FUTURES PRICES INFORMATION FOR SMALL AND MEDIUM FARMERS*

Policy and practice implications from a series of field experiments in Gujarat, India

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1. INTRODUCTION

Although the last several decades have seen the gradual industrialization of the Indian economy, agriculture and allied activities still employ 52% of the workforce and account for 17.2% of GDP (CIA, 2011). At the same time, average land holding sizes remain very low, with 70% of the land held by farmers who own 2.47 acres (1 hectare) or less of land (GOI, 2006).

Small and medium scale farmers do not benefit from economies of scale in production, enjoying limited profitability even in the best of times. They are particularly vulnerable to fluctuations in harvest time output prices. Since many smallholders buy farming inputs on credit, and have few assets, the negative price shocks at harvest time can prove to be disastrous. Even a 10% swing can make the difference between stable consumption and food insecurity. The recent arrival of national agricultural futures markets in India holds the promise of providing both producers and consumers with additional tools to manage price fluctuation risk.

This policy paper reports on a series of interventions designed to enable farmers to use information from futures markets with the goal of helping them improve agricultural planning and decision-making, reduce their risk exposure, and increase harvest time revenue. While most medium and small-scale farmers cannot directly participate in futures markets because of minimum trading quantity thresholds, exchanges may nevertheless offer important benefits to all farmers. Most saliently, the availability of futures price information can help farmers make informed agricultural decisions about which crop to plant, when, in what quantity, when to harvest their crops, as well as provide guidance about when to sell, and at which markets.

These studies find a number of important effects of providing futures prices to farmers. Most notably in improving farmers' price knowledge as well as price expectations. When asked to predict prices 1-2 months into the future, farmers who received text and voice messages with price information were 15 to 18% more likely to have an answer correctly (within 10% of the actual price) compared to those who didn't receive this information. Additionally, we also find evidence that our interventions incorporate futures prices in agricultural decisions, including crop selection and improve their willingness to participate in futures markets.

This paper is organized as follows. Section 2 briefly discusses the history of futures market in India, which dates back to 1875. In section 3, we discuss the relevance of providing spot and futures price information to small and medium scale farmers. This section explains the potential channels through which farmers can benefit from having price information even if they cannot directly trade in futures markets. Section 4 discusses the academic literature on the impact of derivative markets on spot markets.

The details of the studies we conducted in Gujarat, India, between 2007 and 2012, providing spot and futures prices information for three cash crops to 540 farmers through village boards and a mobile-based platform are provided in section 5.

Section 6 discusses results from the price information interventions. Finally, section 7 concludes with the implications of this research study for policy-makers and practitioners, and proposes some directions for future research.

2. FUTURES MARKETS IN INDIA

The first formal futures markets were established in India in 1875, primarily dealing in cotton. Through the 1960s several futures exchanges for agricultural and non-agricultural commodities continued to operate. However, formal markets had all but disappeared by the 1970s, as a result of government policies aimed at reducing price volatility perceived to be caused by speculation on these exchanges and controlling domestic prices. Small regional exchanges re-emerged in the 1980s, however legislative restrictions prevented any significant growth (see Kolamkar, 2003; Thomas, 2003, Sarkar, 2006; Naik and Jain, 2002).

Legislative reform in 2003 led to the establishment of modern electronic commodities markets, which were permitted to trade in fifty-four agricultural commodities mostly cash crops such as cotton, castor, jute, turmeric and sugar. Markets in non-cash crops such as wheat and rice continue to be heavily regulated.

Indian commodities markets have quickly attracted capital and grown rapidly seeing a twenty-fold increase in trading volume between 2002 and 2007. National Commodities and Derivatives Exchange (NCDEX), which accounts for 80% of India's domestic commodities market, has grown to become the third largest agricultural futures market in the world behind Chicago and, Dalian (UNCTAD, 2006).

3. RELEVANCE TO SMALL AND MEDIUM SCALE FARMERS

Investors, traders and brokers have been able to directly benefit from price hedging and options contracts. The benefits of futures markets to small and medium scale farmers are not as direct. Minimum trading quantity thresholds (a selected list is provided in Exhibit 1 below) prevent this latter group from direct participation in agricultural futures market.

Most marginal farmers do not produce crops in large enough quantities to be able to trade in the futures market (MCA, 2008). While in theory farmers could combine output to meet minimum lot size requirements, in practice quality differences vary significantly by producer, and may make such aggregation difficult.

Exhibit 1: Minimum quantity thresholds for participating in selected agricultural commodity trades on NCDEX.

Commodity	Minimum Quantity Threshold
Cotton	4 Tons
Castor	10 Tons
Guar Seed	10 Tons
Cumin	3 Tons
Chickpeas	10 Tons

An alternative mechanism would be for farmers to engage in cash, rather than physical settlement. However, low participation in formal banking, would make margin management difficult. As the ability to enforce contracts in rural India is limited, counter-party risk without margin accounts would be significant. Moreover, focus groups suggest that farmers are averse to the risk arising from a futures price that, ex-post, results in a loss, which may make them reluctant to participate in futures contracts.

However, futures markets may aid price discovery and price expectation formation for small and medium farmers. Although their forecasting value is not a settled matter, futures prices are better forecasts of future spot prices, using both international and Indian data, than other empirical models such as the random walk (Chinn and Coibion, 2010).

If futures prices do help farmers improve their estimate of spot prices at a future date, farmers can use these prices to make investment, planting, harvesting, storage and sales decisions. Soil fertility, previous experiences in planting crops, cost of inputs, and other unobservable factors have a strong influence on farmers' crop choice. However on the margin, futures prices information should help a farmer decide an optimal crop mix.

Similarly, futures market may also help farmers in making storage decisions after the harvest. Post-

harvest liquidity constraints faced by small and medium scale farmers could be a significant obstacle to this mechanism. While farmers maybe willing to wait to get higher revenues for their produce, they might be forced to sell their crops early because of liquidity constraints aggravated by limited assets or savings, the need to repay creditors including inputs suppliers as well as basic household consumption needs.

Another potential channel through which spot and futures prices could help farmers is by increasing their bargaining power in price negotiations with local traders and middlemen. Many small-scale farmers sell their produce to local traders at their own villages; this saves the cost of transporting the harvest to the district market. However, if farmers lack accurate knowledge of market prices, the intermediaries may underpay for the farmers output preventing them from fully realizing their potential income.

Accurate knowledge of prevailing prices at different markets may also help farmers who can afford to transport their produce to local district markets by helping them choose the markets at which they want to sell their produce.

4. ACADEMIC LITERATURE REVIEW

A substantial theoretical and empirical literature identifies three channels through which futures markets affect price formation in spot markets:

1. Risk sharing,
2. Information, and
3. Spot market oligopoly and manipulation.

Theoretical literature

Risk sharing and information can reduce price volatility. The transfer of risk away from agents who store commodities decreases price volatility and improves welfare (Telser, 1959; Farrell, 1966; Gilbert, 1989). And futures markets may allow more information to be embedded into prices, as the existence of a large set of market prices conveys greater information to market participants (Grossman, 1977, 1989).

However, risk sharing and information may also increase price volatility, and may even lead to decreases in welfare. If farmers use derivatives to hedge they may take on more risky activity and this can lead to price volatility (e.g. Chari, Jagannathan and Jones, 1990; Holthausen, 1979; Newbery 1987), although welfare does not decrease with the introduction of futures markets in these models. If speculators respond to naïve investors (Hart and Kreps, 1986) or if new investors drawn to futures have worse information than existing market participants (Stein, 1987) then prices can be destabilized and society could be worse off because of the introduction of futures markets.

Several different futures market manipulation mechanisms have also been identified that may bias prices away from fundamental values, and lead to greater price volatility and price autocorrelation (e.g. Pirrong 1993, 1995, 2001; Kumar and Seppi, 1992; Muermann and Shore, 2005). Futures markets could also increase competition and cause spot prices to move closer to marginal costs. However, futures markets may also increase price volatility if dominant firms undertake excessive storage to undermine the forward market, and harm consumers (Newbery, 1990).

Empirical studies

The empirical literature, in contrast, does not typically identify the effect of specific channels, but rather examines the net effect of futures on spot markets. Most empirical studies focus on the effect of futures markets on price volatility, either examining specific markets before and after the introduction of futures markets, or evaluating the impact of the level of activity in the futures market on contemporary or subsequent changes in the spot markets.

Before and after analysis

An older literature that uses the first method looked at simple comparisons of either the inter-seasonal price range or other measures of volatility before and after the introduction of futures. These papers concluded that the introduction of futures decreased volatility and reduced the inter-seasonal price-range (Emery, 1896; Hooker, 1901; Working, 1960; Gray, 1963, Powers, 1970). A recent paper in this tradition is Jacks (2007) that analyzes the introduction of futures for 16 different storable and non-storable agricultural commodities, and metals in the 19th and 20th century and finds the introduction of futures is associated with decreased volatility for almost all commodities.

A newer literature emerging in the 1990s utilizes various advances in financial and statistical analysis, such as Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models, and obtains mixed results (see Weaver and Banerjee, 1990; Netz, 1995; and Kocagil, 1997).

Level of futures trading

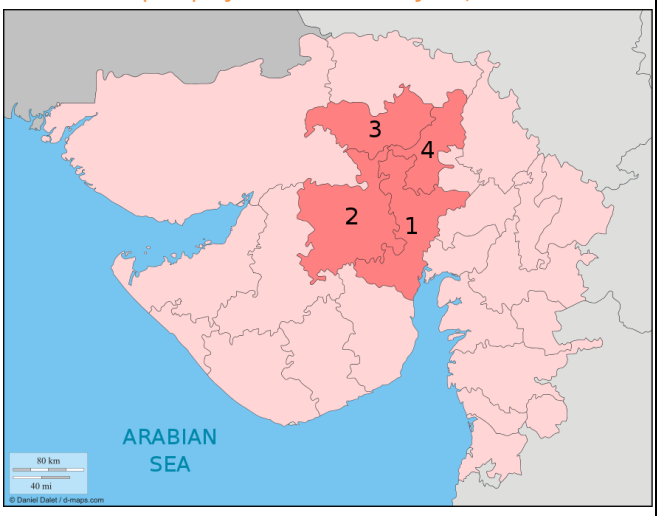
This set of papers examines the correlation between the level activity in the futures market and the current or subsequent price movements in the spot market. Bessembinder and Seguin (1992) introduced a methodology where futures activity is decomposed into expected and unexpected components, which are then added to the equation governing the evolution of simultaneously occurring price volatility. Yang, Balyeat and Leatham (2005) apply a similar method to commodity futures activity and then regress activity on lagged spot price volatility and current spot price volatility on lagged futures activity. IMF (2005) and Interagency Task Force on Commodity Markets (2008) conduct similar analysis. Slade & Thille (2006) try to circumvent the simultaneous determination of spot price volatility and futures trading when regressing price moments on contemporaneous futures activity by using instruments for activity.

Overall in the empirical literature most, but not all studies, find that the introduction of futures markets leads to some decrease in price volatility, however identifying causal relationship remains challenging.

5. STUDY DESCRIPTION

Researchers from Harvard University collaborating with evaluation partner Centre for Micro Finance (CMF) at the Institute of Financial Management and Research (IFMR) and implementation partner Self-Employed Women's Association (SEWA) started the futures price information study in April 2007. Drawing on SEWA's established network of village leaders, 108 villages were identified in Ahmedabad, Surendranagar, Mehsana, and Vadodara districts of Gujarat state in India. SEWA helped identify ten households from each of the 108 villages. The survey data captured important household characteristics as well as price knowledge and expectations, the households' level of trust in financial markets and data on investment and agricultural decisions.

Exhibit 2: Map of project districts in Gujarat, India



Key: The four study districts (1) Ahmedabad, (2) Surendranagar, (3) Patan, and (4) Mehsana are marked in red. The other districts in Gujarat state are marked in pink.

Over the course of the project, two treatments were administered (village blackboards, and text messages

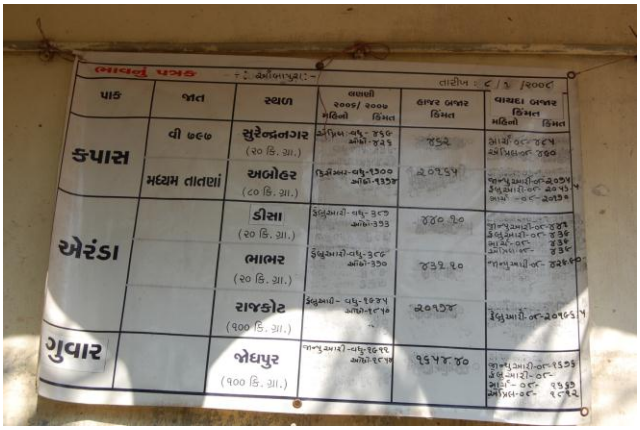
and push calls) in two phases. The next two sub-sections discuss each treatment in detail.

Village boards

In July 2007 54 out of a sample frame of 108 villages were randomly selected to receive low-cost publicly displayed boards. CMF and SEWA regularly posted spot and futures prices for three cash crops (cotton, castor, and guar) on these boards. Boards were placed at easily accessible high-traffic locations within villages such as the Gram Panchayat (Village Committee) offices or near busy marketplaces.

The 54 villages that received the boards were also provided basic training about financial markets including a special training module about futures prices from CMF and NCDEX workers. The other 54 villages did not receive any price information or training and served as the control group. All villages were surveyed twice a year from 2007 to 2012. Since treatment was randomly assigned to 54 out of the 108 villages, we would expect any changes in farmers' price knowledge, expectation, usage of treatment, and investment decisions to be a direct effect of the treatment.

Exhibit 3: A village board showing spot and futures prices for cotton, castor and guar-seed



The three cash crops for which price information was provided were chosen because each had liquid high-volume futures market on the NCDEX. Spot price information from local newspapers and futures prices from NCDEX's website were used to populate the boards.

Every week CMF's research office texted spot and futures prices of crops to a specially appointed local field agent in the treatment villages. The field agent would then post these prices on village boards removing the old ones. Local verification agents were also employed in each treatment village to independently verify that the prices were accurately posted in a timely manner. SEWA members provided an additional layer of oversight as roving camera checkers who would randomly visit 60% of the treatment villages and send photographs of village boards to CMF via multi-media mobile phones.

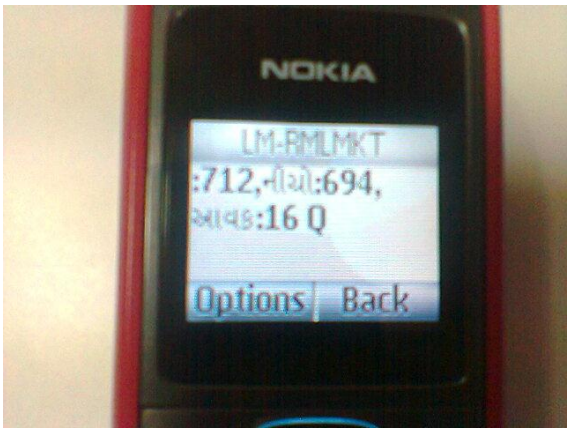
Text messages

Starting August 2011, researchers started providing price information to a randomly assigned subset of the treatment sample through text messages.

Starting in July 2011 60% of the households from the village board treatment groups were randomly selected to receive spot and futures prices on mobile phones. This provided farmers with a more direct method of receiving information.

The text message intervention consisted of three treatments: no text messages, text messages with only spot prices, and text messages with both spot and futures prices.

Exhibit 4: A cell phone showing a sample text message from Reuters Market Light in local Gujarati language



The latter two treatment groups consisted exclusively of households in villages, which already had village boards, while the first group included households in villages with and without village boards. This design permitted the evaluation of the marginal effect of receiving price information text messages on mobile phones, over and above the village boards.

On average 35% percent of respondents in our 108 study villages did not own mobile phones. Before starting the price information intervention half of these respondents were provided with one. Among the 82.5% of respondents in the village board treatment sample who now had access to phones, we randomly placed them into three new text-message treatments. In the village board control group, we included half of the respondents who already had a phone and all the respondents who were provided phones to be a part of the sample for a new study.

Approximately 600 respondents were selected to receive phone surveys once a month. The monthly data collection allowed frequent interaction with our respondents and a finer measure of the evolution of their price knowledge and expectations. It also helped overcome recall error, which is a potential problem with the less frequent paper surveys.

Reuters Market Light (RML) provided scheduled text messaging services for spot and futures prices information. RML offered participants price information for cotton and castor from the closest district market in Gujarat. However guar seed prices were quoted from the only market on which they were traded.

Push calls

Some farmers in our sample were illiterate and had to rely on educated family members to read out the text messages. To overcome this constraint we partnered with Awaaz.de, a telecom technology firm, to use their Awaaz Otalo mobile platform to offer twice weekly price information voice messages. 95% of treatment group respondents opted into this service. These voice messages contained the same price information that respondents received through text messages.

The Awaaz Otalo platform also collected usage data from the push calls by recording the duration for which respondents listened to each call.

Continuing Service

As the research component of the project wraps up in October 2012, our implementation partner SEWA has assumed responsibility for providing price information to farmers. Using village-level SEWA leaders to disseminate price information is a particularly cost-effective approach of achieving outreach. A majority of the yearly cost for the village board intervention was the cost of monitoring the regular price updates of the village boards. With, SEWA taking up this responsibility the costs will be substantially smaller since they already have local leaders in different villages to report the price updates on village boards. Farmers who seek price information can then speak with SEWA leaders and ask them for prices at their convenience.

6. RESULTS AND IMPLICATIONS

Village boards

Access to village boards resulted in three channels of impact detailed below:

1. Improved knowledge and awareness of futures markets
2. Improved awareness of futures prices
3. Increased use of futures prices in agricultural decision-making

Financial education improves knowledge and awareness of futures markets

There were several encouraging findings on respondents' knowledge and perception of financial markets in general and futures markets in particular from this study.

Household data collected from 2007 to 2011 shows that households in the treatment villages are 38.3 percentage points more likely to know what a futures market is in comparison to the control group. This finding is also corroborated by the results of a test measuring knowledge of futures markets in which households receiving spot and futures prices information are also likely to score 23.7 points higher than those households that do not receive price information.

Households in the treatment group have significantly more favorable opinions of financial markets: treatment villagers are 7.3 percentage points more likely to say stock markets are positive for India and 7.9 percentage points more likely to say futures markets are positive for India.

Farmers receiving price information are 11.1 percentage points more likely to be willing to trade in the futures market and 7.3 percentage points more likely to say that farming decisions are riskier without observing futures prices as compared to households that did not receive price information.

These results suggest that the basic training on financial and futures market that CMF provided along with price information on village boards caused them to trust financial markets, including futures markets, more.

Easy access to information through village boards increases awareness of futures prices

Households in treatment villages were 16 percentage points more likely to report hearing about futures prices as compared to the households in control villages.

Households that received price information through village boards were also 58.4 percentage points more likely to use the SEWA village boards to access spot price information and 65.8 percentage points more likely to use the boards to access futures price information.

Even though control villages do not have access to village boards, the spot and futures prices are widely reported in print media such as newspapers and other sources of media such as radio and television. Since treatment villages also have access to these media sources, it is encouraging that they would prefer to use the village boards to get price information.

Perhaps the most encouraging finding in the usage of the treatment is the result implying that participants trust the prices displayed on village boards, as well as spend less time and money on travelling to the market to access price information.

Households in villages with village boards were 11.1 percentage points less likely to travel outside their village to obtain spot price information

They are also 13.5 percentage points less likely to travel outside their village to obtain futures price information.

As travel costs in rural India are high, the savings from the reduction in travel are an added benefit, which might justify scaling up this intervention.

Access to futures prices increases their use in agricultural decision-making

Participants in treatment villages were 28.4 percentage points more likely to use recent futures prices to decide which crops to plant and on average 32 percentage points more likely to use recent

futures prices to form expectations about harvest time prices.

Text messages and phone surveys

This section discusses results presented in Exhibit 5 and 6, which display data about the primary sources of information for spot and futures prices respectively, as reported by farmers in eight consecutive monthly surveys. Each figure incorporates five bar charts for each important information source: SMS or text messages, newspapers, village boards, other peer farmers, and middlemen or traders. The horizontal axes display the three treatment groups: no price information, only village boards and both text messages and village boards.

Exhibit 5: What do farmers view as their primary source of spot price information?

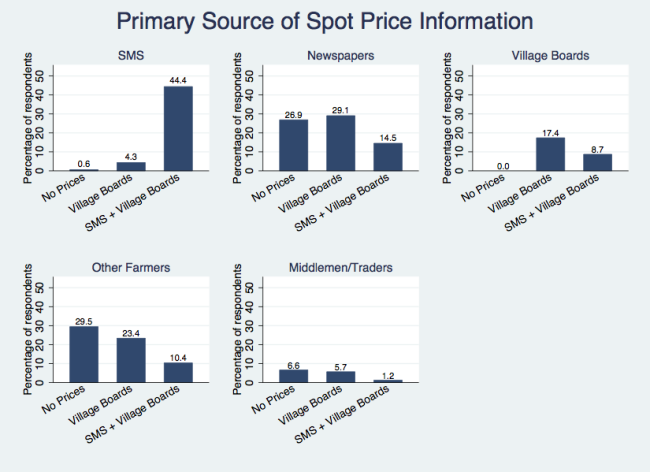
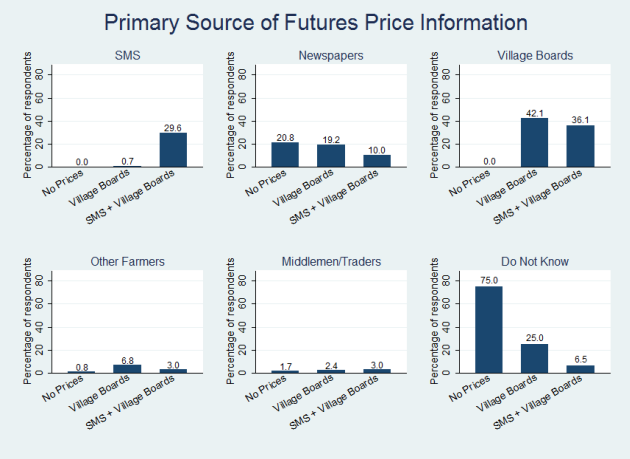


Exhibit 6: What do farmers view as their primary source of futures price information?



The vertical axes display the percentage of respondents for each treatment type who reported using the respective information source.

Text messages are more popular than village boards, when available

We find that mobile-based text and voice messages are more popular with our respondents than village boards and other information sources. 44% of the respondents in our sample who receive price information on their mobile phones said that text messages was the most important source of spot

price information. While 30% of the respondents in our sample who receive price information on their mobile phones quoted text messages as being the most important source of futures price information.

Village boards continue to be a source of information

While the text message intervention was popular, respondents continue to use village boards. Among households that received price information on village boards but not on mobile phones, the percentage of households quoting village boards as the most important source of spot and futures price information was 17% and 42% respectively. 36% households that received price information through both village boards and text messages continued to use village boards as their most important information source for futures price.

Without boards or mobile messages, newspapers and other farmers are the primary source of price information

On the other hand of the households that do not receive price information through village boards or mobile phones more than half primarily rely on newspapers and other peer farmers as information sources. In spite of the availability of futures prices in newspapers only 20% of farmers in this group report this as the primary source of information. The small percentage of farmers in this group reporting that they access futures prices compared to the other two groups also indicates that providing financial education and easier access to futures prices may increase its use.

Price Knowledge and Expectations

The phone surveys also measured price knowledge and expectations of all respondents in our sample, asking them to recall and predict cotton prices in the Halvad market in Gujarat. The collection of expectations information by phone survey enabled a more frequent survey schedule, allowing us to determine how farmers pay attention to prices over the entire crop cycle.

Since the respondents in the 'Spot' and 'Spot + Futures' groups received the spot prices for cotton, we found that these two groups fared better on the price knowledge and expectation questions as compared to the group that did not receive any price information. While the result on price recall was expected, treatment respondents faring well on price expectation question shows that regularly paying attention to prices improves your price forecast in the future.

Exhibit 7: Respondents who receive price SMS have better knowledge of prices.

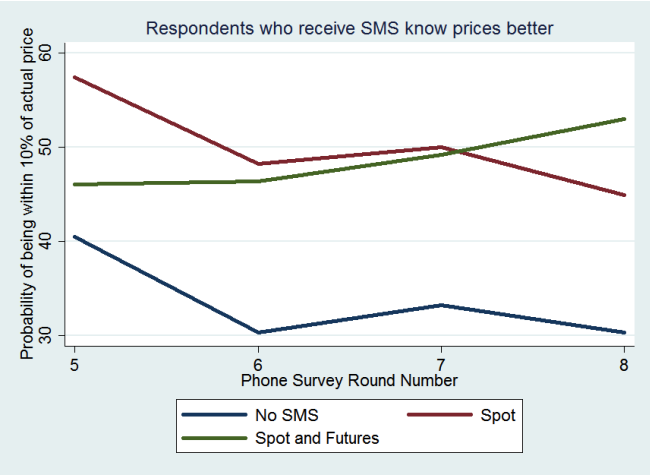
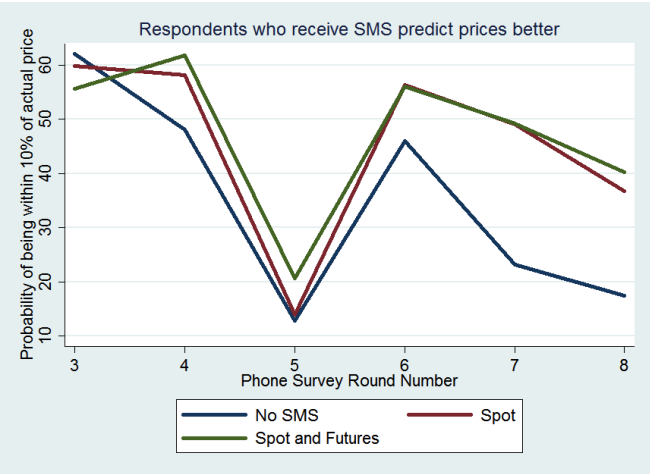


Exhibit 8: Respondents who receive price SMS have better expectation of prices.



In Exhibit 7 we can see that respondents who received no price information at all were on average 33% of the time likely to give an answer that was within 10% of the actual price, whereas respondents who received only spot price information were on average 50% of the time and respondents who received spot and futures prices were on average 48% of the time likely to give an answer that was within 10% of the actual price.

Significantly, the provision of SMS price information also improved farmers' ability to forecast prices. We queried farmers about expectations of price 1-2 months in the future. Exhibit 8 shows that respondents who received no SMS price information correctly predicted the future price of a crop (within 10% of the actual price) only 35% of the time. In contrast, respondents who received spot price information were within 10% of the realized price on average 46% of the time, and respondents who received spot and futures prices 47% of the time.

This result confirms that paying attention to spot and futures prices not only improves price knowledge of farmers but also improves their price expectations in the future.

7. FURTHER RESEARCH AND POLICY CONCLUSIONS

These experiments find several positive impacts of providing access to price information to farmers especially in terms of improved price knowledge and awareness of financial markets. The interventions also resulted in farmers utilizing futures prices in making crop selection and setting expectation of harvest time prices. However this study does not find any evidence of impact on harvesting, storage and selling decisions or on the prices farmers received at harvest-time sales.

Future studies could incorporate factors such as soil conditions, liquidity constraints, and familiarity with new crops that may limit farmers' ability to change their cropping and sales patterns that were not accounted for in these studies.

From a policy perspective, we have found that providing spot and futures prices information to farmers does change their knowledge and perception of financial markets in general and futures markets in particular, and makes them more willing to trust and get actively involved in financial markets. All three forms of our treatment have been very popular with farmers. Although these interventions were provided free of cost, the only significant cost that we had to bear for this intervention was the monitoring cost of making sure that village boards got updated on a weekly basis.

The use of mobile phone technology makes this an easily scalable intervention, since the cost of sending text messages is less than a rupee per farmer (approximately USD 0.02). Using a village board style intervention, local village leaders could be sent crop prices every day making them local resource persons who update village boards and are also able to answer farmer's questions about the latest prices.

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