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Government-Supported Marketing Channels Increase Incomes only for Producers of Local Staples: Evidence from Fruit and Vegetables Farmers in India

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Abstract

Government-supported marketing channels (GSMCs) for agricultural output are widespread in developing and emerging economies to overcome ineffectivenesses caused by market malfunctions. However, government interventions may also create new inefficiencies compared to a profit-driven private sector. This study fills the lacuna in the empirical literature on the effect of such GSMCs on small-scale farmers' incomes, allowing for different effects on crops for local consumption and export. A case in point is the Mandi system, a network of GSMCs in India, the world's second-largest producer of fruits and vegetables. In India, most producers are small-scale farmers who face significant marketing problems. We examine the marketing arrangements of farmers producing perishable high-value products, okra, onions, baby corn, and pomegranate. We assess the determinants of farmers' choice of market channels and the prices they receive from them. Our findings reveal that producers of staple crops (okra, onions, baby corn) obtain greater benefits from engaging in commercial relationships with Mandis. In contrast, producers of high-value crops (pomegranate) are better off by avoiding them and engaging instead with post-harvest contractors and private traders. These findings highlight the within-heterogeneity in the marketing arrangements of perishable products. Further, they indicate that "one size fits all" policies are counterproductive for improving market efficiency and prices received by producers of fruits and vegetables in India.

Keywords: India, government-supported marketing channels, market choice, producers price, perishability, fruits and vegetables.

JEL classification: O17, Q12, Q13, Q18.

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1. Introduction

The functioning of local and global value chains plays a vital role in the income of small-scale farmers in developing and emerging economies (DEE) and is, therefore, crucial for poverty alleviation worldwide (Mishra, Kumar, and Joshi, 2021). Many authors have found a lack of market institutions in such contexts, including market power by agricultural buyers and further downstream (Grosh, 1994; Key and Rusten, 1999; Kopp and Sexton, 2021), the urgency to sell (Kopp and Mishra, 2022), asymmetric information (Winters et al., 2005; Simmons et al., 2005), lack of trust (Singh, 2002, and 2019), liquidity constraints (Ellis and Biggs, 2001; Swinnen and Maertens, 2007; Mishra et al., 2016), or high entrance barriers (Ba et al. 219). To overcome entrance barriers, governments may be inclined to set up government-supported marketing channels (GSMCs) as public services (Nuthalapati et al., 2020). However, to the best of our knowledge, no study has evaluated the effect of GSMCs on the prices received by smallholders. It is further unknown whether such institutions' success depends on whether the crop is a local staple crop or an export cash crop. This paper fills this lacuna in the literature by evaluating the success of the so-called “Mandis”, a GSMC for agricultural output in India, in terms of the resulting returns for producers.

In India, marketing channels for fruits and vegetables have evolved substantially during the second half of the 20th century (Nedumaran et al., 2020). For instance, most fruits are sold through contracting, which provides farmers with fixed prices in advance. This helps them mitigate risk and reduce losses due to weather, pests, diseases, and market price volatility (Mysore and Kruijssen, 2006). Direct marketing to consumers has also taken root in several parts of the country. Large producers sell their farm output to wholesalers or processing firms in towns and near urban areas. Similarly, vegetable farmers select and participate in several marketing channels when

selling their products. These channels include selling to pre-harvest contractors (PHCs), private traders, or government-sponsored outlets (Mandis), which are agricultural markets run by the Agricultural Produce Market Committee (APMC) (Nuthalapati et al., 2020).

The okra, onion, baby corn, and pomegranate markets in India serve as a critical empirical example to allow for a comparison between cash crops and local staples. India is particularly relevant, given its status as the world's second-largest producer of fruits and vegetables. For instance, in 2020, India produced 61 percent of the global production of okra and 26 percent of the worldwide output of onion (FAO, 2020). It also produces about 10 million tonnes of baby corn, representing approximately 1.74 percent of worldwide production (Singh, 2019). And finally, India is the world's largest producer of pomegranate, followed by China and Iran (GoI 2018)¹. These commodities are increasingly becoming important for the livelihood of Indian farmers and in global value chains in horticulture.

Given the ideal agroclimatic conditions and soil diversity, suitable marketing arrangements in India could be a boon for producing fruits and vegetables and lift many smallholders above the poverty threshold (Kulanthaivelu, Iyyanar, and Ramakishnan, 2022; Gulati and Juneja, 2022; Birthal Roy and Negi, 2015; Christiaensen, Demery, and Kuhl, 2011). Analogously, poor marketing arrangements can discourage smallholders from entering or even remaining in the production of horticultural crops, especially vegetables (Mishra et al., 2018). Several marketing arrangements have been recently investigated in the context of grain farmers producing wheat and paddy (Negi et al., 2018) or dairy (Vandeplas et al., 2013)². However, the literature falls short

¹ In 2016 the state of Maharashtra produced 6.5 million tonnes and 1.5 million tonnes of onion and pomegranate, respectively. Maharashtra, in 2016, also produced 0.12 million tonnes okra (GoI 2017a). During 2016, Maharashtra accounted for 31%, 64%, and 2% of onion, pomegranate, and okra production in India.

² Marketing outlets examined in Negi et al (2018) include local traders, government-regulated markets, input dealers, processing firms, and government agencies (such as the Food Corporation of India).

when examining the marketing arrangements of smallholders producing perishable commodities like fruits and vegetables³.

This paper makes several particular contributions to our understanding of the welfare implications of the choice of marketing channels (Fafchamps and Hill, 2005; Mason et al., 2015; Hao et al., 2018; Negi et al., 2018). First, we investigate the marketing choices of farmers, who, unlike the wheat and paddy farmers in Negi et al. (2018), tend to be small (in landholding size and sales volume), face credit constraints, experience higher transaction costs, and often lack information on markets and prices. This paper further differs from previous studies by centering the analysis around the effects of government innovations on marketing arrangements for perishable commodities. Such commodities are highly seasonal and exhibit, therefore, high price volatility. These characteristics represent a source of heterogeneity in the welfare implications of the choice of marketing channels.

The analysis focuses on two crucial elements of the marketing arrangements of Indian farmers producing them. First, we examine the determinants of the choice of marketing channels by farmers growing fruits and vegetables. Unlike grain producers, most fruit and vegetable farmers use three prominent marketing outlets: Private traders, pre-harvest contracting firms (PHCs), and APMC Mandis. Second, we assess the implications of the choice of marketing channels on the prices received by vegetable and fruit producers. In other words, we explore if there are significant differences in prices received by fruit and vegetable farmers in the three marketing outlets mentioned above. The empirical analysis is based on a unique farm-level survey data set collected from smallholders producing perishable local staples (baby corn, okra, and onion) and perishable

³ Some exceptions include Kopp and Mishra (2022) who examine crop perishability and market power, and Fafchamps and Minten (2012) and Mitra et al. (2013) who assess the role of information in the farm-gate prices of semi-perishable commodities.

high-value export crops (pomegranate) in three regions of India: Punjab, Haryana, and Maharashtra.

Results suggest that the choice of marketing channels under perishability constraints affects farm profitability. Specifically, producers of staple crops obtain greater benefits from engaging in commercial relationships with APMC Mandis, which should therefore receive ongoing support. In contrast, producers of high-value crops are better off avoiding them and engaging with PHCs and private traders instead. These findings indicate that the nature of the crop produced plays an important role when selecting specific market channels and that “one size fits all” type of policies are counterproductive for improving market efficiency and prices received by producers of fruits and vegetables in India.

The remainder of this paper is organized as follows. The next section reviews the recent developments in fresh food and vegetable marketing in developing and emerging economies (DEE). It then introduces the specific marketing practices and agricultural marketing policies affecting producers of fruit and vegetables in India. Section 3 discusses the study settings and the data employed for our analysis. Section 4 is dedicated to the estimation strategy and discusses the empirical framework employed to assess, first, the effect of the choice of a market channel on producer prices and second, the determinants of farmers’ choice of a market channel. Section 5 reports the main findings, and section 6 discusses policy implications before section 7 concludes.

2. Marketing of fruit and vegetables

2.1 Market developments in the fruit and vegetable industry in development contexts

Economic liberalization in the late 1990s and the opening of the agricultural sector to foreign investments have reduced structural rigidities and thus improved linkages between domestic and international markets and many DEE. At the same time, these policies have guided enhancements

of the quality and standards of agricultural products, especially fruits and vegetables. The flow of foreign direct investment has also driven much of the recent developments in retail markets (Narayanan, 2009). The proliferation of supermarkets and modern retail chains (e.g., neighborhood stores, convenience stores, and modern corporate retailers) represents an opportunity for farmers to engage in vertical coordination (Reardon et al., 2009). Given these recent developments, fruits and vegetables, considered high-value crops, have attracted significant attention from stakeholders along the respective value chains — especially from private contracting firms (Mishra et al., 2018; Mishra, Kumar, and Joshi, 2021).

Albeit the demand for fruits and vegetables is robust, urban consumers often fail to meet the recommended amounts in their diets. This has been argued to result from inadequate storage and transportation infrastructure (Joshi et al., 2004; Pingali, 2015) and the high transaction costs of linking producers to markets. Poor coordination in the value chains for fruits and vegetables typically results in high spoilage rates (Gandhi and Namboodri, 2005). Similarly, the high number of intermediaries along marketing channels has been shown to affect the price received by farmers and their marketing channel choices (Gupta and Rathode, 1998). This is illustrated by the gap between prices paid by (mainly urban) consumers and prices received by farmers, which is significantly larger when contractors are involved in the supply chain, thus reflecting the impact of marketing channel choices. Overall, marketing practices for fruits and vegetables are considered inefficient. Therefore, governments have been called to encourage direct marketing models to improve the sector's efficiency, foster more competitive pricing, increase local consumption, and boost exports (Dastagiri et al., 2013).

The constraints on marketing arrangements of fruits and vegetables follow a similar pattern. Both are bulky, perishable, and exhibit variable production seasons. These aspects create

challenges for farmers when handling and transporting their products to the markets, which result in higher costs and post-harvest losses (Villacis et al., 2022). As a response, many governments have introduced government-sponsored outlets as a new marketing channel in addition to the established channels of direct marketing, local traders and intermediaries, regional wholesalers, and pre-harvest contractors (PHCs). PHCs assume most of the production risks associated with weather, pest, and diseases and earn profits by bundling and selling downstream in the supply chain (Mysore and Kruijssen, 2006). Particularly, vegetable production is highly seasonal, exposing vegetable producers to significant price volatility and leading to substantial variability in farm income. Compared to vegetables, fruits are characterized by fewer post-harvest losses because they are transported in individual boxes with careful packaging.

Evidence from various contexts shows that government-organized marketing channels can benefit farmers through higher prices and less price volatility (Mason et al., 2015). Such market reforms have led to higher prices received by farmers in many countries, resulting in higher production - especially for high-value crops and export crops - and facilitated the emergence of supermarkets, cooperatives, and processing zones (Reardon and Barrett, 2000). However, such regulated markets are becoming less popular among smallholders, especially those who produce fruit and vegetable. Farmers have been reported to consider them too restrictive, as they still allow buyers to exercise oligopsonistic market power, leaving little for the farmer who had no alternative method of selling (Goyal, 2010; Rehman, Selvaraj, and Ibrahim, 2012). As a result, the last decade has witnessed an emergence of direct marketing practices, such as haats⁴ (in India) and wet markets. In addition, private firms increasingly engage in supply chain management and contract

⁴ Haats are open-air markets conducted on a regular basis (weekly or twice a week) that serve as a market place as direct-to-consumers selling points (direct marketing) in rural areas and towns.

farming, including Cargill India, Mahindra, Indian Tobacco Company's e-Choupal and Bharti (Chand, Kumar and Dastagiri, 2019).

2.2 Background and legislative environment for agricultural marketing in India

India ranks second in the world in producing fruits and vegetables after China and shows an increasing trend in the output and land devoted to their production (see Figure 1). According to the Food and Agriculture Organization (FAO) of the United Nations, India is the largest producer of pomegranate and okra and the second-largest producer of onions. Pomegranate accounts for a substantial proportion of fruits exported, while onions contribute a considerable share of vegetable exports (Dastagiri et al., 2013).

Figure 1: Trends in area and output of fruits and vegetables in India, 1990-2020.



Note: Own production, based on data from FAOSTAT (2022).

Two significant pieces of legislation were passed by the Government of India (GoI) on agricultural marketing. First, the Agricultural Produce Marketing Act of 1963 provided relief to smallholders by reducing/eliminating exploitation from market intermediaries (Krishnamurthy, 2020). Second, in the first decade of the 21st century, the GoI passed a series of domestic market reforms to

improve marketing efficiency and attract local and foreign direct investments. Within this framework, the Agriculture Produce Marketing Regulation (APMR) Act was created in 2003 to prevent the exploitation of smallholders by large retailers and significant gaps in the farm-to-retail price spread (GoI, 2017). The 2003 legislation was overseen by an expert panel entitled the Agricultural Produce Market Committee (APMC). Each state in the Union regulates agricultural markets under the APMC Act. Under this Act, the State governments can establish local agricultural markets, the Mandis. Each state operates APMC Mandis in different locations within the state (Krishnamurthy, 2020; GoI, 2017). The number of Mandis in a region is proportional to the state's total area. Farmers are required to sell their produce in their home region. Traders in the Mandi are required to get licensed by the state government. Finally, wholesalers and retailers cannot purchase products directly from the farmers. In the Mandis, the sale of farm produce occurs via auction and the sales process is controlled by commission agents, acting as mediators between farmers and traders⁵.

The APMC Act of 2003 drastically changed the structure of produce marketing. Specifically, the Act introduced contract farming, developed markets for perishable commodities, and allowed farmers to set up their markets. The 2003 Act also relaxed rules for licensing firms, implemented a single market fee, which has been used for improving market infrastructure and provided direct marketing opportunities and private wholesale markets. It has also helped to ensure transparency in the pricing system by providing market-led extension services to deliver information on product prices, promoting payments on time (same-day payment), encouraging agricultural processing, and establishing public-private partnerships.

⁵ However, farmers have been reported to feel that agents tend to exploit them by giving them lower prices, lack of transparency, price-fixing among traders, delay in payments (ranging from three to fifty days), and low-quality mandi infrastructure (Singh, 2002; Singh and Asokan, 2003; Mishra et al., 2018).

In India, APMC Mandis and private traders or contractors are the most popular marketing outlets for smallholders engaged in fresh fruit and vegetable production in many states in India. Additional marketing outlet options for farmers in India include government procurement agencies (such as the Food Corporation of India), input dealers, and processors. In general, small farmers are more likely to sell their products to local private traders, while larger farmers sell their produce to APMC Mandis. However, access to transportation and storage facilities, coupled with the urgency (or lack thereof) to sell after harvest, drives the ultimate market channel choice. According to the 2013 Indian National Sample Survey Office (NSSO), farmers selling to APMC Mandis experienced the least likelihood of selling below-market prices and reported the highest satisfaction regarding sale quality.

3. Study Setting and Data

To understand the farmers' market channel choice and the consequential livelihood effects, this study relies on a representative dataset from a primary survey with 1,349 smallholders that produce four perishable products: okra, onions, baby corn, and pomegranate⁶. The survey was conducted by the International Food Policy Research Institute's (IFPRI-India) South Asia office in March and April 2016⁷. The composition of the survey is provided in Table 1.

⁶ Smallholders farm only one commodity. There is no cross-over in production of the onions, okra, baby corn or pomegranate.

⁷ The United States Agency for International Development (USAID) and Indian Council of Agricultural Research (ICAR) provided the funds to conduct the survey.

Table 1. Sample Composition by Crop, Indian farmers.

Crop	Number of respondents	Surveyed locations
Pomegranates	418	Solapur, a leading pomegranate-producing district: 18 villages in the Pandharpur, Malshiras, and Sangola blocks of Solapur district in Maharashtra.
Baby corn	225	Aterna village, Sonipat district of Haryana.
Okra	159	Solapur, Pune, and Satara districts of Maharashtra.
Onion	547	Nashik and Jalgaon districts, located in the Khandesh and Northern Maharashtra regions of Maharashtra.
Total	1,349	

The survey included questions on household demographics, farming characteristics, marketing arrangements, risk attitudes, and sources of nonfarm income. Summary statistics on key household characteristics of the sample farmers are presented in Table 2, differentiating between the crops. An overwhelming majority of surveyed households are male-headed⁸, with the average farmer being 46 years old, having nine years of education and 21 years of farming experience. Pomegranate and baby corn producers use all three marketing outlets. None of the sampled onion and okra producers sells their produce through private traders (locally or outside the district). Almost all farmers purchase crop insurance across all crops. However, access to credit seems to be low, especially for baby corn producers, with only 6 percent of baby corn producers reporting having access to credit. Table 2 also reports the sources of information used by producers. Mishra et al. (2018) note that high-value crops in India are capital and information-intensive. The literature generally shows that more-informed farmers obtain better prices and higher profits (Davis et al., 2012; Birthal et al., 2015; Negi et al., 2018).

⁸ Women comprise over 42% of the agricultural labour force in India, yet they own less than 2% of its farm land (Mehta, 2018). In a related study, Negi et al. (2018) report a sample composition of 94% male-headed households.

Table 2. Summary Statistics: Characteristics of Farmers by Crop Produced

Variables	Crops				
	Pomegranate	Baby corn	Okra	Onion	All
Age (Years)	44.10	50.85	43.61	47.33	46.48
Gender of household head (Female=1)	0.02	0.02	0.02	-	0.01
Education of household head (Years)	8.29	9.49	9.92	9.43	9.15
Experience in farming (years)	19.08	24.05	19.19	21.42	20.87
Market Channel (PHCs=1)	0.16	0.05	0.57	0.18	0.20
Market Channel (APMC Mandi=1)	0.72	0.13	0.43	0.82	0.62
Market Channel (Private Trader=1)	0.13	0.82	-	-	0.18
Access to credit (Yes=1, No=0)	0.34	0.06	0.48	0.45	0.36
Crop insurance (Yes=1, No=0)	1.00	1.00	1.00	0.95	0.98
Distance to contractor (Kms)	16.17	2.93	7.91	9.75	10.39
Distance nearest road (Kms)	3.79	0.58	2.45	2.00	2.37
Distance output market (Kms)	17.61	26.17	12.98	16.23	17.93
Information source (Cooperatives=1)	0.65	0.16	0.50	0.43	0.46
Information source (Farmers' association=1)	0.08	0.03	0.03	0.12	0.08
Information source (Registered organization=1)	0.15	0.02	0.20	0.24	0.17
Information source (NGO=1)	0.08	0.00	0.19	0.15	0.11
Secondary economic activity (Farm wage labor=1)	0.60	0.72	0.28	0.10	0.38
Secondary economic activity (Nonfarm wage labor=1)	0.11	0.11	0.09	0.02	0.07
Secondary economic activity (Self-employment=1)	0.06	0.04	0.03	0.04	0.05
Own means of personal transport (Yes=1, No=0)	0.52	0.10	0.35	0.24	0.32
Public transportation in the village (Yes=1, No=0)	0.28	0.07	0.26	0.30	0.25
Observations	418	225	159	547	1349

Source: Authors' draft, based on IFPRI-India survey data.

The survey respondents reported the average gross production and crop price received during the survey reference period (2016). Table 3 reports summary statistics of producer's price (Rs/Kg) and gross quantity of output (Kg), grouped by commodities and marketing channels used by producers of high-value fruit and vegetables. Columns 3-5 reveal the average prices received and output produced under PHCs, APMC Mandi, and private traders.

Table 3: Mean Values of Gross Production and Prices Received by Farmers Grouped by Market Channels and Crops

		PHCs	APMC Mandi	Private trader	All
Pomegranate	Price (Rs/Kg)	58.92	53.45	51.61	54.06
		(13.39)	(12.88)	(11.81)	(12.98)
	Gross Production (Kg)	7,370.00	8,862.44	17,851.85	9,791.67
		(5,992.89)	(7,774.86)	(23,411.21)	(11,327.71)
Baby Corn	Price (Rs/Kg)	12.68	48.55	33.52	34.43
		(12.41)	(16.25)	(22.86)	(22.78)
	Gross Production (Kg)	64,818.17	31,212.93	41,717.91	41,493.28
		(41,578.39)	(59,480.32)	(84,539.83)	(80,190.98)
Okra	Price (Rs/Kg)	27.07	31.43	-	28.93
		(0.87)	(6.73)		(4.93)
	Gross Production (Kg)	6,249.45	4,965.85	-	5,700.49
		(3,662.74)	(10,081.44)		(7,151.66)
Onion	Price (Rs/Kg)	7.69	9.01	-	8.77
		(4.19)	(7.97)		(7.44)
	Gross Production (Kg)	308.99	171.26	-	196.44
		(310.99)	(219.17)		(244.16)

Source: Authors' draft, based on IFPRI-India survey data.

Note: The Indian rupee exchange rate was USD 1 = INR 65 at the time of the survey. Standard deviation in parentheses. Private trader market channel not found for okra and onion crops.

Except for the case of pomegranate, the average price per kilogram received by farmers was consistently lower when farmers used PHCs as their choice of market channel. Higher prices for pomegranate across all market channels may be due to the fruit being used for export purposes (Dastagiri et al., 2013)⁹. In our sample, okra and onions are sold via PHCs and APMC Mandi outlets only. This is consistent with recent studies showing that okra and onion smallholders actively engage in contract farming (Dsouza, Mishra and Webster, 2022; Mishra et al., 2018). Farmers of those crops received lower prices when selling output via PHCs than when using APMC Mandi as an outlet. Much of the okra and onions produced in India are consumed locally, with only small amounts being exported to neighboring countries (Nepal, Bangladesh, and

⁹ Pomegranate is mainly exported to nearby countries like UAE (43%), Bangladesh (16%) & European Countries (14%). Small amounts are also exported to Saudi Arabia, Russia, Thailand, Nepal, Kuwait (Ganeshkumar et al. 2016).

Pakistan). It must be noted that the simple comparisons of summary statistics can be misleading, given that many factors may influence producers' prices. In addition to the type of crop and market channels, geographic factors, distance to markets, and access to information might also affect producers' prices. Thus, a multivariate regression framework is required.

4. Estimation Strategy

The choice of marketing outlets by small farmers is driven by the farmer's desire to maximize profits (Frank & Glass, 1991) or, to be more precise, expected utility from profits (Salvatore, 2003). To do so, the farmer decides on a specific marketing outlet by assessing the expected returns while accounting for the related variable costs, including transaction costs (Salvatore, 2003). In addition, the choice of marketing outlet is also affected by other factors, such as farm size, educational attainment of farmers, farmer's age, availability of transportation, and the surrounding infrastructure (Benfica, Tschirley, & Boughton, 2006; Boughton et al., 2007). In the Indian case, smallholders make subjective comparisons of market attributes, capacity, and managerial attributes to meet the market's demand. In other words, a farmer's decision to choose a marketing outlet is made by assessing the return on expected utility while accounting for the related investments, transaction costs, and (other) variable costs. Smallholders can choose between PHCs, private contractors, and APMC Mandi to generate the highest positive utility.

Using a simple expected utility framework, equation (1) defines U_{ji} as farmer i 's relative advantage from selecting market channel j compared to alternatives, such that:

$$U_{ij} = (\pi_{ij}^m - \pi_{ij}^0) \quad (1)$$

where π_{ij}^m represents the utility of profit derived from market j if selected by smallholder i . The average utility of profits derived, if any market other than j is selected, is denoted by π_{ij}^0 . The first component in the calculation of profits, the revenue, is critically determined by the price received

by producers as a result of their marketing choice. We estimate the following regression model to assess the effect of market channel choice on the price received by farmers:

$$\begin{aligned} \ln(P_{ie}) = & \alpha + \beta \text{Choice}_{ie} + \delta \text{Distance}_{ie} + \lambda \text{Info}_{ie} + \zeta[\text{Choice}_{ie} \times \text{Distance}_{ie}] \\ & + \phi[\text{Choice}_{ie} \times \text{Info}_{ie}] + \gamma_e + \eta_e + \varepsilon_{ie}, \end{aligned} \quad (2)$$

in which P_{ie} stands for the price (in rupees per kilogram) that farmer i receives from selling his/her crop in location e . Choice_{ie} is the set of key variables of interest, representing a vector of indicator variables that capture the farmer's choice of market channel. Distance_{ie} is a vector of variables representing distances to contractors and the distance to the nearest road, and Info_{ie} is a vector of indicator variables representing farmers' access to different information sources. To capture the potential complementarity effects of the choice of market channel and distance to services, we interact the Choice_{ie} and Distance_{ie} variables. Likewise, we interact Choice_{ie} and Info_{ie} to capture the potential complementarity effects of the choice of market channel and information sources. γ_e represents a vector of location-fixed-effects and η_e represents month-fixed-effects that capture location and month-of-the-year invariant characteristics. Finally, ε_{ie} is an idiosyncratic error term. The standard errors are clustered at the location level. We estimate separate price regressions for each of the crops produced.

To develop policy implications, we assess the determinants of farmers' marketing channel choices by estimating the following linear probability model:

$$P(Y_{ie} | X_{ie}, \theta_e, \gamma_e) = \alpha + \psi X_{ie} + \theta_e + \gamma_e + \varepsilon_i. \quad (3)$$

In equation (3), Y_{ie} represents a binary variable that equals 1 if farmer i sells their crop in location e in a specific market channel. X_{ie} represents a vector of personal and farm-level characteristics, and θ_e represents a vector of crop fixed effects. The rest of the notations in equation (3) are the same as in equation (2). We estimate separate regressions for each of the market channels.

Furthermore, to test the robustness of the results in equation (3), we ran regressions of the farmer's choice of a market channel separating the two categories of crops – staples and high-value crops.

5. Results

5.1 Effect of marketing channel choices on the price received by farmers

Estimation results for the effects of marketing channel choice on prices and, correspondingly, farm revenues are displayed in Table 4. They indicate that channel choice is an important determinant for farm revenue. In what follows, we differentiate our analysis between local staples (onion, baby corn, okra) and the high-value export crop pomegranate.

Table 4: Estimates of Price Regressions by Crop

VARIABLES	Dependent Variable: Log of Price			
	(1) Pomegranate	(2) Baby corn	(3) Okra	(4) Onion
Buyer (PHCs=1)	0.106 (0.047)	-4.976 (0.016)	- -	- -
Buyer (APMC Mandi=1)	-0.170 (0.027)	0.126 (0.003)	0.241 (0.057)	0.544 (0.155)
Distance to contractor (Kms)	0.003 (0.000)	-0.053 (0.000)	-0.002 (0.006)	0.004 (0.006)
Distance nearest road (Kms)	-0.009 (0.002)	-0.185 (0.000)	-0.019 (0.011)	0.085 (0.027)
Information source (cooperatives=1)	-0.188 (0.195)	0.302 (0.016)	-0.027 (0.024)	0.004 (0.105)
Information source (farmers' association=1)	-0.295 (0.222)	-0.012 (0.007)	-0.053 (0.052)	-0.105 (0.075)
Information source (registered organization=1)	-0.249 (0.199)	0.172 (0.010)	0.129 (0.053)	-0.062 (0.110)
Information source (NGO=1)	0.163 (0.216)	- -	0.192 (0.042)	0.131 (0.146)
Type of Buyer x Distance to Services Interactions	Yes	Yes	Yes	Yes
Type of Buyer x Information Sources Interactions	Yes	Yes	Yes	Yes
Months fixed effects	Yes	Yes	Yes	Yes
Location fixed effects	Yes	Yes	Yes	Yes
Observations	418	225	159	547
R-squared	0.286	0.569	0.471	0.318

Notes: Robust standard errors clustered at the block level in parenthesis. Private trader is the base characteristic for buyers in columns (1) and (2). PHCs are the base characteristic for buyers in columns (3) and (4). Information received from the government is the base characteristic for information sources for columns (1), (3), and (4). Information received from NGOs is the base characteristic for the information source for column (2). Complete regression results are shown in Appendix.

P-values or asterisks to indicate statistical significance are not indicated. See Imbens (2021) for a critical review of the role of statistical significance in empirical studies.

Selling local staples (columns 2, 3, and 4) to PHCs or private traders yields the lowest prices for farmers compared to all other marketing channels while selling at the APMC Mandi, on the other hand, is the option associated with the highest prices¹⁰. A first potential explanation for this observation is rooted in the relationships and the substantial social capital between small

¹⁰ As there is no single okra or onion farmer selling to private traders for these crops, the PHCs serve as the base category in these regressions (columns 3 and 4). The positive coefficients of APMC mandi indicate that this is the channel that yields higher prices.

farmers and the APMC Mandi buyers. Krishnamurthy (2018) noted that smallholders producing perishable commodities trust the APMC Mandi because of the relatively long-standing tradition and trust in government-backed organizations. Farmers feel that the government has their back; if a problem arises, they have recourse to local government officials. Second is market power in contract farming (Kopp and Mishra, 2022), caused by farmers' credit constraints (Kopp and Sexton, 2021) and lock-in of farmers (Kopp, 2022).

In many cases in India, contract farming has led to disputes between farmers and contractors. On one side, the contractors have been reported to penalize farmers at will by rejecting produce of lower quality and violating the terms of the contract, while, on the other side, farmers are often accused of side selling (Grosh, 1994; Key and Runsten, 1999; Oya, 2012; Sharma, 2014; Mishra et al. 2018; Vicol, et al., 2022). In other cases, farmers are simply dissatisfied with the contractors (Gatto et al., 2017; Ochieng, Veetil, & Qaim, 2017). In a recent study, Ruml and Qaim (2021) point out that farmers drop out of contracts because of violating contract conditions and / or farmers are unable to meet the quality requirements.

For the cash crop pomegranate, the situation is different. As this crop is considered a luxury product, primarily produced for export and rarely used by local consumers, the demand for this crop in the APMC Mandi markets is low, not justifying a high price. Local consumers rarely have pomegranate on their shopping lists because it is not part of their diet, is seldom known to the average Indian consumer, and has high prices (Meena, Asrey, and Baghel, 2018). Given that the transportation and handling of pomegranates require specialized packaging (Ladaniya, Wanjari, and Mahalle, 2003), it is no surprise that APMC Mandi buyers do not specialize in their commercialization. Therefore, selling to private traders and/or PHCs more connected to international markets naturally yields higher prices.

5.2 Determinants of market channel choice

Results of equation (3), showing the determinants of marketing channel choice, are displayed in Table 5. We analyze all crops together because there is no reason to expect differences across crops. Consistent with the existing literature, the results highlight the importance of access to credit when selecting marketing channels (Baylis et al., 2015). They suggest that those with credit access are more likely to engage with APMC Mandis. Distance to contractors and roads appears to negatively influence the likelihood of engaging in marketing relationships with PHCs and highlights the role of transaction costs in contract farming in low-and-middle-income countries (Fafchmaps and Hill, 2005). Access to public transportation has heterogeneous effects depending on the type of market channel, but it does not influence the engagement with APMC Mandis. We provide an in-depth discussion of the policy implications of these results in the next section.

Table 5: Correlates of Farmers' Choice of Market Channel (Pooled Sample)

VARIABLES	(1) PHCs	(2) APMC Mandi	(3) Private rader
Access to credit (Yes=1, No=0)	-0.033 (0.017)	0.067 (0.032)	-0.034 (0.017)
Distance to contractor (Kms)	-0.003 (0.001)	0.001 (0.002)	0.001 (0.001)
Distance nearest road (Kms)	-0.016 (0.007)	0.012 (0.007)	0.004 (0.003)
Education of household head (Years)	0.005 (0.003)	-0.006 (0.003)	0.001 (0.001)
Availability of public transport in the village (Yes=1, No=0)	0.049 (0.019)	0.021 (0.025)	-0.070 (0.016)
Age (years)	-0.001 (0.001)	0.003 (0.001)	-0.001 (0.001)
Gender of household head (Female=1)	-0.046 (0.059)	-0.116 (0.034)	0.162 (0.071)
Gross production (Log of Kg)	-0.003 (0.011)	-0.024 (0.011)	0.028 (0.010)
Risk Proxies	Yes	Yes	Yes
Information sources controls	Yes	Yes	Yes
Seed sources controls	Yes	Yes	Yes
Additional Control Variables	Yes	Yes	Yes
Crop fixed effects	Yes	Yes	Yes
Location fixed effects	Yes	Yes	Yes
Observations	1,349	1,349	1,349
R-squared	0.736	0.654	0.679

Notes: Robust standard errors clustered at the block level in parenthesis. Additional controls include crop insurance use, distance to output market, experience in farming, farm wage labor, nonfarm wage labor, self-employment, scheduled caste, and scheduled tribe. Complete regression results with all control variables are shown in Appendix. P-values or asterisks to indicate statistical significance are not indicated. See Imbens (2021) for a critical review of the role of statistical significance in empirical studies.

The results of the robustness checks that conduct the estimations of equation (3) separately by type of crop – staples (baby corn, okra, and onion) and high-value crops (pomegranate) – are provided in Tables A3 and A4 of the Appendix. Most signs and coefficients of the policy-relevant variables remain the same in the disaggregated regressions, albeit the reduced number of observations reduces the statistical significance of the measured effects. The fraction of the variation of the dependent variable that the disaggregated regressions explain increases for the staple crops and decreases for the high-value crop (the resulting R^2 are all still within acceptable

boundaries). Therefore, we conclude that the politically relevant determinants of marketing channel choice are similar across the two categories of crops.

6. Policy implications

The empirical results suggest that distance to the closest road negatively relates to the probability of engaging with PHCs, which can be explained by the fact that the more difficult it is for a contractor to reach a farmer, the less likely it is that a contracting relationship occurs. Producers of high-value export crops, i.e., pomegranate, would benefit from a better road infrastructure as this helps the outreach of the market channel that is most beneficial to them. For producers of staples, an improvement of road infrastructure might be of little concern, as these farmers can still choose to sell to APMC Mandi, as it is more profitable for them. The negative relationship between the distance to the closest contractor and the probability of engaging with PHCs is not surprising. PHCs prefer to give contracts to farmers within a maximum radius. The availability of public transportation and education are positively related to selling to PHCs. This implies that improvements in the public transportation system and education alike would increase farmers' revenue from producing high-value export crops.

An interesting finding is that females are generally less likely to sell in the APMC Mandi. This could be caused by gender imbalances and male dominance in these places. However, this finding requires more future research, as only two percent of the farmers in our sample are female. Finally, farmers with better credit access are less likely to sell to PHCs and private traders. This can be explained by (i) contract farming requiring less capital as inputs are more likely provided by contracting firms and (ii) private traders potentially acting as informal credit providers. As discussed above, both channels – PHCs and private traders – are not optimal for staple crop farmers. They lead to sub-optimal lock-in relationships because farmers are obliged to sell their

harvest to the credit provider, which allows them to mark down prices. A potential solution to this challenge would be an improvement of the formal lending system (Kopp and Brümmer, 2017), such as micro-credit schemes, for example (Andriani, Lal and Kalam, 2022; Khandelwal, 2007; Anjugam and Ramasamy, 2007), or self-help groups (SHGs, Deininger and Liu, 2017; Desai and Olofsgård, 2019). These schemes would lift some constraints on the farmers' ability to choose a marketing channel. SHGs are particularly interested in empowering women in agriculture, as they have been considered sources of credit and extension services that help improve women's status in society and household productivity (Meizen-Dick et al., 2019). Policymakers could encourage, through incentives, the formation of women's SHGs to increase access to information, participation in decision-making, marketing, and adoption of technology.

Anecdotal evidence in India suggests that smallholders with transportation facilities (small trucks and tractor-trailers) tend to help neighboring farmers transport their produce to the private traders' market. These alliances are usually confined to farmers within the village. Thus, a good relationship between farm families and neighbors is paramount. To this end, the Government of India recently launched the "Kisan Rath App" to facilitate the transportation of agricultural and horticultural produce from farms to regulated markets.

As elaborated in the introduction, government interventions to diversify marketing options for smallholders play an increasing role in many DEE. The results of this analysis provide encouraging evidence for staple crops in India. There is substantial scope for additional research to investigate whether such interventions may also be beneficial for small scale farmers in similar contexts, i.e., markets for products of high perishability in which local traders are the typical intermediaries and associated with market power. Examples include tomatoes and ginger in Nepal (Kopp and Mishra, 2022), vegetables in Madagascar (Minten et al., 2009), or tomatoes in Senegal (Maertens

et al., 2011). Based on the results of this paper, policy makers in those contexts could consider implementing institutions similar to the Mandi system in India.

7. Conclusions

This study contributes to the literature on marketing channel choice, which is a critical determinant of the livelihoods of small-scale farmers in developing and emerging economies. Particularly the role of government-supported marketing channels, as introduced in many DEE contexts, is considered. Our analysis builds on a novel data set from a survey with smallholders from three regions in India who specialize either in a local staple crop or a high-value export crop. Results indicate that channel choice is an essential determinant for smallholders' revenues. For instance, producers of high-value crops receive the highest prices when selling to contracting firms. In contrast, the producers of local staples receive the best prices at so-called Mandis, a network of government-operated agricultural markets. In the second step, our analysis identifies determinants of channel choices to derive future policy options.

In summary, our results imply for policymakers that strategies to increase farm revenues need to account for the differences between producers of high-value export crops and local staples. Results suggest that the producers of high-value export crops (i.e., pomegranate) would benefit from improved road infrastructures, better public transport, and innovations in the formal education system as such measures improve their access to PHCs, which are associated with the highest revenues. Farmers of local staples (i.e., baby corn, onion, and okra) would benefit most from improved access to formal lending services.

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APPENDIX

Table A1. Estimates of Price Regressions by Crop

VARIABLES	Dependent Variable: Log of Price			
	(1) Pomegranate	(2) Baby corn	(3) Okra	(4) Onion
Buyer (PHCs=1)	0.106 (0.047)	-4.976 (0.016)		
Buyer (Trader in Mandi=1)	-0.170 (0.027)	0.126 (0.003)	0.241 (0.057)	0.544 (0.155)
Distance to contractor (Kms)	0.003 (0.000)	-0.053 (0.000)	-0.002 (0.006)	0.004 (0.006)
Distance nearest road (Kms)	-0.009 (0.002)	-0.185 (0.000)	-0.019 (0.011)	0.085 (0.021)
Information source (cooperatives=1)	-0.188 (0.195)	0.302 (0.016)	-0.027 (0.024)	0.004 (0.105)
Information source (farmers' association=1)	-0.295 (0.222)	-0.012 (0.007)	-0.053 (0.052)	-0.105 (0.075)
Information source (registered organization=1)	-0.249 (0.199)	0.172 (0.010)	0.129 (0.053)	-0.062 (0.110)
Information source (NGO=1)	0.163 (0.216)		0.192 (0.042)	0.131 (0.146)
b1_d1	-0.011 (0.005)	-6.262 (0.019)	-0.001 (0.001)	-0.015 (0.001)
b1_d2	-0.002 (0.006)	1.101 (0.003)	0.002 (0.003)	0.012 (0.001)
b1_d3	-0.002 (0.007)	1.725 (0.004)	0.001 (0.005)	-0.005 (0.006)
b1_d4	0.004 (0.005)	-1.546 (0.003)	0.003 (0.002)	0.000 (0.000)
b1_d5	-0.008 (0.008)	4.589 (0.013)	0.032 (0.015)	-0.075 (0.048)
b2_d1	0.002 (0.001)	-0.019 (0.000)	0.000 (0.008)	-0.002 (0.001)
b2_d2	0.000 (0.000)	-0.001 (0.000)	-0.009 (0.007)	-0.001 (0.001)
b2_d3	-0.001 (0.001)	-0.562 (0.000)		
b2_d4	-0.002 (0.001)	-0.076 (0.000)	0.005 (0.005)	-0.019 (0.005)
b2_d5	0.003 (0.003)	-0.155 (0.004)		
b3_d1	0.006	0.030		

	(0.000)	(0.000)		
b3_d2	-0.002	-0.017		
	(0.000)	(0.000)		
b3_d3				
b3_d4	-0.012	-0.100		
	(0.001)	(0.000)		
b3_d5				
b1_i1	0.128		0.021	0.497
	(0.109)		(0.027)	(0.022)
b1_i2	-0.164	-7.624	-0.040	-0.272
	(0.162)	(0.030)	(0.035)	(0.137)
b1_i3	0.112	0.965	-0.129	-0.108
	(0.068)	(0.004)	(0.054)	(0.049)
b1_i4	-0.552		-0.200	-0.250
	(0.078)		(0.039)	(0.099)
b2_i1	0.105			
	(0.043)			
b2_i2	-0.223	0.302	0.029	-0.071
	(0.288)	(0.000)	(0.026)	(0.117)
b2_i3	0.133	-0.189		
	(0.071)	(0.010)		
b2_i4				
b3_i2	-0.281	-0.186		
	(0.194)	(0.002)		
b3_i3				
Constant	4.236	2.967	3.600	1.755
	(0.217)	(0.007)	(0.206)	(0.148)
Months fixed effects	Yes	Yes	Yes	Yes
Location fixed effects	Yes	Yes	Yes	Yes
Observations	418	225	159	547
R-squared	0.286	0.569	0.471	0.318

Notes: Robust standard errors clustered at the block level (location) in parenthesis. Buyer types: b1=contractor, b2=trader in Mandi, b3=trader outside. Distance types: d1= distance to input market, d2= distance to output market, d3=distance to contractor, d4=distance to extension services, d5=distance to nearest road. Information source types: i1= from farmers' association, i2=from government, i3=from registered organization, i4=from NGO.

P-values or asterisks to indicate statistical significance are not indicated. See Imbens (2021) for a critical review of the role of statistical significance in empirical studies.

Table A2. Correlates of Farmers' Choice of Market Channel (Pooled Sample)

VARIABLES	(1) PHCs	(2) APMC Mandi	(3) Private rader
Access to credit (Yes=1, No=0)	-0.033 (0.017)	0.067 (0.032)	-0.034 (0.017)
Distance to contractor (Kms)	-0.003 (0.001)	0.001 (0.002)	0.001 (0.001)
Distance nearest road (Kms)	-0.016 (0.007)	0.012 (0.007)	0.004 (0.003)
Age (years)	-0.001 (0.001)	0.003 (0.001)	-0.001 (0.001)
Gender (Female=1)	-0.046 (0.059)	-0.116 (0.034)	0.162 (0.071)
Crop insurance (Yes=1, No=0)	-0.013 (0.025)	0.002 (0.029)	0.012 (0.015)
Distance output market (Kms)	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
Experience in farming (years)	0.001 (0.001)	-0.002 (0.002)	0.001 (0.001)
Education of household head (Years)	0.005 (0.003)	-0.006 (0.003)	0.001 (0.001)
Information source (Cooperatives=1)	-0.030 (0.014)	0.034 (0.060)	-0.004 (0.051)
Information source (Farmers' association=1)	-0.052 (0.031)	-0.045 (0.061)	0.097 (0.058)
Information source (Registered organization=1)	-0.074 (0.029)	0.063 (0.054)	0.011 (0.042)
Information source (NGO=1)	-0.061 (0.034)	0.077 (0.069)	-0.016 (0.050)
Gross production (Log of Kg)	-0.003 (0.011)	-0.024 (0.011)	0.028 (0.010)
Secondary economic activity (Farm wage labor=1)	0.083 (0.041)	-0.119 (0.059)	0.036 (0.023)
Secondary economic activity (Non farm wage labor=1)	0.005 (0.028)	-0.097 (0.069)	0.092 (0.050)
Secondary economic activity (Self-employment=1)	0.037 (0.053)	-0.168 (0.111)	0.131 (0.073)
Own means of personal transport (Yes=1, No=0)	-0.085 (0.022)	-0.001 (0.033)	0.086 (0.026)
Availability of public transport in the village (Yes=1, No=0)	0.049 (0.019)	0.021 (0.025)	-0.070 (0.016)
Social group (Scheduled caste=1)	0.050 (0.043)	-0.009 (0.044)	-0.041 (0.022)
Social group (Scheduled tribe=1)	0.114 (0.098)	-0.119 (0.096)	0.005 (0.008)

Risk Averse (Yes=1, No=0)	-0.024 (0.028)	-0.028 (0.019)	0.052 (0.034)
Risk Loving (Yes=1, No=0)	-0.048 (0.026)	0.056 (0.034)	-0.008 (0.012)
Source of seed (Contractor=1)	0.681 (0.089)	-0.626 (0.089)	-0.055 (0.026)
Source of seed (Market=1)	-0.101 (0.041)	0.075 (0.036)	0.025 (0.010)
Source of seed (Relative=1)	0.041 (0.090)	-0.051 (0.041)	0.011 (0.054)
Constant	0.331 (0.174)	0.989 (0.195)	-0.320 (0.105)
Crop fixed effects	Yes	Yes	Yes
Location fixed effects	Yes	Yes	Yes
Observations	1,349	1,349	1,349
R-squared	0.736	0.654	0.679

Notes: Robust standard errors clustered at the block level (location) in parenthesis. P-values or asterisks to indicate statistical significance are not indicated. See Imbens (2021) for a critical review of the role of statistical significance in empirical studies.

Table A3. Correlates of Farmers' Choice of Market Channel: Pomegranate

VARIABLES	(1) PHCs	(2) APMC Mandi	(3) Private trader
Access to credit (Yes=1, No=0)	-0.093 (0.033)	0.160 (0.041)	-0.067 (0.011)
Distance to contractor (Kms)	-0.004 (0.002)	0.004 (0.003)	-0.000 (0.001)
Distance nearest road (Kms)	-0.017 (0.009)	0.014 (0.010)	0.003 (0.005)
Education of household head (Years)	0.010 (0.004)	-0.009 (0.007)	-0.001 (0.004)
Availability of public transport in the village (Yes=1, No=0)	-0.025 (0.063)	0.074 (0.068)	-0.050 (0.007)
Age (years)	-0.002 (0.001)	0.002 (0.002)	-0.000 (0.001)
Gender (Female=1)	-0.091 (0.017)	-0.063 (0.087)	0.153 (0.074)
Gross production (Log of Kg)	-0.030 (0.035)	-0.058 (0.046)	0.088 (0.020)
Risk Proxies	Yes	Yes	Yes
Information sources controls	Yes	Yes	Yes
Seed sources controls	Yes	Yes	Yes
Additional Control Variables	Yes	Yes	Yes
Crop fixed effects	Yes	Yes	Yes
Blocks fixed effects	Yes	Yes	Yes
Observations	418	418	418
R-squared	0.404	0.322	0.396

Notes: Robust standard errors clustered at the block level (location) in parenthesis. P-values or asterisks to indicate statistical significance are not indicated. See Imbens (2021) for a critical review of the role of statistical significance in empirical studies.

Table A4. Correlates of Farmers' Choice of Market Channel: Baby corn, onion, and okra combined

VARIABLES	(1) PHCs	(2) APMC Mandi	(3) Private trader
Access to credit (Yes=1, No=0)	0.004 (0.007)	-0.002 (0.009)	-0.002 (0.006)
Distance to contractor (Kms)	-0.000 (0.000)	-0.000 (0.001)	0.000 (0.001)
Distance nearest road (Kms)	-0.003 (0.004)	-0.000 (0.004)	0.004 (0.002)
Education of household head (Years)	-0.001 (0.001)	0.000 (0.001)	0.001 (0.001)
Availability of public transport in the village (Yes=1, No=0)	0.021 (0.017)	-0.020 (0.020)	-0.000 (0.003)
Age (years)	0.000 (0.000)	0.001 (0.001)	-0.002 (0.001)
Gender (Female=1)	0.016 (0.021)	-0.090 (0.038)	0.074 (0.048)
Gross production (Log of Kg)	0.015 (0.009)	-0.028 (0.008)	0.013 (0.007)
Risk Proxies	Yes	Yes	Yes
Information sources controls	Yes	Yes	Yes
Seed sources controls	Yes	Yes	Yes
Additional Control Variables	Yes	Yes	Yes
Crop fixed effects	Yes	Yes	Yes
Blocks fixed effects	Yes	Yes	Yes
Observations	931	931	931
R-squared	0.914	0.845	0.834

Notes: Robust standard errors clustered at the block level (location) in parenthesis. P-values or asterisks to indicate statistical significance are not indicated. See Imbens (2021) for a critical review of the role of statistical significance in empirical studies.