3.12***	1.05	0.42	1.17
Literate but below primary (1/0)	0.42	0.29	–0.13	0.24	0.43*	0.24	0.80*	0.43
Primary (1/0)	–0.14	0.37	–0.36	0.26	–0.22	0.31	0.16	0.57
Middle (1/0)	0.08	0.27	–0.43	0.26	–0.10	0.35	0.15	0.53
Secondary (1/0)	0.07	0.29	–0.43	0.29	–0.69	0.42	1.05	0.66
Graduate and above (1/0)	0.58	0.40	0.19	0.44	0.44	0.42	–0.93	0.91
Land holding (Base: Marginal)								
Small (1–2 ha)	–0.45***	0.18	0.08	0.20	0.20	0.28	0.04	0.35
Medium (2–4 ha)	0.12	0.19	0.39	0.26	–0.22	0.30	1.15**	0.52
Large (>4 ha)	0.52	0.32	0.81***	0.30	0.15	0.53	1.48***	0.50
Social group (Base: Scheduled Caste)								
Scheduled tribe (1/0)	0.12	0.33	0.04	0.34	–0.24	0.45	1.13*	0.62
Other backward castes (1/0)	–0.08	0.26	0.26	0.29	–0.07	0.40	–0.33	0.49
General (1/0)	0.45	0.28	0.04	0.30	0.44	0.52	0.26	0.55
Access to social safety net								
Antyodaya card (1/0)	–0.36	0.37	–0.13	0.43	–0.04	0.52	–1.06	0.71
BPL card (1/0)	–0.47***	0.19	–0.19	0.22	–0.11	0.23	0.64	0.39
MGNREGA (1/0)	–0.04	0.20	–0.03	0.20	0.76***	0.26	0.21	0.34
Formal training in agriculture (1/0)	–0.10	0.95	–1.44*	0.79	1.54**	0.71	–5.12***	1.18
Credit								
Loan outstanding (INR)	0.00	0.00	0.00	0.00	0.00	0.00	0.00*	0.00
Cooperative and government (1/0)	0.16	0.26	–0.14	0.28	0.37	0.39	0.18	0.55
Bank (1/0)	–0.18	0.24	0.40*	0.21	0.21	0.28	0.28	0.43
Agricultural/ professional moneylender (1/0)	0.39	0.27	0.69***	0.21	0.06	0.28	–0.31	0.64
Shopkeeper/Trader (1/0)	0.26	0.33	0.59**	0.30	0.87***	0.32	0.32	0.55
Input source								
Own farm (1/0)	0.13	0.25	0.48**	0.22	0.15	0.22	0.42	0.44
Local trader (1/0)	–0.01	0.20	0.34	0.22	0.02	0.26	0.09	0.56
Input dealer (1/0)	0.37	0.37	0.66	0.50	0.85*	0.47	0.97*	0.56
Cooperative/Government agency (1/0)	–0.37	0.24	0.38	0.27	–0.37	0.37	–1.08**	0.49
Aware of MSP (1/0)	0.18	0.25	–0.54**	0.24	–0.18	0.27	0.50	0.50
Quantity sold (Log)	0.36***	0.09	0.10	0.07	0.73***	0.09	0.15	0.13
Access to technical advice								
Extension agent (1/0)	0.30	0.31	–0.47*	0.25	–0.27	0.38	0.83	0.82
Krishi Vigyan Kendra (1/0)	0.68***	0.28	–0.14	0.30	–0.01	0.35	0.82	0.62
Agricultural university/college (1/0)	0.16	0.32	0.09	0.31	–0.05	0.34	–0.07	0.77
Private commercial agents (1/0)	0.78**	0.39	–0.35	0.29	0.36	0.35	–0.46	0.64
Progressive farmers (1/0)	0.40	0.32	–0.14	0.34	–0.02	0.29	0.65	0.64
Radio/TV (1/0)	0.58	0.37	–0.14	0.27	0.06	0.39	–0.05	0.80
NGO (1/0)	0.32	0.27	–0.67**	0.28	–0.54	0.39	0.18	0.65
Constant term	–4.76***	0.80	–3.52***	0.60	–8.11***	0.80	–7.78***	1.40

Note ***, ** and * indicate statistical significance at 1%, 5% and 10% level, respectively. Standard errors (robust) are clustered at district level (512 clusters)

Table 7 Multiple treatment effect regression estimates with endogenous market channel

	Price realized (Log)	SE
Difference form base category: 1 if mandi, 0 otherwise	0.082**	0.036
Difference form base category: 1 if input dealers, 0 otherwise	–0.023	0.040
Difference form base category: 1 if cooperatives, 0 otherwise	0.011	0.053
Difference form base category: 1 if processors, 0 otherwise	0.113	0.083
Difference form base category: 1 if others, 0 otherwise	–0.064	0.068
Age (years)	–0.002	0.002
Age^2	0.000	0.000
Literate without formal schooling (1/0)	–0.063	0.079
Literate but below primary (1/0)	0.019	0.032
Primary (1/0)	–0.017	0.025
Middle (1/0)	0.075**	0.038
Secondary (1/0)	–0.043	0.031
Graduate and above (1/0)	–0.017	0.029
Small (1–2 ha)	0.022	0.021
Medium (2–4 ha)	0.038*	0.020
Large (>4 ha)	0.026	0.033
Scheduled tribe (1/0)	0.008	0.054
Other backward castes (1/0)	0.026	0.032
General (1/0)	–0.015	0.033
Antyodaya card (1/0)	0.048	0.038
BPL card (1/0)	0.023	0.021
MGNREGA (1/0)	0.010	0.024
Formal training in agriculture (1/0)	0.036	0.106
Loan outstanding (INR)	0.000	0.000
Cooperative and government (1/0)	0.003	0.025
Bank (1/0)	0.014	0.026
Agricultural/ Professional moneylender (1/0)	–0.060***	0.023
Shopkeeper/trader (1/0)	–0.036	0.030
Own farm (1/0)	0.000	0.028
Local trader (1/0)	–0.020	0.023
Input dealer (1/0)	0.017	0.041
Cooperative/government agency (1/0)	–0.038	0.040
Aware of MSP (1/0)	0.002	0.030
Constant term	2.419***	0.065
Ln (sigma)	–1.187***	0.053
Lambda (mandi)	0.011	0.022
Lambda (input dealers)	0.002	0.033
Lambda (cooperatives)	0.082	0.054
Lambda (processors)	0.034**	0.055
Lambda (others)	0.017	0.026
Sigma	0.305	0.016
Number of observations	9,216	

Note ***, **, and * indicate statistical significance at 1%, 5% and 10% level, respectively. Standard errors are clustered at district level (512 clusters)

Similarly, the positive inverse Mills ratio of all other value chains would have led to the estimation of an upwardly biased effect on prices realized. Our estimates reveal that the prices differ significantly by value chain, and the product price depends on the farmers' choice of value chain. The coefficient of 'mandi' value chain is positive and significant (0.08), implying that farmers selling to mandis earn a significantly higher price.

If we multiply the increased price realization in mandis (8%) with the quantity of paddy sold, we find households selling in mandis will earn INR 3,752 more per hectare than households selling to other marketing channels. This finding is a bit surprising, because commission agents at mandis form cartels (Meenakshi and Banerji 2005; Gulati 2009; Chand 2012; Singh and Bhogal 2015), but this finding supports the argument of Banerji and Meenakshi (2008) that the sellers do not lose significantly when commission agents, majorly in play at mandis, bid as a cartel.

Conclusions

Doubling farmers' income and eradicating poverty is at the forefront of policy decisions in India. Connecting farmers to market (market access) is an integral part of achieving this goal. This study attempts to identify the factors determining farm households' choice of value chain and to estimate the effect of the choice on the price realized. Few researchers have studied this topic. Our study makes some vital contributions to the literature. Our results indicate that mandis are the most efficient and profitable market channel. This can be attributed to the higher price transmission evident in mandis procuring at 3% higher than the government-set floor price (MSP).

The credit, factor, and product markets, though not very definitive, are interlinked. Input dealers, some local traders, and commission agents provide short-term credit and also sell inputs either directly or through other channels. The farmers pledge their produce against the credit and sell their produce soon after the harvest to pay the loan and to buy inputs for the next season. More often than not farmers are paid the monopsonistic (lower) price, because they are small, they have little bargaining power, and they are not aware of the MSP.

Our results suggest that if they have access to credit and input markets, farmers are likely to move away from local informal traders and sell their produce to alternate channels. Additionally, access to technical advice and market information (awareness of the MSP) increases the chance that farmers will choose a more profitable value chain (like mandis) than local traders. Only 25% of the farmers are aware of the floor price (MSP) and, therefore, our study is policy-relevant.

The economic development of the nation requires holistic policy measures, like financial inclusion (to make farmers borrow from formal sources), encouraging farmers to cooperate, incentivizing them to use regulated markets, and regulating against foul play in formal markets. Recent policy measures like Pradhan Mantri Jan Dhan Yojana (PMJDY), unified electronic market (E-NAM), and direct cash transfers (PM-KISAN) to timely buy inputs are deeply appreciated.

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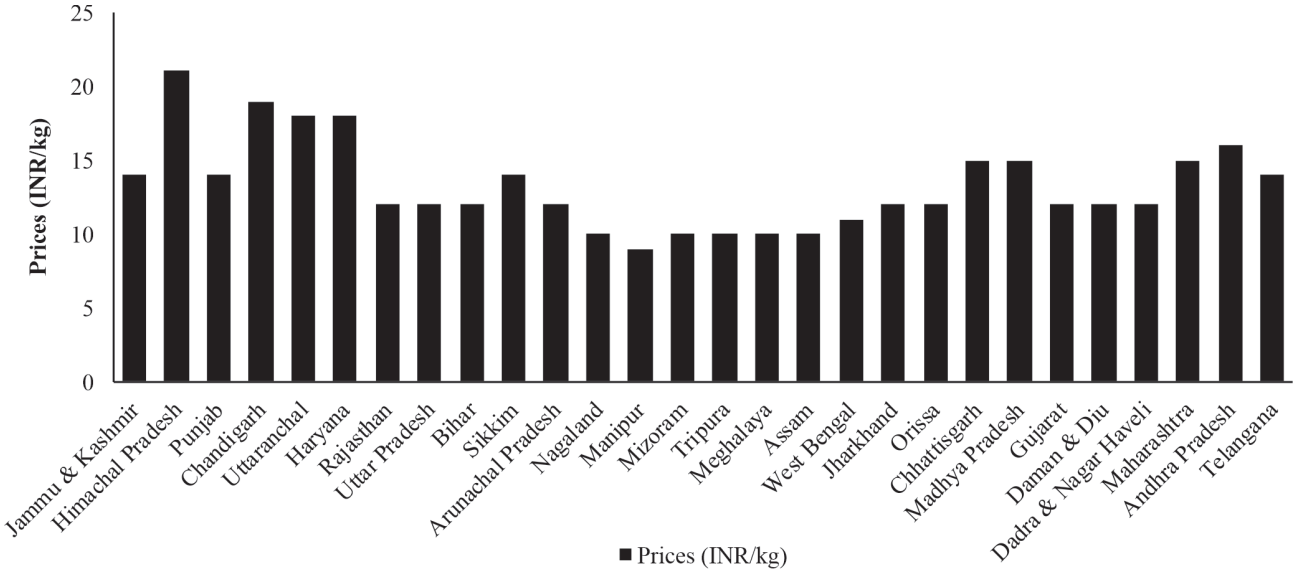

Appendix A 1 State-wise distribution of prices

Source Authors' calculation based on data from GoI (2014)