Do Marketing Channel Reforms Increase Competition? Evidence from Indian Produce Markets*

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Abstract

In this paper we investigate the effectiveness of marketing channel liberalization in increasing prices obtained by farmers for their produce. Regulated market places are considered to concentrate market power in the hands of licensed traders and provide low prices to farmers. We evaluate two types of reforms: (i) 'in-market ammendments' aimed to increase competition and efficiency within regulated markets, and (ii) 'out-of-market ammendments' aimed to allow alternative marketing channels outside of regulated markets. We take advantage of a marketing channel reform which was proposed by the central government of India in 2003. In the following years, the individual states chose the timing and extent of reform adoption. This unique scenario presents an opportunity to study the effect of the reform, but also compare the effectiveness of different ammendments. We use a difference-in-difference specification to compare between reformed and unreformed state before and after the reform, and an event-study approach to analyse the dynamics of the reform. We find a 3-5% overall increase in prices following the reform. Out of market reforms seem to be passed more easily, but their effectiveness in increasing prices for farmers remains questionable. In contrast, in-market reforms increase prices for farmers starting at the time of the reform and have a lasting effect.

1 Introduction

STILL PRELIMINARY

Developing countries are often plagued with regulations that increase the market power of some agents at the expense of others. What is the best way to undertake liberalization of

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markets in developing countries? Processes of reform in developing countries form a growing debate in the development economics literature. Although efficient and functioning markets increase productivity and overall welfare, many times attempts to undertake broad market reforms fail. This problem is especially acute in cases where market regulations have led to the regulatory capture of markets by some agents. In such instances, the regulator has only limited power to carry out encompassing market reforms or the dominant agents could make the reforms ineffectual. In such instances, the regulations are kept in place because of the political power of the agents that benefit from them. Hence, it is important to know whether and when market reforms are able to overcome regulatory capture in order to extend it and replicate it in other jurisdictions. What are the aspects of a reform that are the most effective, and to which points should the regulator give priority?

In this paper we analyze the effects of a reform of agricultural wholesale markets in India. Agriculture in India employs 80 percent of more than its 1.3 billion inhabitants, which makes the study of these markets a first order question. The reform sought to remove regulations introduced in the 1960s by the Agricultural Produce Market Committees (APMC) that limited the access of farmers only to markets in their geographical region. While the set of original regulations arguably intended to protect agricultural producers from large corporations, the norms ended up limiting the entry of traders, which were the main buyers of the farmers' produce. These barriers to entry provided the traders with substantial market power.

The APMC reform was a definite policy objective of the central Indian government and part of its broader liberalization program. Yet, the adoption of these reforms was a decision of each state. Moreover, the APMC reform consisted of five main provisions. We divide these provisions into two groups: in market provisions, which were aimed at increasing competition and efficiency of traders within the state; and new market provisions, which allowed for the establishment of new private marketing channels outside of the scope of the regulated markets. We expect the out-of-market reforms to take a longer time to take effect, as those are dependent on the physical establishment of new marketing infrastructure and arrangements. In contrast, in-market reforms may be more effectively undermined in practice by incumbent traders and officials.

We study the effects of the APMC reform on three outcomes: prices, quantities, and yields. We identify the effect of the reform provisions from the variation in the timing in its adoption across states and from the variation across the provisions adopted. Our results are robust to taking into account the endogeneity of the states adoption decision. We find that in-market reforms have a positive effect on price, which indicates a reduction in traders' market power.

Yet, out-of-market reforms have virtually no effect. There are two potential explainations for this result, either new markets have not been established at a general account, or they did not provide substantial competition to the existing regulated markets. Looking at mandi prices alone, we cannot distinguish between the two explainations. We also find stronger price effects for storable crops, in which traders had originally more market power due to their access to storing facilities.

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Related Literature

Our paper contributes to different strands of the literature. The closest work is the literature on the effects of market power of intermediate sellers on trade outcomes. Our work contributes to the literature on the effects of market power of intermediate sellers on trade outcomes. Antras and Costinaut (2011) develop a theoretical trade model with intermediaries. Dhingra and Teneyro (2017) study the gains of farmers when dealing with agribusiness companies instead of selling to traders. Atkin and Donaldson (2015) estimate the share of the surplus that is captured by intermediaries. Chatterjee (2018) studies spatial competition among traders in India, but abstains from analyzing the AMPC reform. Some papers measure the market power of intermediaries by studying the pass through (Casaburi and Reed, 2018), entry and exit of intermediaries (Fafchamps et al, 2015), or measuring margins directly (Fafchamps and Minten, 2002). Some other papers study the Indian market. Reardon and Minten (2011) provide an analysis of agricultural wholesale markets in India. Meenakshi and Banerji (2004) and Banerji and Meenakshi (2005) study collusion among traders in auctions. Goyal (AEJ, 2010) uses one aspect of the APMC reform to study the effect of information provision on prices. Mitra et al (2018) find considerable market power among potato traders in West Bengal. We have data on prices in wholesale markets and, thus, we see intermediate markets outcomes directly. Moreover, we study how the aspects of a particular reform were effective in reducing the market power of intermediaries.[1]

Our paper also relates to the literature on the political economy of market reforms. [2] We

[1] Our empirical implementation follows Besley and Burgess (2000) that coded aspects of land reform in Indian states to examine their impact on growth and poverty.

[2] Jayne et al. (2002) show that many liberalization reforms in African countries were either implemented temporarily or partially. Bates and Krueger (1993) examine which are the elements of successful reforms in developing countries. A strand of the literature examines the relationship between market reforms and political institutions. (Denisova, Irina, et al. "Who wants to revise privatization? The complementarity of market skills and institutions." American Political Science Review 103.2 (2009): 284-304. study the support for privatization of state companies from surveys.)

analyze the types of policies that were effective in promoting market activity.

We contribute to the empirical literature on regulatory capture. In particular, we study the effects of removing regulation that benefits some agents. A broad theoretical literature analyzes political or regulatory decision making when agents can influence them through bribes or interest groups. (Stigler (1971), Pelzman (1976), Laffont and Tirole (QJE 1991)). Dal Bo and Rossi (2004) show that utilities in countries more prone to corruption are less efficient. Kwoka (2002) and Besley and Coate (2003) find that elected commissioners are associated with lower electricity prices. Dal Bo (Oxford Review 2006) provides a thorough review.

We also contribute to the literature of trade liberalization, reviewed in Goldberg and Pavnick (JEL, 2007) (See, for example, Atanasio, Goldberg and Pavnick (2004), Goldberg and Pavnick (JEL, 2003)) De Loecker, Goldberg Khandelwal, and Pavnick (ECMA 2016) develop a framework to estimate the effect of trade liberalization on markups. We focus on prices because we analyze the division of surplus between traders and producers. Most of this literature studies how firm respond when countries open to international trade. We study reforms of market distribution channels, which were part of broader pro market reforms. Moreover, we analyze changes in the distribution of profits as a result of such liberalization reforms of markets within a state.

Some studies provide non-causal evidence that prices obtain higher prices when selling to private companies (e.g., Managala and Chengappa, 2008). Managala and Chengappa (2008) is a case study of a new retail chain procurement system in Karnataka. They compare outcomes for farmers selling their produce through Spencers Consolidation Center with those of other farmers from the same area. They found that prices were higher at the center compared to regular market prices. Marketing costs were lower at the center. Annual income was higher for farmers trading at the center. They found an 18-24% increase in profitability from participating in the direct marketing. We are not sure this can be attributed entirely to a causal relationship, because participation is not random, and more efficient farmers could have been selected to participate. Because they only observe both groups in the after period, they cannot control for unobserved characteristics of farmers. In any case, this study provides some insights regarding the retail procurement system. Farmers participating in the center were found to be younger and more educated compared to other farmers. Farmers with larger families were also more likely to participate in the center (family labor is considered valuable for required packaging and sorting activities required by the center). The share of marginal farmers was found to be much smaller at the center (3%) compared to regular markets (28%). A difficulty in studying the effectiveness of the APMC reform is that the

information on actual results in the different states is scattered and anecdotal at best. Ghosh 2013 presents a survey of marketing channels that appear in several Indian states. He reports that different types of new arrangements have been slowly emerging following the reforms, like direct marketing in Andhra Pradesh, or organized retail in Haryana. However those still remain small in number. In some cases, new marketing channels have appeared also in none reformed states, like contract farming in Punjab. This could be a pitfall in our analysis, if the control group is also affected. We think that in this case the effect that we find should be under-estimated. Another difficulty is that we only observe prices in the regulated markets and not prices in the new marketing channels. Thus we are able to address the competitive effect of new channels on prices in regulated markets, but this again would be an under-evaluation of the total improvement of farmer welfare. Another in depth survey of the evolution of agricultural wholesale appears in Reardon and Minten (2011). They too describe an ambiguous picture regarding the effects of the reform, as well as the initial status of regulation enforcement.

Holmes (1998) also studies the effect of state-level policy, the right-to-work law, on an ot come at a lower level of aggregation: location of manufacturing firms. Holmes focuses on the geographical aspect of the data, looking for a discontinuity in the outcome variable at state borders, when going from a "pro-business" to an "anti-business" state. Since we have information from before and after periods in the states adopting the marketing channel reform, we choose instead to combine the geographical and time dimensions in a difference-in-difference type strategy. A closely related paper is Besley and Burgess (2004) studying a different process of policy changes within the states of India. They code changes in work regulations as pro-worker or pro-employer in the states of India between 1958-1992, and use a difference-in-difference strategy to test how pro-worker laws affect different economic outcomes. We use a similar approach on the staggered adoption of the marketing channel amendments. One advantage of our scenario is that we compare very similar changes, where the individual reforms are based on a modal act proposed by the central government, although de-facto implementation may still differ between states. Besley and Burgess use state specific time trends to rule out linear pre-trends, we also use this approach to check our results. Another related paper is Banerjee, Cole and Duflo (2003) who study the effect of a change in the priority-sector-regulation in India banking, to study effects on marginal firms who were not eligible for priority loans prior to the change, and became eligible after the reform. In our case, we do not use variation in the exposure of different markets to the reforms (which we do not have information on). Instead we further exploit the variation in the timing of the adoption, and look at dynamics in outcomes in periods before and after the reform. A similar approach appears in Di-Tella and Schargrodsky (2003), who study the changes in

crime rates before and after police deployment following a terrorist attack. Another related paper is Bertrand & Kramarz (2001), who also use both time and regional variation in policy (zoning bard approval) to study the effect of entry regulations on employment rates.

The remainder of this paper is organized as follows. Chapter 2 provides background on the Agricultural Produce Marketing Committees in India and a description of the reforms. Chapter 3 describes the data. Chapter 4 presents the empirical specification. Chapter 5 presents the results and Chapter 6 concludes.

2 Agricultural produce marketing in India

2.1 The history of APMCs

In the past 50 years, the government of India has intervened in the agricultural wholesale sector, both directly, as a wholesaler, and indirectly, by regulating and investing in the wholesale sector. In the 1960s the government set up a parastatal organization to purchase grain directly from farmers as a wholesale entity. The goal was to maintain and control reserve stocks, influence prices and subsidize the poor [Rashid, Cummings and Gulati, 2007]. This role of the government remains mainly for rice and wheat only, and its share in total food expenditure is minor (6-7%) [Reardon and Minten, 2011]. The plan was originally conceived to counter percieved exploitation of farmers by traditional wholesalers, and thus the government presented itself as a substitute for a part of the market. Starting at the same time, the government began transforming the wholesale system in another way. From the fragmented structure of the traditional system, it began to organize market centers as part of a public wholesale network. In the 1950s and 1960s India built public wholesale markets, also known as*mandis*. The first several five-year plans, beginning in 1951, focused on building physical wholesale market places, storage structures and warehouses, and transport lines. From 268 markets in 1947, the system grew into 5,964 markets by 2004 [Agmarknet].

The produce marketing regulation (APMC), started in the 1960s and 1970s. The central government enacted overall APMC (Agricultural Pce Marketing Committee) legislation in the 1960s. Following this, each state decided whether to enact state specific regulation (usually called an APMC act) along the general guidelines of the central government, an set up its own APMC to regulate and invest in the state wholesale markets. The committee is empowered to establish markets, control the admission of traders into the market, charge fees and control market trading licenses. All wholesale trade was required to pass through the

APMC yards, paying commissions to commission agents, a tax to the market, to off-loaders and loaders, and to weighing men who registered the transaction. This injunction, forbade by implication contract farming arrangements, collection centers by private retailers, direct marketing by farmers and private market yards.

However, the regulation of the wholesale sector was not in all senses complete and uniform. First, rural periodic markets at the local level remained mostly unregulated (around 20 thousand in number by 2000), where very small and marginal farmers sell their produce [GOI, 2010]. Second, two states, Kerala and Manipur never established APMC's. Another state, Tamil Nadu, included in its original APMC act provisions (which later became part of the APMC reform in other states) allowing marketing outside of the *mandi* system. Third, there is some evidence that not all markets were in fact regulated even in APMC states, and that farmers sometimes sold their produce or some of it to agents out side of the *mandi*s [Shilpi and Umali-Deininger 2008; Das Gupta et al. 2010]. On the other hand, there is also evidence that in some cases (states that did not enact APMC acts or reformed them), farmers sold most of their produce directly to wholesale markets, even when not required to do so by law. Finally, there are also a few examples of retail chains participating in procurement from farmers, under APMC acts, simply by obtaining licenses to do so at the regulated markets (i.e. Spencer's collection center in Karnataka [Reardon and Minten, 2011]).

2.2 The APMC reforms

By the early 2000s, criticism of the APMC system was pervasive in multiple policy reports, newspaper articles and public opinion. The Guru report, summarizing the conclusions of the 2001 Expert Committee on Agricultural Marketing, presented the first critique. It laid forward that the APMC system has hurt competition in the wholesale sector; Trade licensing has given rise to entry barriers; APMCs failed to control unethical trading practices in the *mandi*s; APMCs used collected taxes for purposes other than infrastructure and development. These observations were corroborated in several studies [Palaskas and Hariss-White 1996; Ramaswami and Balakrishman 2002; Mattoo, Mishra and Narain 2007]. Banerji and Meenkashi (2004) used auction theory to identify patterns of collusion among buyers in two wholesale markets in Northern India.

In 2003, the central government, under the tenure of Atal Bihari Vajpayee (BJP[3]), leading a general pro-liberalization policy line, announced a new model APMC act, which proposed several amendments compared to the existing state APMC acts. The model act had no legal

[3]BJP- Bharatiya Janata Party, or India's People Party.

effect on its own, as implementation was left to individual state governments. Five major changes were introduced in the model act: (I) *Private markets*: allowing private actors to operate markets outside of the regulated markets system; (II) *Contract Farming*: allowing the establishment of direct relationships between farmers and large producers, contracting the crops to the producer before cultivation; (III) *Farmers markets:* allowing farmers to open markets and sell their own produce; (IV) *Single license:* opening the trading licenses to allow traders to operate in any market across the state instead of only in a particular market; (V) *Single point of levy:* creating one point of levy during the sales stages. The central govrnment left it to the hands of individual states to choose the timing and the extent of the reform. Different states chose to amend their acts at different times, and implement part or all the reform provisions. Some states chose to leave their acts unchanged.[4] Several attempt have been made to assess the success of different aspects of the reforms, however this proved to be quite difficult. Anecdotal evidence on the actual emergence of new marketing channels after the reform implementation shows a scattered picture. Nilbja Ghosh in his book title "India's Agricultural Marketing: Market Reforms and the Emergence of New Channels" provides the following description:

> *"Emergence of new marketing channels in India has been neither uniform nor has it replaced the traditional market channels that tied the farmers to their customers, many of whom are located in the growing cities. If anything, they have surfaced sporadically, with certain systems appearing in specific regions that seemed to be the fertile grounds suitable for their proliferation, and these channels vary widely among themselves. They have even failed to emerge all together in some places. In some cases, indigenous forces imposed sever hindrance, and what evolved was more novel and probably more aligned to local sociopolitical reality than what was expected. Part of the success in the emergence of new channels and the pattern of emergence can be attributed to legislative action in the states, but part of it is embedded in the politic and culture of the region".*

Unfortunatly, no systematic information exists regarding the extent of actual implementation of the reforms in the reformed states. Some evidence, regarding the entry of retail and processing firms into direct procurement from farmers appears in Reardon and Minten (2011b). They find that in the absence of APMC reform, companies set up procurement centers by obtaining a license from APMCs to operate within the market yard (i.e. Spencer's in Karnataka and ITC's Choupal and e-Choupal hub-and-spoke system for grain procurement

[4]We present the details of implementation by state in the data section.

in Madhya Pradesh). After the reforms, collection centers began to be established out side of regulated markets. These collection centers are usually locates in semi-urban areas and procure highly perishable products or semi perishables, for stores in the city. Companies and public-private partnerships have set up several private *mandi*s, agrifood parks and logistic parks. Companies have also started or extended contract farming arrangements after APMC reform, i.e. Godrej industries in Maharashtra. So at least some evidence is presented on the consequences of the reform. In a survey of marketing arrangements in Maharashtra, the authors have found that in the three years from the beginning of the reform, 79 licenses were granted for direct marketing (to retailers and processors), a number of contract farming schemes had been approved, and hundreds of licenses for *mandi* stalls were granted to a number of retailers. On the other hand, the authors found that that off-market collection centers were still required to pay a tax to the APMC; they were often coerced by the network of market officials to have on premises payed weighing men, although not required by law. Anecdotal evidence was also found on different types of harassment of the new arrangements by traditional *mandi* actors. In general, there is a controversy about how significant was the rise of new marketing channels in the past decade. In this paper we strive to fill this gap by systematically assessing the effect of the reform. We do this by using prices obtained by farmers in the regulated *mandi*s as the outcome variable, to test whether they were affected by the changes in the law. If the reforms succeded to increase competition among traders and marketing channels, we expect the farmers to obtain higher prices in the regulated markets. Ideally, we want to test these changes arround actual implementation of the new laws, i.e. the entry of a new marketing actor, etc. Unfortunatly, we do not observe actual implementation, so in the case of no effect found, we cannot distinguish wether it is due to lack of implementation de-facto, or because new channels had no affect on outcomes for farmers.

2.3 Other wholesale sector reforms

Several other policy changes took place during the 2000s with regard to the wholesale sector in India, as part of the response to the growing dissatisfaction from the policy status-quo. These other changes were implemented at the central government level and thus should not affect our analysis comparing reformed and unreformed states. We will give a brief survey for a general background. Since the beginning of the 1990s, the Indian government has been introducing a process of liberalizing FDI regulation in the food sector. These changes included removal of restrictions of FDI[5] in bulk handling and storage, reduction of

[5]Foreign direct investment.

licensing requirements, stocking limits and movement restrictions on certain crops (Reardon and Minten, 2011). This process brought a boost in FDI in India in the 2000s, and in the food processing industries in particular (Franz and Muller, 2015). The establishment of a unified Food Safety and Standards Act in 2006, in the place of scattered safety standards that existed beforehand, also contributed to the attractiveness of the Indian market. In 2007 the central government introduced the Warehousing Receipt Program, taking effect in 2010, allowing farmers to obtain financing from banks with produce kept in program warehouses as collateral, to finance their post-harvest expenses and allow them to wait for favorable prices (Agarwal, 2016). 2003 also witnessed a revival of commodity spot exchange in India, when a government notification allowed futures trade in 103 commodities. It appears that the Indian agricultural produce market is in a general process of change and liberalization. In our analysis we aim to isolate the effect of one particular policy change in marketing channel regulation. The next sections present the data we use and the identification strategy.

3 Data

3.1 Prices

The main source of data for the reform analysis is the "AGMARKNET" system which was launched in 2000 by the Ministry of Agriculture. The portal documents daily prices and arrivals of crops in wholesale markets across the country, as reported by market administration. We have collected daily prices at the different markets for 16 of the largest crops: Cotton, Paddy, Wheat, Tomato, Red grams, Apple, Banana, Black grams, Groundnut, Sorghum, Maize, Onion, Potato, Ragi, Rice, and Soybeans. The main crops were chosen in a way to represent the main crop groups: cereals, fiber crops, pulses, fruit and vegetables. Prices were collected from 2,981 markets[6] reporting to the system.[7] In order to reduce the noise in the data, we aggregated prices to a monthly frequency using weighted averages.

3.2 Reform

We collected information from a number of policy reports on the progress of the reform amendments in each one of the 33 states and union territories. We supplemented this with information from news articles and the amended acts themselves. Table 6 in the appendix

[6]Table 5 in the appendix shows the number of markets covered in each state.

[7]Figure 7 in the appendix presents prices data from large markets for four main crops.

documents the collected information on the timing of the amendments in the different states. In some cases, we were able to find the specific date of notification which followed the amendment. Otherwise, we assumed notification was one year after the amendment (except for Bihar which repealed the act all together, this is consistent with timing of notification in the states for which we have this information) . Because of the noise in the reported date of implementation, we use the year of notification as the time of implementation and consider year-intervals before and after the reform. This is also suitable for the evaluation of some of the reform provisions, which could potentially take a substantial amount of time to take effect (i.e. the establishment of private markets).

Figure 1 presents the variation in the timing of adoption between states. A reformed state here is a state that implemented at least one reform provision. The number of reformed states increases substantially in the years between 2004 and 2007. After that, a few more states initiate reforms but at a lower rate. A group of six states remains unreformed at the end of the period. Figure 2 presents the cumulative number of amendments passed by each year. Again, there is a significant increase between 2004 and 2007. The in-market amendments, which include the single license and the single point levy provisions comprise a relatively small share of the adopted reforms, where the rest are out-of market reforms. Table 1 bellow summarizes the relative timing of adoption of the two types of reforms. Fourteen states made in and out of market amendments at the same time; four more states made out of market amendments first (and on average 6.75 years later, they made in-market amendments), another four states only implemented out-of market amendments. No states implemented in-market amendments before out-of-market amendments and only one state implemented only in-market amendments. According to this summery it seems that out-of-market amendments are easier to pass than in-market amendments. Perhaps due to pressure from incumbents benefiting from rent-seeking arrangements within these markets. We continue to test the effect of these different types of amendments on market prices in the following sections.[8]

Table 1: Timing of "In-market" and "Out-of-market" ammendments

Same year	Out first	In first	Only out	Only in
14	4	0	4	1
Avg. years after:	6.75			
Std.	(1.50)			

[8]Figure 8 in the appendix presents the geographical variation in the adoption of the different amendments by 2016.

Figure 1: Number of reformed and unreformed states, by year

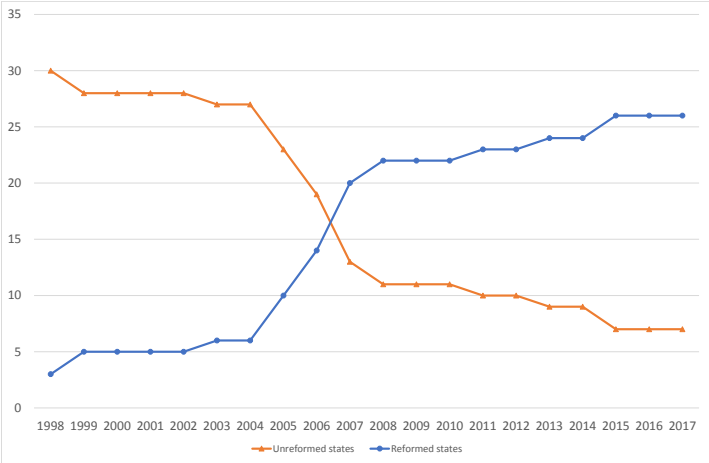
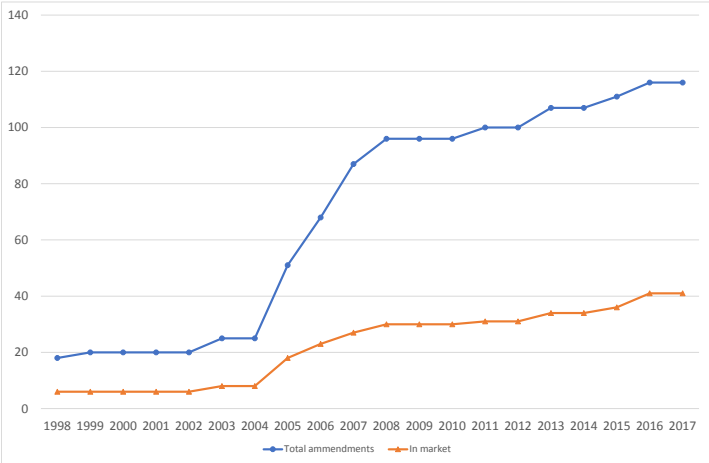


Figure 2: Number of amendments passed (Cum.)



4 Methodology

We base our analysis on the heterogeneity among the different state, in the take up of the reform, the choice of provisions and the timing of implementation. We use a difference-in-difference strategy, dividing markets into treatment and control groups based on adoption choices[9], and before and after time periods based on time of implementation. The general

[9]We use a reform index which aggregates the number of amendments implemented, which we discuss in the results section.

specification is:

$$\ln(P_{cmsdtj}) = \alpha + \beta \cdot \text{reform}_{st} + \delta_m + \delta_c + \delta_{tj} + \epsilon_{cmsdtj} \tag{1}$$

where P_{cmsdtj} is price of crop c in market m located in district d in state s, in month j of year t. Reform_{st} is a interaction term taking the value 1 for markets located in adopting states viewed in the $after$ period, making β the coefficient measuring the effect of the reform. δ_c is a crop fixed effect allowing different intercepts for different crops; δ_m is a market fixed controlling for unobserved market characteristics. δ_{tj} is a year-month fixed effects, eliminating month specific shocks that affect both treatment and control groups. ϵ is an error term which we cluster at the district level to correct for serial correlation within district over time (Bertrand, Duflo and Mullainathan, 2002) and group correlation between markets in the same district. To test for the parallel trends condition, we do two things. First, we check our results by adding state-specific time trends. In this way we can rule out that our results are actually capturing pre-existing state trends. Second, we apply a dynamic fixed effects regression, to consider the effect in intervals before and after the reform. The general specification we use for this approach is:

$$\ln(P_{cmsdtj}) = \alpha + \sum_{\tau=-\infty}^{\infty} \lambda_\tau + \delta_m + \delta_c + \delta_{tj} + \epsilon_{cmsdtj} \tag{2}$$

This is very similar to the previous equation, except here we replace the reform variable with a series of pre- and post periods fixed effects. λ_τ here is a state-year specific coefficient where state s is τ years after the reform at year t. The λ coefficients allow us to examine both pre-trends and reform dynamics post-adoption. The number of coefficients we observe is constrained by the earliest we observe any state prior to reform notification, and the latest we observe any state post-notification. In this specification we only include state which had a change in policy durring the time of analysis.

5 Results

5.1 Difference-in-difference

5.1.1 Wholesale prices

First we present a a difference-in-difference analysis, comparing markets in reformed and in non-reformed states, in periods before and after reform implementation. In addition to the reform status, we also take into account the extent of the reform. We construct a reform index which is assigned the value of zero for non-reformed states, and for reformed states for the pre-reform periods. For post-reform periods, the index is assigned the number of reform amendments divided by five. So, a state that implemented all five suggested amendments by year t will have an index of 1, while a state that only adopted two amendments will have an index of 0.4. At this point we do not distinguish between in and out of market reforms. There are three states that never had an APMC act (Andaman & Nicobar, Kerala, Manipur) and one state (Bihar) that abolished the act entirely in 2006. We interpret "no act" as a complete adoption of the reform, and assign an index of one for these cases. We do take into account that the complete abolishing of the act (or the initial lack of one) might have more far-reaching effects than the reform alone. To confirm that our results are not driven by these extreme cases, we present robustness checks excluding these cases from the analysis. We add an interaction term between the reform and storable crops to asses the impact on storable and non-storable crops.[10]

[10]Storable crops are: cotton, groundnut, jowar, maize, masur, paddy, rice, redgram, wheat; Non-storable crops are: apple, banana, ginger, onion, orange, papaya, pomegranate, potato, pumpkin, tomato.

Table 2: Reform effect on log prices

VARIABLES	(1) Log-price	(2) Log-price	(3) Log-price Excl. no act	(4) Log-price Excl. no act & Bihar
all_notif	-0.0875	-0.0901*	-0.0750	-0.0745
	(0.0553)	(0.0473)	(0.0447)	(0.0447)
all_notif_storable	0.162**	0.186***	0.167***	0.166***
	(0.0597)	(0.0548)	(0.0536)	(0.0538)
Constant	7.084***	-6.458**	-4.872*	-4.957*
	(0.00785)	(2.811)	(2.740)	(2.763)
Observations	676,695	676,695	629,074	623,800
R-squared	0.696	0.698	0.693	0.692
Makret FE	Yes	Yes	Yes	Yes
Crop FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
State-Trends	No	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2 presents the results of regressing the log price on the reform index. An observation in this regression is a monthly-crop-market combination. We include month-year fixed effects, to account for time specific shocks affecting all markets and market specific fixed effects to control for unobserved market characteristics. The error terms are clustered at the state level (since the reform is at the state level), to correct for serial correlation over time and group correlation between markets in the same state.

Column (1) reports an average 17% increase in prices following the reform for storable crops, and no effect on none-storable crops. In column (2) we include state specific (annual) time trends, this reduces the estimated effect to 10% for storable crops and presents a small negative effect for none-storeable crops. Columns (3) and (4) present specifications excluding states which never had an APMC act and Bihar. The results continue to hold, and the point estimate is even slightly higher, around 18% increase for storables and no effect for none-storables.

Next, we divide the reform amendments into two groups: "in-market amendments" which include the single license and single point of levy provisions, and "out-of-market amendments", which include private markets, direct marketing and contract farming. We construct two reform indices similar to the original index. The in-market index is assigned a zero for non-reform states, for reformed states that only implemented out-of-market reforms, and for pre-periods of states that implemented in-market amendments. For post-periods, it is

assigned the number of in-market amendments adopted divided by two. The out-of-market index is constructed in a similar fashion.

Table 3: In and out-of-market reform effect on log prices

VARIABLES	(1) Log-price	(2) Log-price	(3) Log-price Excl. no act	(4) Log-price Excl. no act & Bihar
in_ref	-0.00643	0.0689*	0.0627*	0.0658*
	(0.0376)	(0.0368)	(0.0356)	(0.0360)
out_ref	0.0344	-0.0187	-0.0123	-0.0155
	(0.0379)	(0.0336)	(0.0332)	(0.0338)
Constant	7.083***	-6.149**	-4.636*	-4.744*
	(0.00744)	(2.415)	(2.383)	(2.427)
Observations	676,695	676,695	629,074	623,800
R-squared	0.694	0.696	0.692	0.691
Makret FE	Yes	Yes	Yes	Yes
Crop FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
State-Trends	No	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3 presents the results for regressions of log prices on these two reform indices. Column (1) reports no significant effect for both types of reforms. When we include state specific time trends in column (2) we obtain a significant (at the 10% level) positive effect for the in-market reform of a 7% increase in prices, and no significant effect for the out-of-market reforms. Excluding no-act states slightly reduces the estimate to 6.5%, when we exclude Bihar as well we get an estimate of 6.8% for the in-market reforms and again no effect for out-of-market reforms.

5.1.2 Retail prices

We repeat the same analysis using retail prices collected from retail markets. Although crops may travel between states untill they reach the final consumer, we think this can still provide some evidence on the effect of the reform as a large share of crops would still be sold in-state. No effect is found in specifications considering the reform as a whole. When considering the effects of in and out of market reforms separately we find a positive effect of around 30% increase in retail prices following in-market reforms, indicating price transmission mechanisms which may allow traders to exploit market power further down the

supply channel, to compensate for lost market power in the wholesale market. For out of market reforms we find a negative effect of 19.7% on retail prices. All results hold when we exclude no-APMC states and Bihar.

Table 4: Reform effect on log retail prices

VARIABLES	(1) Log-price	(2) Log-price Excl. no act	(3) Log-price Escl. no act &Bihar	(4) Log-price	(5) Log-price Excl. no act &Bihar	(6) Log-price Escl. no act
in_ref				0.263**	0.256**	0.257**
				(0.116)	(0.113)	(0.113)
out_ref				-0.220***	-0.220***	-0.220***
				(0.0712)	(0.0685)	(0.0682)
all_notif	-0.0154	-0.0212	-0.0211			
	(0.0600)	(0.0607)	(0.0608)			
Constant	53.59	57.21	57.56	53.97	57.54	57.89
	(34.41)	(35.53)	(35.78)	(34.85)	(36.01)	(36.26)
Observations	3,246	3,103	3,084	3,246	3,103	3,084
R-squared	0.788	0.792	0.791	0.788	0.792	0.792
Number of market_id	52	47	45	52	47	45
Makret FE	Yes	Yes	Yes	Yes	Yes	Yes
Crop FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes
State-Trends	No	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.1.3 Arrivals

To test the reform effect on crop quantities arrived at the market, we repeat the analysis with arrivals as the independent variable. We use levels and not logs of arrivals, to include zero values, because market-crop panels are highly unbalanced across time (crops appear and disappear from markets, on top of seasonal fluctuations), so considering only changes in positive quantities hides substantial information. To use levels, we first complete the data set to include all possible combinations of crops-months-markets, completing new combinations with zeros. Table 5 presents the results. We find an overall positive effect of the reform, increasing monthly arrivals by 524.3 tons. When considering the effect of the two types of amendments, we find a positive effect for in-market amendments and no effect for out of market reforms, similar to the result for prices. The results hold when we leave out Bihar and no-APMC states.

Table 5: Reform effect on arrivals (in tons)

VARIABLES	(1) Arrivals	(2) Arrivals	(3) Arrivals excl. no APMC	(4) Arrivals excl. no APMC	(5) Arrivals excl. no APMC & Bihar	(6) Arrivals excl. no APMC & Bihar
in_ref		614.8**		609.7*		607.3*
		(300.8)		(304.9)		(304.9)
out_ref		-36.19		-18.82		-16.84
		(219.2)		(221.5)		(221.6)
all_notif	524.3***		538.1***		538.0***	
	(94.07)		(95.66)		(95.68)	
Constant	159.3***	163.3***	151.7***	155.6***	151.3***	155.2***
	(20.66)	(20.45)	(21.41)	(21.23)	(21.43)	(21.25))
Observations	7,083,342	7,083,342	7,035,484	7,035,484	7,030,091	7,030,091
R-squared	0.008	0.008	0.008	0.008	0.008	0.008
Makret FE	Yes	Yes	Yes	Yes	Yes	Yes
Crop FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.1.4 Productivity and market concentration

Next, we consider the reform effect on farmer productivity. An increase in profits may drive new opportunities to invest in better inputs, while modern marketing channels may even require it as a pre-requisite for participation. We use district level data on yield and area under different crops from the ICRISAT-VDSA database[11] to calculate productivity (measured as crop yield per acre of land). We find no effect on productivity of farmers both for the reform as a whole and for the two types of reforms.

[11] http://vdsa.icrisat.ac.in/

Table 6: Reform effect on agricultural productivity and market HHI

VARIABLES	(1) yield	(2) yield	(3) HHI	(4) HHI
in_ref		3.821		2.037
		(4.716)		(7.954)
out_ref		-6.244		20.75**
		(6.269)		(8.836)
all_notif	-3.579		23.69***	
	(3.649)		(3.095)	
Constant	1.912	-0.228	6.038***	5.953***
	(11.06)	(2.138)	(1.193)	(1.198)
Observations	14,377	14,377	7,083,342	7,083,342
R-squared	0.025	0.025	0.112	0.114
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
State-time trends	No	No	No	No

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

If marketing channel liberalization was to increase competition, we would expect to see a negative effect on market concentration. We cannot test this hypothesis at the trader level, since we only have market level data, but we can test it at the market level. We calculate HHI indices for each crop, district and month, and use this as another outcome variable for the reform difference-in-difference analysis. We do not find a reduction in market concentration following the reform (we cannot rule out within market reduction in trader concentration that may have occurred following in-market amendments). On the contrary, we find an increase in market concentration following the reform as a whole, and the same for the out-of market amendments.

5.2 Event study

5.2.1 Wholesale prices

To consider dynamics of the reform effect, we turn to an event study framework. Unreformed states are excluded from this analysis, as well as states that never had am APMC act. Instead, we focus on reforming states at intervals before and after the reform. We now ignore the intensity of the reform and consider only the relative time to the first amendment. Figures 4-7 present the time-to-reform coefficients, and Table 6 presents the complete regression information. Looking at the year-to-first amendment (of any kind) coefficients in figure 3,

an increase in prices is evident starting at year two to the reform. It increases up to five years to the first amendment, and then diminishes. The effect seems to disappear in the long run. The pre-trend is not clear in this specification. Figure 4 presents the time to first in-market reform coefficients. In this regression we control for the intensity of out of market reforms. Most pre-reform coefficients are not significant. A positive effect is present from the year of the reform and increases until year five to the reform and then diminishes. The effect seems to disappear after year ten to the reform. Figure 5 present coefficients from time to first out-of-market amendment, here there is no. We control for the intensity of in-market amendments. None of the time-to-reform coefficients in this regression are found to be significant, consistent with the results from the difference-in-difference analysis.

Figure 3: Time to reform effects on prices

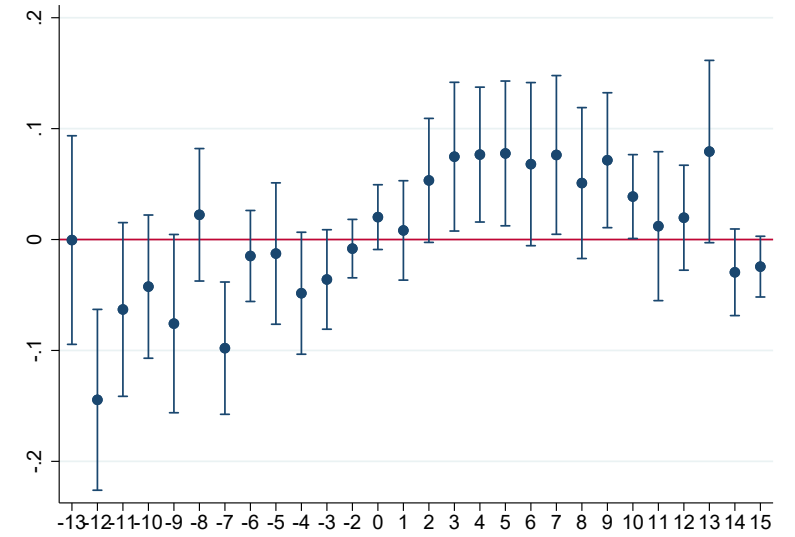


Figure 4: Time to reform effects on prices, in market amendments

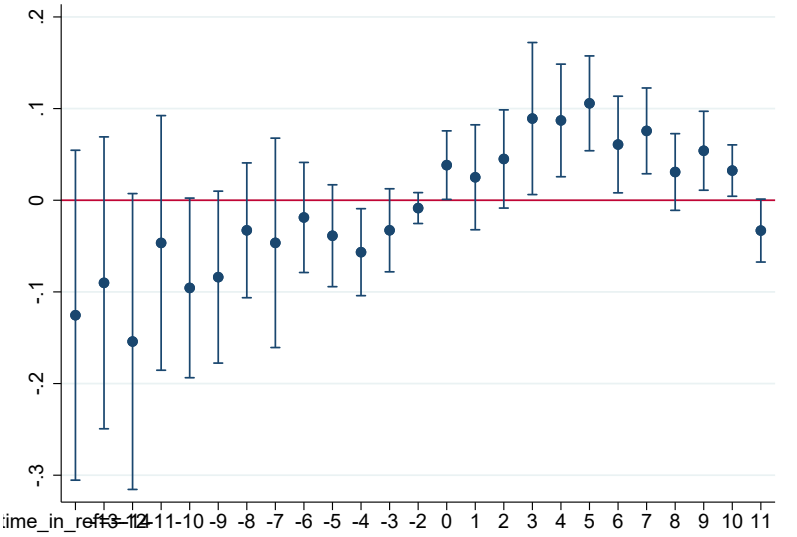


Figure 5: Time to reform effect on prices, out of market amendments

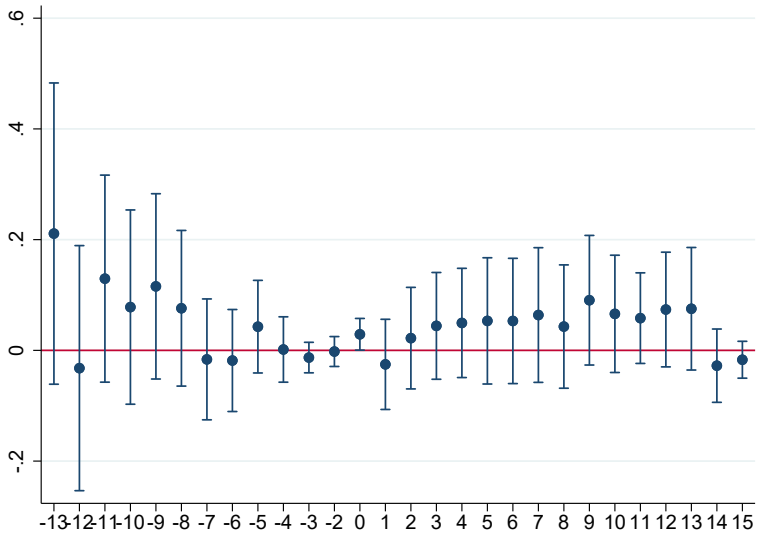


Table 7: Reform effect on prices in regulated markets

VARIABLES	(1) Log-price Any-amendment	(2) Log-price In-market	(3) Log-price Out-of market
-14		-0.177**	
		(0.0725)	
-13	-0.000463	-0.135**	0.0116
	(0.0452)	(0.0528)	(0.105)
-12	-0.145***	-0.193***	-0.207**
	(0.0392)	(0.0590)	(0.0809)
-11	-0.0631	-0.0799	-0.0258
	(0.0377)	(0.0559)	(0.0677)
-10	-0.0424	-0.125***	-0.0571
	(0.0310)	(0.0391)	(0.0668)
-9	-0.0758*	-0.109**	-0.00602
	(0.0386)	(0.0421)	(0.0682)
-8	0.0223	-0.0502	-0.0296
	(0.0287)	(0.0303)	(0.0507)
-7	-0.0979***	-0.0618	-0.102**
	(0.0287)	(0.0551)	(0.0397)
-6	-0.0148	-0.0309	-0.0735*
	(0.0197)	(0.0245)	(0.0402)
-5	-0.0126	-0.0465*	0.00307
	(0.0307)	(0.0240)	(0.0354)
-4	-0.0484*	-0.0621**	-0.0276
	(0.0264)	(0.0236)	(0.0230)
-3	-0.0360	-0.0360	-0.0314***
	(0.0216)	(0.0218)	(0.0110)
-2	-0.00818	-0.0100	-0.0112
	(0.0127)	(0.00745)	(0.0132)
0	0.0202	0.0389**	0.0379**
	(0.0140)	(0.0169)	(0.0148)
1	0.00822	0.0427**	0.0351
	(0.0215)	(0.0153)	(0.0242)
2	0.0533*	0.0618***	0.0902***
	(0.0269)	(0.0155)	(0.0304)
3	0.0747**	0.105***	0.119***
	(0.0322)	(0.0314)	(0.0356)
4	0.0766**	0.102***	0.129***
	(0.0292)	(0.0202)	(0.0345)
5	0.0776**	0.119***	0.137***
	(0.0314)	(0.0198)	(0.0405)
6	0.0680*	0.0732***	0.138***
	(0.0354)	(0.0199)	(0.0465)
7	0.0763**	0.0864***	0.154***
	(0.0344)	(0.0215)	(0.0478)
8	0.0509	0.0396**	0.134***
	(0.0327)	(0.0164)	(0.0404)
9	0.0715**	0.0610***	0.174***
	(0.0292)	(0.0195)	(0.0433)
10	0.0388**	0.0370***	0.144***
	(0.0182)	(0.0111)	(0.0383)
11	0.0120	-0.0299*	0.128***
	(0.0323)	(0.0155)	(0.0314)
12	0.0197		0.135***
	(0.0228)		(0.0445)
13	0.0793*		0.124**
	(0.0395)		(0.0493)
14	-0.0295		0.00815
	(0.0188)		(0.0264)
15	-0.0244*		-0.000479
	(0.0132)		(0.0168)
16			3.375
			(8.563)
Observations	540,667	180,927	472,417
R-squared	0.695	0.670	0.689
Makret FE	Yes	Yes	Yes
Crop FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
State-trends	Yes	Yes	Yes

Standard errors are clustered at the state level, $^{***}p < 0.01$,** $p < 0.05$,* $p < 0.1$

5.3

6 Conclusion

We presented here an analysis of the effect of agricultural produce market liberalization on prices obtained by farmers. We expected that farmers would get higher prices, following an increase in competition among buyers within the markets, as well as outside competition from new private marketing channels. Our findings show an overall 5% increase in prices following the reform. We compare between "in-market" amendments aimed to increase competition and efficiency within the APMC markets, and "out-of-market" amendments which allow the establishment of private marketing arrangements. Out-of-market reforms are adopted by a higher number of states compared to in-market reforms. Eight states initially adopted only out-of-market reforms. Out of these only four adopted in-market reforms at a later stage. Almost no state has adopted in-market reforms only. This could point to a stronger opposing lobby to the in-market reforms, as these may be perceived as more directly affecting the power of market officials and traders. Our initial premise was that in-market reforms would take effect sooner than out-of-market reforms, since the latter require the actual physical establishment of new markets. In the diff-in-diff analysis we find a 7% increase in prices due to the in-market amendments, and no significant effect for the out-of-market amendments. The dynamic analysis shows a positive effect for the in-market reforms starting at the year of the reform. The effect seems to last even ten years after the reform (although at a lower level than the initial increase). For the out-of-market reforms we find only a small and temporary effect beginning 8 years after the reform (which might also be partially due to a subsequent adoption of in-market reforms. Our results regarding the out-of-market reforms can be interpreted in two ways. First, it might be that new marketing channels do not affect prices in the regulated markets so much, because a substantial share of the farmers is left out from the new marketing channels and continues to sell at the regulated markets regardless of the outside competition. Moreover, new marketing channels may still be too few and too far apart to significantly affect prices in the regulated markets at the state level. It would be useful to obtain detailed information on the establishment and spreading out of specific marketing channels (like retailer led procurement) to further investigate this point. Finally, it is possible that simply allowing the establishment of competing marketing channels by legal reform is not enough to generate private investment at a large scale, and better regulation and enforcement of the "rules of the game" might be necessary to reduce the costs and risks at entry.

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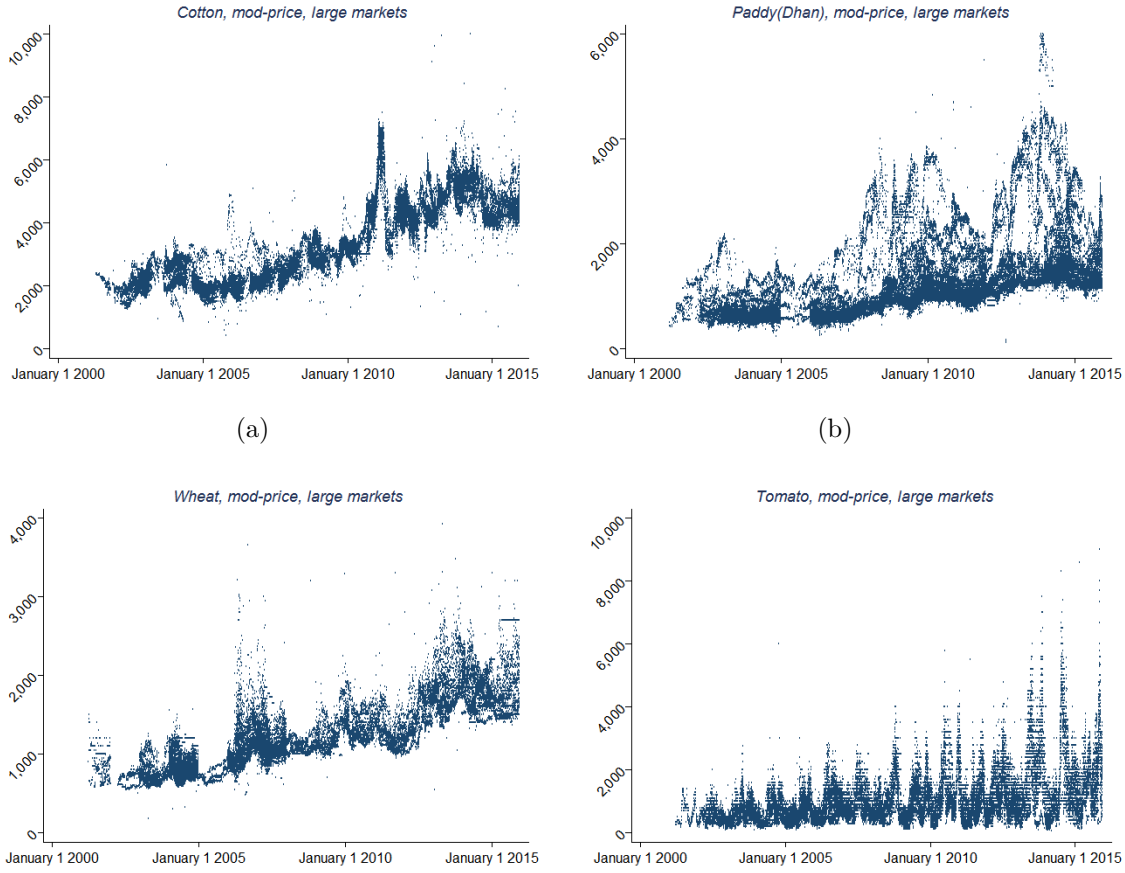
7 Appendix.

Figure 6: Price data for four main crops

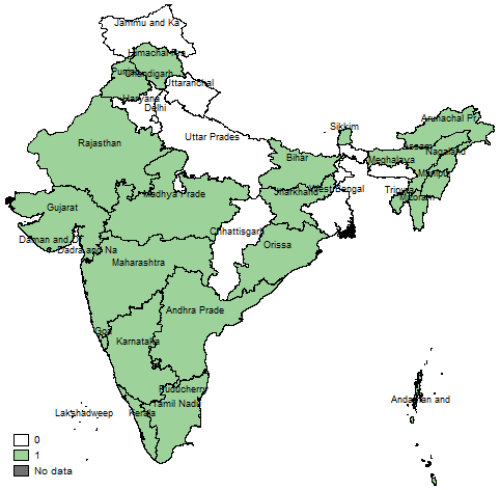


The figures above plot prices in large markets for some selected crops. The price data seem to be reliable. The figures show the price trends and seasonality that characterize each crop (the figures do not include small markets because they are noisier and make trends less apparent).

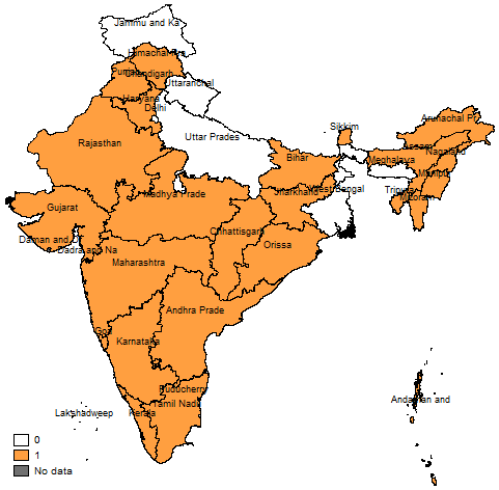
Table 8: Number of wholesale markets in our data

State	No. of Rural Markets
Andhra Pradesh	190
Arunachal Pradesh	5
Assam	23
Bihar	41
Chattisgarh	161
Goa	3
Gujarat	241
Haryana	135
Himachal Pradesh	41
Jammu and Kashmir	21
Jharkhand	26
Karnataka	154
Kerala	99
Madhya Pradesh	262
Maharashtra	339
Manipur	5
Meghalaya	18
Mizoram	4
NCT of Delhi	5
Nagaland	17
Orissa	102
Punjab	197
Rajasthan	164
Sikkim	3
Tamil Nadu	174
Telangana	159
Tripura	21
Union Territories	7
Uttar Pradesh	249
Uttrakhand	22
West Bengal	93
Total	2981

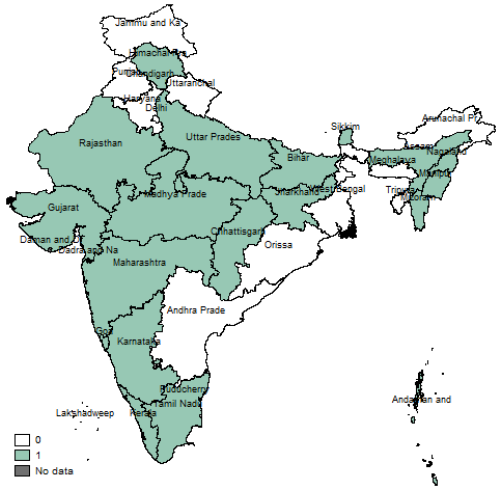
Figure 7: Reform adoption, 2016



(a) Private Markets

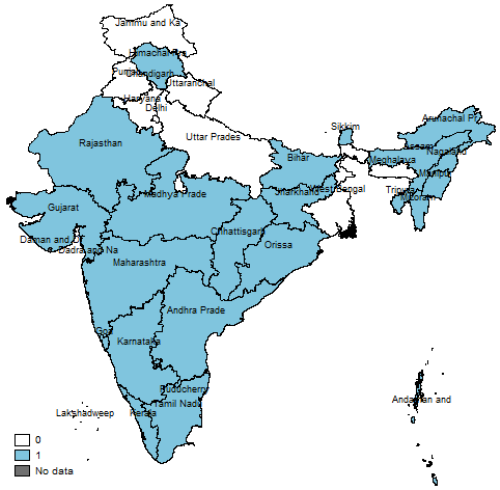


(b) Contract Farming



(c) Single License

(d) Single Point Levy



(e) Direct Marketing

Table 9: Reform ammendment date, by state

state	DM	CF	PM	SL	SPL	Date amm.	Year Amm.	Date notif.	Year notif.	Note
Andaman and Nicobar	1	1	1	1	1		0		1	
Andhra Pradesh	1999	2005	2005	2015	2005	10/26/2005	2005		2006	New reform 2015
Arunachal Pradesh	2006	2006	2006	0	0	9/5/2006	2006		2007	
Assam	2007	2007	2007	0	0	1/19/2007	2007		0	Annual report 2015-16 doesn't mention single license
Bihar	2006	2006	2006	2006	2006	9/1/2006	2006	9/1/2006	2006	APMC repealed
Chandigarh	0	0	0	0	0		0		0	
Chhattisgarh	2006	2006	2006	2006	2006	2/10/2006	2006		2007	Private markets amendment appears in official reports
Goa	2007	2007	2007	2007	2007	8/6/2008	2008		2009	
Gujarat	2007	2007	2007	2007	2007	5/1/2007	2007		0	
Haryana	2013	2007	0	2013	2016	8/9/2007	2007		2008	New amendments in Dec 2012, after 25/2/2016. See Annual Report, Min Agric
Himachal Pradesh	2005	2005	2005	2005	2005	5/26/2005	2005		2006	
Jammu and Kashmir	0	0	0	0	0		0		0	
Jharkhand	2008	2008	2008	0	2008	3/26/2008	2008		0	Official reports say no single license
Karnataka	2013	2013	2013	2013	2013	7/1/2013	2013	1/1/2014	2014	
Kerala	1	1	1	1	1		1		1	
Madhya Pradesh	2003	2003	2003	2003	2003	6/15/2003	2003		2004	
Maharashtra	2006	2006	2006	2006	0	7/11/2006	2006		2007	
Manipur	1	1	1	1	1		1		1	
Meghalaya	0	0	0	0	0		0		0	
Mizoram	2008	2008	2008	2008	2008	4/3/2008	2008		2010	
Nagaland	2005	2005	2005	2005	2005	9/8/2005	2005		2006	
NCT of Delhi	0	0	0	0	0		0		0	
Orissa	0	2007	2007	2016	2016	5/17/2006	2006	7/5/2007	2007	17/05/2006 first amendement. 12/8/2016 new amendment for eNAM
Pondicherry	0	0	0	0	0		0		0	
Punjab	0	0	0	0	0		0		0	Contract Farming Act 2013 not implemented, Amendments never implemented. 2017 new reforms
Rajasthan	2005	2005	2005	2005	2005	11/18/2005	2005		2006	
Sikkim	2005	2005	2005	2005	2005	4/20/2005	2005		0	
Tamil Nadu	1	1	1	0	0		1		1	
Telangana	1999	2005	2005	2016	2005	10/26/2005	2005		2006	Single license 12-4-2016
Tripura	2007	2007	2007	0	0	5/11/2007	2007		0	
Uttar Pradesh	0	0	0	2016	2015		0		0	1 PM allowed, 2015 report says SPL
Uttarakhand	2011	2011	2011	0	2011	4/19/2011	2011		2011	
West Bengal	2015	0	2015	0	0	12/8/2014	0		0	

Sources: Department of Agriculture, 2016; Department of Agriculture, 2017; Chand and Singh 2016; World Bank 2014; Ministry of agriculture, 2016; Swanti initiative, 2016; Patnik, 2011; Ghosh, 2013; Status of market reforms, 2008.
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