Impacts of sweeping agricultural marketing reforms in a poor state of India: Evidence from repeal of the APMC act

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Abstract

Bihar, among the poorest and least industrialized states in India implemented the most far reaching agricultural market reforms in 2006 by removing law (APMC act) that restricted farmers to selling in government regulated markets. With the unmatched radicalness of this reform, its impacts, and implications for farmers, has not been analyzed. Taking the natural experiment of repeal of APMC, we first assess the impacts on market level outcomes employing synthetic control method and find that repeal of APMC act did not lead to increase in market efficiency, reduction in the wholesale-retail price wedge and wholesale prices of food items. Yet, at the farmer level, by uniquely employing panel data on farm harvest prices (FHP) and farming characteristics, we find evidence of impacts on FHP that varies by crop. The DID estimates show that repeal of APMC actually impacted in terms of lower FHP of paddy with a larger negative effect on marginal farmers. FHP of maize, grown mainly for exports to other states and countries and where new entry of buyers took place, was higher possibly because of increased competition among buyers and use of alternate and more direct channels of procurement from farmers that increased marketing efficiency.

1. Introduction

The major concern of the policy makers in India with regard to agricultural marketing has always been to keep the prices of food for the consumers and agro-raw materials for the industry under check. However, the need to protect the interest of farming community and to provide them incentive prices for production is also important. Recognizing various shortcomings in the marketing system, the government has introduced regulations from time to time, to safeguard the interest of producer and consumer. Historically, regulated agricultural markets in India, date back to the British period. Raw cotton, the first produce to attract the attention of the British government was traded in regulated markets to ensure continuous supplies of pure cotton to the textile mills of Manchester in the UK.

Post-independence, transactions in agricultural markets have principally been regulated through two acts viz. the Essential Commodities Act (ECA), 1955 and the Agricultural Produce Market Committee (APMC) Act in 1960s. To protect consumers, ECA imposes restrictions on storage and movement of "essential" commodities by private parties.[1] The APMC Act, aims to ensure reasonable returns to the farmers by aiming to contain market power and attain transparency in transactions. Most state governments and union territories have since enacted legislations for buying and selling of agricultural commodities and development of market

[1] Only in 2020 reforms in both these acts have been proposed by the federal government.

infrastructure. APMC is a statutory market committee responsible for ensuring transparency in pricing system and transactions in designated market area aimed to ensure fair return to farmers. The geographical area in the state is divided with each division being managed by the respective Market Committee (APMC) constituted by the state government. Once, a particular area falls under the jurisdiction of a Market Committee, no person or agency is allowed to freely engage in wholesale marketing activities.

These primary wholesale markets thus have been highly restrictive due to APMC Act that mandates all transactions (based on auction) through licensed traders and commission agents subject to payment of various taxes and fees. Though the main aim of the act was to protect farmers' interests but over the years, it seems to have led to perverse outcomes for the farmers by foreclosing their selling options. Regulations overall seem to have achieved limited success in providing an efficient agricultural marketing system in the country. Over the years, APMCs turned out to be more of a revenue generating institution than facilitating efficient marketing practices to benefit the farmers and other market participants.

Several orders promulgated under APMC act created barriers to entry and prevented development of free and competitive marketing system for agricultural commodities. For example, there is compulsory requirement of owning a shop or a godown for obtaining a license for being commission agents or trader in the regulated markets that has created significant entry barrier for entrepreneurs and stifled competition. Similarly, the requirement that farmers can sell their produce only in regulated markets, and that too, only to commission agents or traders has stymied competition. Moreover, agents in APMC often form cartels and manipulate prices accruing to the farmers and high margin for commission agents in the wholesale markets thus defeating the very purpose of APMCs i.e. to ensure higher prices to farmers (Banerji et al 2012, Banerji and Meenakshi 2005, 2004). Traders, commission agents, and other functionaries have often organized themselves into associations, restricting entry of new players, resulting in lack of fair competition in markets (Acharya 2004). Lack of institutions and infrastructure has kept Indian farmers (particularly the small ones) dependent on middlemen for critical services such as finance, information, and marketing.

Overall, middlemen usually turned marketing policies in their favor, dictated terms to producers, and prevented entry of new capital in agricultural marketing by increasing the commission rates of 'arhtiyas' i.e. commission agents, rejecting direct payment to producers and fixing prices through non-transparent methods (Chand, 2016). Moreover, commission agents often charge unreasonably high fees for carrying out auctions. The commission agent legally can have 6-10 percent and 8-15 percent commission in main markets like Azadpur (New Delhi) and Vashi in Mumbai for an auction that takes just five minutes (Gulati 2009).

Hence, though the act was aimed at protecting small farmers against the market power of traders, it has been argued to impair farmers, consumers and even processing firms. In 2003, Government of India thus recommended changes in the existing APMC acts as very first attempt in reforms i.e. "The State Agricultural Produce Marketing (Development and Regulation) Act, 2003.

Agriculture being a state subject, federal government could only propose a model act, adoption of which were left to state governments' discretion. The Model APMC Act aimed at bringing efficiency in the marketing system through competitive and transparent bidding mechanism with suitable application of IT such as e-trading which in principle would minimize manipulation in trading practices and would considerably be time saving for stakeholders (Chengappa, 2012).

Several state governments did take initiatives to adopt components of the model Act. Karnataka for example permitted the National Dairy Development Board to set up a fruit and vegetable wholesale market. State governments in Punjab, Haryana, Madhya Pradesh, and Tamil Nadu allowed contract farming to enable selling directly to private buyers i.e. outside the purview of the regulated markets. These reforms also envisaged use of technology for marketing and online trading of agricultural produce. The overall objective was to bring transparency, efficiency and to provide choices to farmers to sell their produce to the agent of their choice - whether a contract-integrator, the government regulated market or to a private market.[2] The Model Act sought to remove the limitations of the old APMC Act by opening the markets to private sector and cooperatives by allowing direct farm sales and contract farming.

Amid these attempts to bring agricultural market reforms, one of the poorest and most agrarian state in India, Bihar went the farthest in reforming the agricultural markets. After assuming power in 2005, one of the first acts of the government was to abolish the Agricultural Product Marketing Act (APMA), making Bihar the first state in India to do so. This was particularly profound considering that Bihar is an overwhelmingly rural state (85%) with much of its population dependent on agriculture. What have been the impacts of this radical policy reform? Which groups have benefited or suffered?

[2] Until 2016, there still remained wide variation in policies and states of agricultural markets such as the extent of regulation in marketing, sales and trading, marketing infrastructure (Purohit, 2016). Where relevant components of the Model APMC Act were adopted, it resulted in direct purchases by the private sector from farmers and contract farming also grew in some parts of the country.

In this paper, we look at the impacts of this all-encompassing market regulation change i.e. the repeal of the APMC act in one of the poorest and overwhelmingly small farmers dominated agrarian economy of Bihar. Overall, the model act did not seem to have succeeded in persuading the private sector or cooperatives to set up agricultural marketing infrastructure as an alternative to the state-owned mandi (wholesale market) system (Chand, 2016). Possibly the Model APMC Act does not seem to go far enough, as per the final report of the Committee of State Ministers, in-charge of Agriculture Marketing to Promote Reforms, in January 2013, only 16 states have amended their Act and only six states had notified the amended rules. There are some states like Jammu and Kashmir, Kerala and Manipur which do not have APMC Act at all. Could the complete revocation of the act, like Bihar be any different?

Bihar clearly implemented the most drastic of reforms by completely repealing the APMC act. Notwithstanding the base effect, in recent time, Bihar emerged as one of the fastest growing states in India. During 2005-06 to 2014-15, the GSDP at constant prices grew annually at 10.5%. The growth rate of Agriculture and Animal Husbandry sector which is the main sources of livelihood of nearly 90% of states' population, has been 6.02 percent with share of 20.5% in state's GDP. Yet, in-spite of a high growth particularly in the main sector i.e. agriculture and reforms therein, the state remains low ranking in economic indicators like per capita income, poverty, education, income, and housing (Economic Survey of Bihar, 2016).

With a foundational reform in agricultural markets, Bihar continued to lack adequate marketing infrastructure to handle the agricultural commodities efficiently. Prior to the reform, World Bank (2005) ranked Bihar third from bottom amongst states in the level and quality of its regulated marketing infrastructure. The state was also ranked fourth from the last in the level of farmers' satisfaction with existing market conditions. The small and marginal scale farmers, nearly 96% of farming community, have had no alternate channels of marketing except to use trader dominated system (Intodia, 2011).

The repeal of APMC act just three years after the promulgation of the model act in 2003 is a large natural experiment to study the impact of considerable agricultural market reforms on market and farmer outcomes in a state of 120 million people with over 80% employment in agriculture and allied activities. The agricultural market reform aimed to create new markets and attract private investment and players to improve the efficiency in the agricultural marketing and infrastructure by abolishing old mandis. The research questions that we address are:

a. What was the impact of repeal of APMC Act on wholesale and retail prices of staples and perishable commodities? What was its impact on the margins between i) farm harvest prices and wholesale prices and ii) wholesale and retail prices?

b. What was the impact of repeal of APMC Act in Bihar on farm harvest prices (FHP) of staples like paddy and maize? Did the repeal affect small & marginal farmers differently than the larger landholders in the state?

In this paper that focuses on market outcomes and returns to farmers, we argue and find no significant impact on market outcomes at an aggregate level. In terms of farmer level outcomes across commodities we find significant differential outcomes i.e. due to the emergence of supra APMC options for marketing as in maize that bears on farmer prices and returns. If the amendments in APMC including its repeal engenders new choice sets for selling or eases utilizing options other than government regulated markets, it seems to benefit the farmers.

The paper is organized as follows. Section 2 provides a review of relevant literature in relation to agricultural market reforms.

2. Review of relevant literature

Purohit (2016) measured the state-led regulatory institutions aiming to understand market systems of 14 states of India for the period 1970–2008 with the help of indices based on legal and administrative norms. APMC indices show an upward trend from very low score of 0.006 in 1970 to 0.609 in 2008, which implies strengthening of legal and administrative framework of agricultural markets. However, there is a wide difference in the measures across the states. In Bihar, absence of the institutional agency to manage functioning of the markets, there is continuous decline in the facilities provided by the agricultural markets.

Elsewhere du Toit and Ortmann (2009) studied dairy market deregulation in South Africa, which began in 1971. The amendments to legislation in the 1980s ended up increasing uncertainty, reduced milk producer profitability and increased producers exit rates from the industry due to declining real net prices relative to real total costs over the period. Yet, from 1993 to 1997 milk producer prices remained relatively stable despite the increased import of dairy products. Market deregulation in south Africa impacted differently the relative competitiveness of milk producers.

Producers in the top one-third category were able to remain competitive and earned positive returns whereas producers in the bottom one-third category were not competitive over the study period and the differences in relative competitiveness between the top and bottom one-third categories were statistically significant. This finding is comparable to the finding in this paper of heterogenous effects on farm returns from market reforms possibly due to the asymmetry in capacity across farmers in utilizing the options that the reforms bring (credit, information, risk bearing capacity). The options because of the reforms varied across crops and types of farmers.

Chand (2012) indicated that various factors negatively affect agricultural marketing in India such as marketing margin, fragmented marketing channels, poor infrastructure, and policy distortions. Reforms are thus rationalizable in agricultural marketing to achieve goals for efficiency and improved farm incomes. At the same time, while encouraging new models that improve the bargaining power of producers and scaling up successful experiments, producers' companies and cooperative marketing societies could be promoted to provide alternative avenues for sale of produce. Meanwhile, price policy has to be reoriented to bring it in tune with the emerging demand and supply of various crops. The demand pattern for agricultural commodities, both at the consumer and industry levels, has been changing rapidly towards processed products, quality products, and specific traits in products. These changes favor integrated supply chains over conventional marketing channels, assured markets over open markets, and specific produce over generic produce. Such supply chains offer scope to reduce the margins paid to middlemen.

Mather and Jayne (2011) studied the impact of marketing arrangements using micro-level panel data on smallholders in rural Kenya to investigate the effect of the activities of Kenya's National Cereal Produce Board (NCPB) on smallholders' farm-gate maize price expectations, output supply and factor demand. Results show that the NCPB pan-territorial maize purchase price had a strong, positive effect on smallholders' maize price expectations, and that smallholders respond to higher expected maize prices by increasing maize production via intensification – through increased fertilizer use as well as higher maize seeding rates within intercrops. In addition, NCPB purchases and sales appear to affect smallholder maize price expectations indirectly through a positive effect on expected farm-gate maize prices via regional wholesale maize prices.

Dembélé and Staatz (1999) study the impact of market reform on agricultural transformation in Mali. The market reforms were effective in reducing the costs of grain distribution, particularly in the south, where transport infrastructure was comparatively good. The reforms also substantially reduced government budget deficits relative to the old official marketing system. The removal of restrictions on who could legally trade grain led to an influx of new entrants and a greater reliance on the open market for coordinating economic activity. Increased competition, combined with better market information led to lower marketing margins, which benefitted both consumers and producers. In addition, food deficit households in rural areas reported that it was now easier to find grain to buy when they needed it, as they no longer had to get authorizations to buy from OPAM and could buy in whatever quantities they needed. In the context of Bihar experiment in repealing APMC act, this is distinctive as there were no new entrants in the market post reform nor there was any greater reliance on open markets.

More et al (2016) study agricultural marketing reform in Maharashtra state in India in context with model act found that despite of concerted efforts in amending the APMC act by Maharashtra government, the impact of changes in APMC is not seen in all part of the state. There are few issues related to commission agent, investment in private market, high market fee which need to be addressed at policy level.

Reddy (2016) analyze e-market in Karnataka using difference in difference approach and find 128 percent increase in average prices in e-market compared to 88 per cent in non e-market between 2007 and 2015. Price variability also reduced in e-market by 3 percent compared to 1 per cent in non e-market. There was an increase in prices and arrival quantity with the introduction of e-markets. Improvement in broadband connectivity, placing skilled manpower, setting help desks for farmers, traders and commission agents are deemed important factor for the success of e-market network.

Karunakaran (2014) **s**tudies impact of a cooperative society (CAMPCO) on the arecanut marketing in Kerala and found that lower price spread and better price to arecanut growers in the cooperative marketing channel vis-à-vis any other marketing channel in Kerala are due to the establishment of CAMPCO depots in the state. There was increase in farmgate price of arecanut with minor fluctuations due to the establishment of CAMPCO and cultivators started grading in scientific manner.

Idowu et al (2007) worked on effects of market deregulation on cocoa (*Theobroma cacao*) production in Southwest Nigeria and found that after two decades of Structural Adjustment Programme (SAP) and economic liberalization in the country, cocoa production still remains in the hands of smallholder operators with little application of chemical inputs to enhance output. The authors suggested that significant increases in aggregate cocoa output in southwestern Nigeria can be achieved through a combination of sustained increase in real producer and world prices and an increase in aggregate fertilizer supply.

Jahanmohan et al (2016) while reviewing model APMC Act and its impact on agricultural marketing in Tamil Nadu found major constraint faced was the dominance of informal channels, large number of intermediaries resulting in higher cost of goods and services, inadequate infrastructure for storage, sorting and grading and licensing systems that created entry barriers for new traders. Also existence of multi point levy of market fee and essential commodity act impedes free movement of farm produce across the country. The authors suggested that reforms in APMC must be accompanied with easier access in credit and market information service and cooperative groups so that marginal and small farmers have negotiation capacity in the market.

Towards attempts to expand the choice set of farmers, Chand (2016) observes that India's agricultural markets have been characterized by lack of competitiveness, fragmentation, inefficiency, large presence of middlemen, and frequent price manipulations. In this context, the repeal of APMC may be an attempt for transforming the system of agricultural marketing. The outcomes however are contingent on uptake in market through larger participation of buyers and more transparent system of marketing, and some complementary reforms to facilitate APMC direct sale by farmers, establishment of private markets, removal of legal barriers to entry and rationalization of market fee.

Data and methodology

The secondary data on prices for agricultural commodities: rice, wheat, gram, tur (arhar), potato, onion and other vegetables since 1994 were extracted from https://data.gov.in/, *http://agmarknet.gov.in/*, *http://eands.dacnet.nic.in*, *http://nhb.gov.in*. Arrival data for these agricultural commodities are available after year 2000 but with several missing values for various centers. Non-availability of smooth data for prices and arrival variables has put some constraint on our study. For the same duration, data on variables like agriculture gdp, population, per capita income, agricultural area, net irrigated area, net cropped area, tube well, cropping intensity were collected from state government specific site.

We first conduct a comparative case study to estimate the impact of the repeal of the APMC act by Bihar. Given the magnitude and the extent of the market reforms in the form of repeal of APMC, a proper identification of the causal impacts of these reforms is of crucial importance for policy makers in Bihar but also outside. This estimation, however, faces several challenges. First, the APMC repeal, a state-wide policy, is specific to Bihar (barring the three states that did not have APMC to begin with). With just a single treatment unit, accurate inference is difficult, perhaps impossible (Buchmueller, DiNardo, and Valletta 2011; Donald and Lang 2007). We, therefore, adopt a case-study approach and use the Synthetic Control Method (SCM), which is devised to precisely address these kinds of situations (Abadie et al. 2010).

SCM provides a data-driven approach in choosing comparison units in comparative case studies. The synthetic control method pioneered by Abadie and Gardeazabal (2003) offers a bridge between qualitative and quantitative methodologies, as it provides a systematic way to choose comparison units. Instead of comparing the outcome in a state, subjected to a specific policy change and other states that were not, SCM construct a counterfactual group which is obtained as a weighted combination of non-treated states (called the "donor pool"). Divergence in outcome values between the synthetic and treated unit if happens in the post-treatment period indicates intervention had an impact.

In contrast to a difference-in-differences design, SCM does not give same weight to untreated units in the comparison (Galiani and Quistorff, 2016). Further, contrast to the difference-in-differences method, SCM allows the effects of observed and unobserved predictors of the outcome to change over time, while assuming that pre-intervention covariates have a linear relationship with outcomes post-treatment (Kreif et al., 2016). The advantage of building this counterfactual unit is that "the pre-intervention characteristics of the treated unit can often be much more accurately approximated by a combination of untreated units than by any single untreated unit" (Abadie et al. 2015).

These non-treated states are chosen to match as closely as possible the pre-treatment trajectories of the treated state i.e. Bihar. The states used to obtain the synthetic control (those in the "donor pool") must not be affected by the treatment. Population, per capita income, agricultural area, net irrigated area, net cropped area, tube well, cropping intensity are some of the predictors used in the analysis. We use annual state-level panel data for the period 1984– 2012. Hence, the length of the pre-intervention window i.e. 20 years is a comparatively large pre-intervention period to get a good synthetic. The central idea behind SCM is that outcomes from the control units are weighted to construct the counterfactual outcome for the treated unit, in the absence of the treatment (Kreif et al., 2016). The SCM is useful for policy evaluations when the validity of the parallel trends assumption is questionable in DID estimation.

We use other states in India to construct a 'synthetic' Bihar. This synthetic Bihar is obtained by a very specific weighting scheme that assigns different weights on each (control) state in the donor pool. This 'optimal' weighting scheme is obtained by achieving the best possible match of the pre-intervention (pre-repeal of APMC) outcome as well as pre-intervention characteristics between Bihar and the set of donor pool states.

This cross-state context is essential due to time varying events. In impact evaluation, the reliability of an estimate critically hinges on the accuracy of the counterfactual (Abadie et al. 2010). Because of time-varying factors, both observed and unobservable, the pre-APMC repeal Bihar is unlikely to be an accurate counterfactual for post-repeal Bihar. Due to the food price crisis of 2008-09, for example, a comparison of pre-repeal Bihar to post-repeal Bihar is likely to be flawed from the perspective of impact evaluation.

While constructing a counterfactual Bihar using the other states, we recognize that it is highly improbable that a single state would make for an adequate counterfactual Bihar (no state is exactly like Bihar); it is also unlikely that all states/Union territories would play an equally important role in the construction of the counterfactual Bihar (some states are more like Bihar than others). SCM provides a systematic way to choose comparison units: the counterfactual is the weighted average of the control states/UTs, where pre-intervention matching across a range of characteristics over a long period generates the weights. SCM also naturally lends itself to permutations or randomization tests for inference (Bertrand, Duflo, and Mullainathan 2004; Abadie, Diamond, and Hainmueller 2010; Buchmueller, DiNardo, and Valletta 2011; Bohn et al.

2014). The synthetic control technique, subjects the comparison units' predictor variables' attribute data in the pre-treatment period to a dual optimization process that minimizes:

$$\sum_{m=1}^{k} Vm\ (X_1m - X_0mW)^2$$

by selecting the optimal values of *W* and *Vm*—where X_1m is the value of the *m*-th attribute of the treated unit; X_0m is a 1 x *j* vector containing the values of the *m*-th predictor attribute of each of the *j* potential comparison or control units; *W* is a vector of weights on control units; and *Vm* is a vector of weights on attributes of the control units that maximize the ability to predict the outcome variable of interest (Abadie et al. 2010). This optimization process minimizes prediction error between the actual and the synthetic in the pre-treatment period.

Y_1 is the observed outcome data for the treated, unit. Y_0W is the weighted average of outcome variables for the included control units. If there are no important omitted predictor variables then a reliable synthetic match will be created such that Y_1 -Y_0W— the distance between the actual unit's outcome variable and the synthetic unit's outcome variable—will be small in the pre-intervention period (Abadie et al. 2010). This is particularly likely when the pre-intervention period is sufficiently long. If the outcome variable of the synthetic control diverges significantly from the actual outcome in the post-treatment period, the performance gap may be attributed to the effect of the treatment.

On the side of inference, placebo-tests help ensure that results on impacts that we estimate are not spurious. The fake treatments are applied to donor units that were not subjected to the intervention to analyse the divergence between synthetic and treated unit. Replicating the synthetic control analysis should not generate a significant divergence between synthetic and actual outcomes in the absence of treatment. Creating a synthetic for each donor unit in the population enables researchers to ascertain whether the estimated treatment effect for the treated unit is of unique magnitude and direction. A ratio of the treatment period prediction errors to the pre-treatment prediction errors on these can be used to calculate a scale-free measure of the extremity of the impact of the fake treatment on each donor unit. The empirical distributions of these extremity measures also allow researchers to compute pseudo p-values based on permutation inference in the population (Rosenbaum, 2002) rather than frequentist inference which relies on assumptions about the functional form of underlying distributions. These pseudo p-values can be interpreted, in much the same way as p-values in traditional regression.

It is important that our analyses cover a long-time span. With long years of pre-repeal data, we can achieve good pre-intervention fits, i.e. generate a good counterfactual Bihar i.e. with APMC in place. Equally important is the long post-intervention data that offers a major advantage for assessing the impacts. The long-time is crucial to account for factors such as changes in technology, farmer and trader responses to the policy change, and individuals' responses to the changed market conditions. Policy responses often are affected by lags and might require time to unfold. Such a long-term view, however, has accompanying empirical issues; it is difficult to expect that unobservable factors would remain invariant over the entire period. Therefore, the fact that SCM does not assume unobservable factors to be time-invariant (Abadie et al. 2010) is a notable strength of this estimation strategy.

Based on mandi price data, available in daily and weekly form since 1994, SCM was employed to assess the impact of Bihar APMC Act repeal on price behavior of rice, wheat, gram, tur, potato, onion, and other vegetables like tomato, brinjal and chillies. We also try to assess the impacts if any on agricultural GDP of Bihar.

Figure 1 and

Figure 2 plot for neighboring state of Bihar the weekly retail and wholesale prices of tur dal (pigeon pea) along with figures for Patna market (the biggest market in the state). The figures show much similar price movement during these periods with the other centers of nearby state which indicate potentially insignificant impact on the prices of agricultural commodities. The similarity in price movement does not change relative to pre-repeal period. There is no discernible difference in price behavior either at the retail or wholesale level.

Figure 1: Comparison of prices- Patna and other centers

Tur retail price

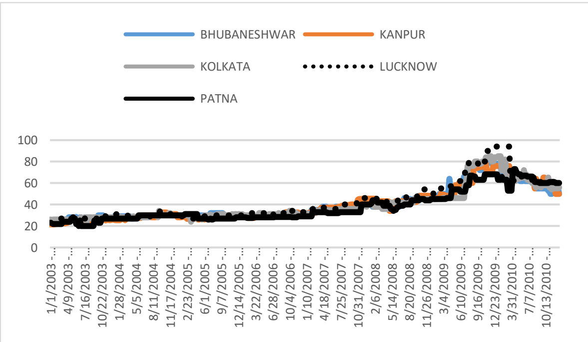


Figure 2: Tur wholesale price

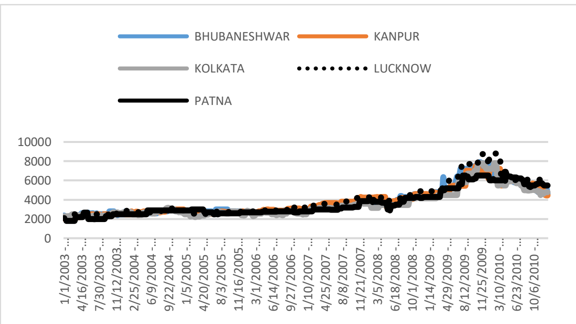


Figure 3: potato wholesale price

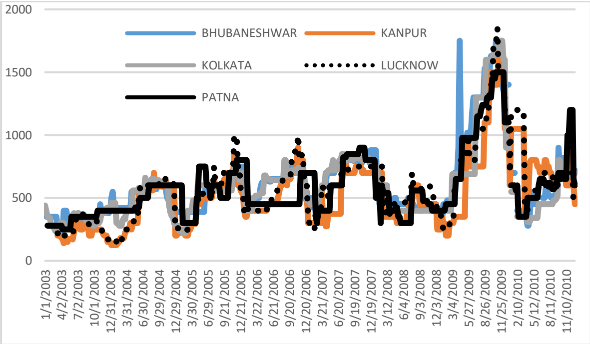


Figure 4: Potato retail price

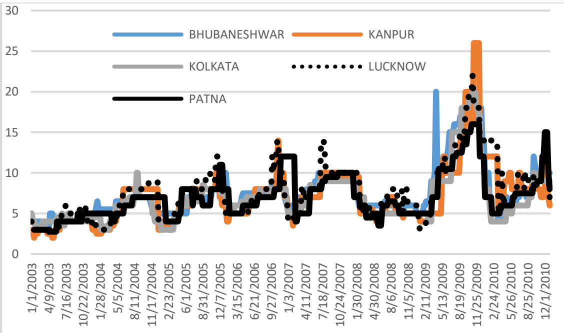


Figure 5: Onion retail price

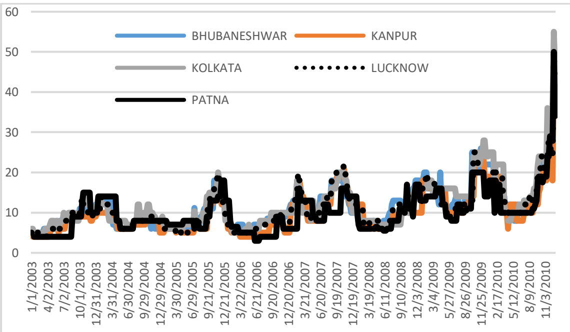


Figure 6: Onion wholesale price

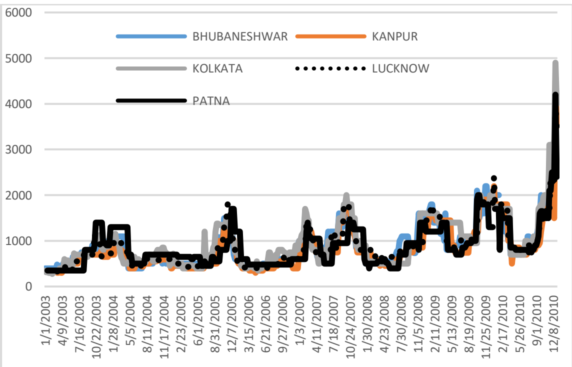


Figure 7: wholesale gram

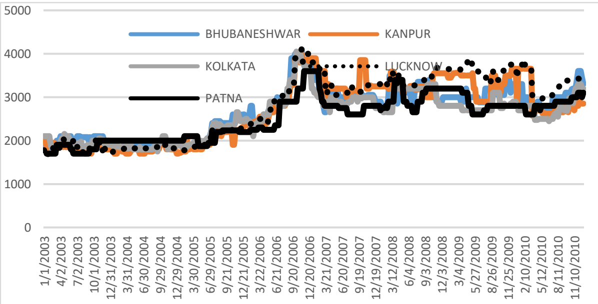


Figure 8: Retail gram

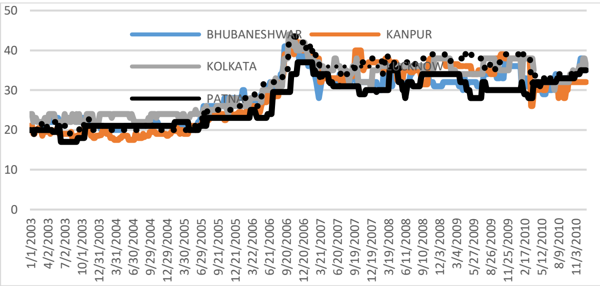


Figure 9:Cereals wholesale and retail prices

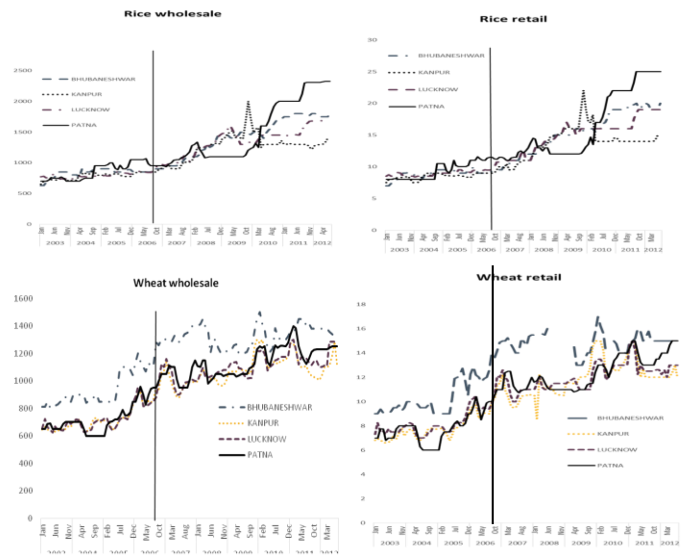


Figure 10: Price spread of Rice, Wheat, Gram and Tur

Figures show that across a host of commodities, the behavior of retail and wholesale prices in Bihar is quite similar in the pre and post intervention period relative to markets in states/UTs that will constitute the donor pool for comparison. The evolution of prices over time has not been any different from comparable markets after the repeal of the APMC act (Figure 10). We also analysed price spread between retail-wholesale, retail-farm harvest, wholesale-farm harvest, and MSP-farm harvest prices. The agricultural market reforms are expected to compress the margins and reduce the wedge between farmgate and wholesale prices and wholesale and retail prices as well. But here too, price spread does not seem to be materially affected by the repeal of APMC Act which indicates possible lack of impact of this large reform on aggregate market level indicators. The price behaviour of vegetable crops also indicates insignificant impact of repeal of APMC Act. Only in rice there is a trend separation at a much later period which could be a function of other factors like government procurement. The price behaviour of vegetable crops also showed similar patterns pre and post APMC Act repeal.

In case of impacts on farmers, this study uses a novel plot-level cost of cultivation data provided by Commission for Agricultural Costs and Prices (CACP). The Directorate of Economics & Statistics (DES), Ministry of Agriculture, has been implementing a Comprehensive Scheme for Studying the Cost of Cultivation of Principal Crops in India since 1970-71 to generate estimates of cost of cultivation/production of the principal crops to meet cost of cultivation data requirement. The field data are collected through the agricultural/general universities and a college.

We use unit level data on cost of cultivation and production collected under the Comprehensive Scheme for Studying the Cost of Cultivation of Principal Crops by the Directorate of Economics & Statistics (DES) in the Ministry of Agriculture and Farmers' Welfare, Government of India. The cost of production of agricultural crops is the most important factor used by the Commission on Agricultural Cost and Prices (CACP) to decide the recommended minimum support prices (MSPs) of various crops.

A network of agricultural universities and agricultural economic research centres (AERCs) collect the cost of cultivation data for 26 principal crops from 108 homogenous agro-climatic zones (ACZs) covering 19 major agricultural states using a three-stage stratified random sampling. Tehsils or taluks (sub-district units) form the first stage sampling units (FSUs); villages form the second stage sampling units and operational holdings form the third stage sampling unit.

The FSUs (tehsils) are allocated to different ACZs in proportion to the total area of all crops covered in the study. The FSUs are selected in each zone (stratum) with probability proportional to the area under the selected crops, and with replacement. Within each FSU, the village is also selected following the same procedure. In each selected village, all the operational holdings are enumerated and classified into 5 size classes: a) less than 1 hectare; b) between 1 and 2 hectares, c) between 2 and 4 hectares, d) between 4 and 6 hectares and e) above 6 hectares. Two holdings are randomly selected from each class for collecting detailed input output data, including data on farm-harvest prices and the value of total agricultural assets owned by farmers. Villages and operational holdings, once selected for data collection under the scheme, are retained for three years.

After three years, data are collected from another set of villages within the same tehsils. The cost of cultivation data is representative at the ACZ and the state levels. Therefore, we have operational holding and farmer level rolling panel data for three years and long-term panel data at the ACZ and state levels.

In Bihar, data are collected for paddy, wheat, maize, lentils, chickpea, mustard/rapeseed, and potato. As repeal of APMC Act in Bihar occurred in September 2006, it falls in the second year of the three-year panel (2005-06 to 2007-08) of the cost of cultivation data. We compare farm-harvest prices of selected crops in 2005-06 (pre-treatment period) with prices from 2007-08 (the immediate post-treatment period). Data from earlier years (2000-01 to 2004-05) are used to test for parallel trends. It is possible that within a few years after abolition, farmers and traders may have adjusted in their practices. Therefore, the long-term effect of the policy change may be different from its immediate effect. We explore the long-term effect of abolition of APMC by looking at FHP in years 2011-12 to 2013-14. While the cost of cultivation and production data is used by the CACP every agricultural season as a key input to arrive at minimum support price (MSP) recommendations, this paper may be the first effort to use this rich data to assess the impact of a major policy change on farmers.

The data is a repeated 3-year plot panel, with proper district identifiers, starting from 2008 on the website, but we manage to get the district identifiers for the 2005-06 to 2007-08, panel via ministry of agriculture through handwritten notes. Data is a comprehensive set of all Farm-level attributes from production and its value to fertilizers costs at the crop-level. But since we have used difference in differences approach with famer and plot level fixed effects we only needed time varying controls to fit the model sufficiently, hence, we merged IMD Rainfall data at the district level, to control for droughts.

Our objective is to find the average effect of repeal of APMC Act in September 2006 in Bihar on farm-level prices of paddy, wheat and maize and highlight the contrast between the nature of trade and market between these two crops. Specifically, we are interested in comparing the prices of these two crops after the repeal of APMC Act in Bihar to the counterfactual at the same point in time and at the same place. Though we assessed the outcomes on wheat as well but do not focus on it substantively owing to lack of parallel trends.

Since the counterfactual of Bihar without APMC is never observed we must estimate it. In principle, as the best option we would like to randomly assign repeal of APMC in Bihar and compare the average outcomes/prices of the groups with APMC and without APMC. In the absence of random selection into treatment, we must turn to nonexperimental methods that try to mimic the randomized allocation settings under reasonable conditions. A major concern is that state like Bihar that have chosen to repeal APMC Act could be different from states that have opted to continue to work under it. For example, poorer states might have committed lower existing investment in mandis under APMC and hence it might be easier for them to amend the act than other states in comparison. Also, it is possible that states with better or worse governance of the APMC mandis selectively altered APMC act leading to selection issues. In principle, many of the unobservable characteristics that may confound identification are those that vary across states but are fixed over time. A common method of controlling for time-invariant unobserved heterogeneity is to use panel data and estimate DID models. (Giliani, Gertler and Schargrodsky 2005).

The complete eradication or repeal of APMC Act in Bihar, creates a near "natural experiment" setting. We exploit this exogenous shock to implement our DID strategy. With DID we control for observed and unobserved time-invariant farmer or plot level characteristics that might be correlated with farm-level crop prices. The change in the control group is an estimate of the true counterfactual, that is, what would have happened to the treatment group if there had been no intervention. As Galiani, Gertler, and, Schargrodsky (2005) point out, another way to state this is that the change in outcomes in treatment areas controls for fixed characteristics and the change in outcomes in control areas controls for time varying factors that are common to both control and treatment areas.

Formally, the DID model can be specified as a two-way fixed-effect linear regression model. We use the following DID model to identify the impact of repeal of APMC Act in Bihar on plot-level farm prices:

$$P_{istc} = \beta^{o} + \beta_{Bc} D_{Bc} + \beta_{(t>a^{o})} D_{(t>a^{o})} + \gamma_{DID} W_{Bct} + \mu_f + \delta * X_{isct} + e_{isct} \qquad (1)$$

The dependent variable P_{isct} represents the outcome of interest, i.e., price of crop 'c' for plot 'i' in state 's' at time 't'. The variable D_{Bc}, where B stands for Bihar and c stands for crop represent the y intercept for the treatment variable and the variable $D_{(t>a^{o})}$ represents the y intercept for the time dummy and '$a^{0} = 2006$', i.e., it represents $t > 2006$. The main variable of interest is W_{sct}, which is the interaction of the treatment group dummy with the time indicator. Let I_B be the indicator that represents Bihar, i.e., it takes the value equal to 1 if the plot is in Bihar and equals 0 otherwise. W_{sct} is the interaction of $I_B$with the time dummy, W_{sct} is the indicator variable that equals 1 if the plot is in Bihar at time t and equals 0 otherwise. μ_f is a fixed effect for farmer f.

X_{isct} is a matrix comprising plot-specific and/or time-specific characteristics of plot i. These variables, for example time-variant factors such as drought or rainfall. Since this is the plot level data we can control for farmer level and plot level fixed effects, which is why we do not need any time in-variant controls at these levels. The variable e_{isct} is meant to capture the influence of unobserved factors that vary at the plot, farmer, state, and time level.

The coefficient of W_{isct}, i.e., γ_{DID}, estimates the average difference in the change in price of the crop c between the treatment and the control states in the post-treatment state, which is Bihar relative to the baseline (where in both the treatment as well as the control state, were working under APMC Act).

With farmer-level fixed effects that are included in the estimation equation, we can address some of the concerns related to omitted-variable bias. The fixed effects included in equation 1 can neutralize additive linear effects of other unobserved heterogeneity in terms of disadvantages or advantages associated with location, topology, farm practices, norms, habits and also time-invariant farmer or governance factors.

Apart from these concerns, there is a potential for concern at the geographical level- that is, the state in our case. It is possible that state of Bihar is the worst performing with virtually no infrastructure at APMC mandis to begin with. Hence, the standard errors are clustered at the district level to control for intra-district correlations. Clustering is done at the district level because access to mandis and its infrastructure both vary at the district level.

Issue of Parallel trends

The double difference is a valid estimate of the effect of policy change only if we can show parallel trends between mean outcomes of Bihar and other states before 2006, the year policy changed in Bihar. We show test for parallel trends for FHPs of paddy and maize in figures below. We do not observe parallel trends in the FHP of wheat in Bihar and other states of India. Therefore, we do not show results on the impact of APMC abolition on wheat prices. One key assumption of DID estimation is that the trends in outcomes of interest would have been the same in both the treatment and the control groups—that is, the price of crops for plots in Bihar and in other states. This so-called parallel trend assumption is a necessary condition for the DID methodology for identifying casual impacts. The assumption is that the repeal of APMC Act in Bihar induced a deviation from the common trend.

Recall, γ_{DID} in equation 1 is the DID estimate of the average effect of repeal of APMC Act in Bihar on price of crops. The main identifying assumption for this interpretation is that the change in price of crops in control states is an unbiased estimate of the counterfactual. As Galiani, Gertler, and Schargrodsky (2005) point out, while we cannot directly test this assumption, we can test whether the secular time trend in plot-level prices of crops were the same in the preintervention periods, then it is likely that they would have been the same in the postintervention periods if the treated state i.e. Bihar had continued to work under APMC Act.

Given the nature of problem, it is not possible to discern whether outcomes of Bihar and those without would have moved parallel in the absence of repeal of APMC act. However, the test of parallel trends by checking for relative movement before the repeal of the act in Bihar, can lend confidence to the estimated impacts. With parallel trends, we investigate whether outcomes would have continued to move in tandem in the post intervention period (without the repeal of the APMC Act).

Results

Market outcomes from APMC repeal

Since summary comparisons show no significant difference between Bihar and comparable states following the repeal of APMC, we apply SCM to try and assess if there were any causal impacts of the repeal of APMC act. The goal of synthetic control method in this case is to evaluate the impact of a treatment implemented at the aggregate level (state) in one unit using a small number of controls to build the counterfactual.

Figure 11 presents the pictures for causal impacts on market prices following the repeal of APMC in Bihar in 2006. For illustration cases for gram and tur have been presented. Before intervention Bihar tallies well with its synthetic. The counterfactual Bihar is the weighted average of the states and union territories where the pre-intervention matching across a wide variety of characteristics and over an extended period generates the weights. The pre-intervention fits indicate that the synthetic Bihar makes for a good counterfactual in most cases. A good preintervention fit for a long period can happen only after controlling for unobserved factors. Visually, after repeal also the outcomes are not different in Bihar in any significant way. Based on inferential tests in Table 3, the donor probabilities are high at 0.88 and 0.44 for wholesale and retail prices. Table 1 and Table 2 present the summary comparison of Bihar with donor pool states in terms of outcomes and predictor variables.

Table 1: Summary statistics

	Donor Pool				Bihar
	Mean	Std dev	Min	Max	Mean
Outcomes:					
Farm harvest price (1984-2012)					
Paddy	555.31	334.32	123.00	1808.80	416.62
Wheat	639.89	365.51	144.00	2047.75	561.33
Maize	492.22	292.82	114	1494.32	427.92
Tur/arhar	1631.61	1033.73	324	5166.07	1505.84
Gram	1474.83	932.90	258.00	5371.92	1393.53
Retail Price (1993-2012)					
Paddy	1216.50	439.85	524.48	2567.31	1114.91
Wheat	993.36	405.25	369.94	2266.07	869.50
Tur/arhar	3447.64	1497.82	1311.03	7238.79	3225.85

Gram	2593.65	975.37	1123.81	5628.57	2434.89
Wholesale price (1993-2012)					
Paddy	1085.41	392.16	491.56	2403.10	1024.78
Wheat	897.33	364.15	341.34	2048.64	800.71
Tur/arhar	3164.90	1400.39	1165.19	6885.85	3070.13
Gram	2294.01	902.45	959.50	5149.57	2203.015
Predictors: Characteristics (1984-2012)					
Agricultural area (Thousand hectares)	12255.12	8729.94	800.00	27677.60	9130.98
Net Cropped area (thousand hectares)	9518.71	6447.53	538.41	19898.00	6626.03
Net irrigated area (thousand hectares)	3702.27	3200.49	95.00	13928.52	3319.34
Area irrigated by tube wells (thousand hectares)	1597.18	2319.45	0.00	10175.05	1755.72
Cropping intensity (%)	144.60	25.17	107.56	191.21	136.50
Population (Thousand)	56258.63	42450.72	4585.00	206312.00	84341.79
Per capita GDP (current Rs. lakh)	3.16	4.88	0.05	28.12	1.07
Agricultural GDP (Rs. thousand million)	324.64	538.35	0.91	4117.38	231.30

Note:
1. Donor pool for ever crop will change due to uneven availability of desired data i.e. state in donor pool for paddy retail will differ from donor pool of wheat retail and so on. So value of predictor may change based on number of states considered under donor pool.
2. SCM were analyzed only for maize farm harvest price (not for retail and wholesale prices)

Table 2: Comparison of agricultural GDP

	Donor Pool (31 states/territories)				Bihar
	Mean	Std dev	Min	Max	Mean
Outcomes:					
Agricultural GDP (Rs. thousand million)	184.93	426.08	0.062	4117.38	231.30
Predictors: Characteristics (1984-2012)					
Agricultural area (Thousand hectares)	6704.07	8152.70	29.63	27677.60	9130.98
Net Cropped area (thousand hectares)	5004.94	6112.91	16.13	19898.00	6626.03
Net irrigated area (thousand hectares)	1924.55	2726.17	0.00	13928.52	3319.34
Area irrigated by tube wells (thousand hectares)	727.13	1688.76	0.00	10175.05	1755.72
Cropping intensity (%)	137.52	24.28	100.00	204.30	136.50
Population (Thousand)	32881.38	38323.12	362.00	206312.00	84341.79
Per capita GDP (current Rs. lakh)	3.60	6.02	0.05	49.36	1.07

Figure 11 presents the SCM estimates on wholesale and retail prices of pulses from the repeal of APMC act. There is no evidence for any causal impact of the repeal. The placebo tests also indicate Bihar does not stand out in relation to other donor pool states implying lack of any impact.

Figure 11: SCM estimates for wholesale and retail price of pulses

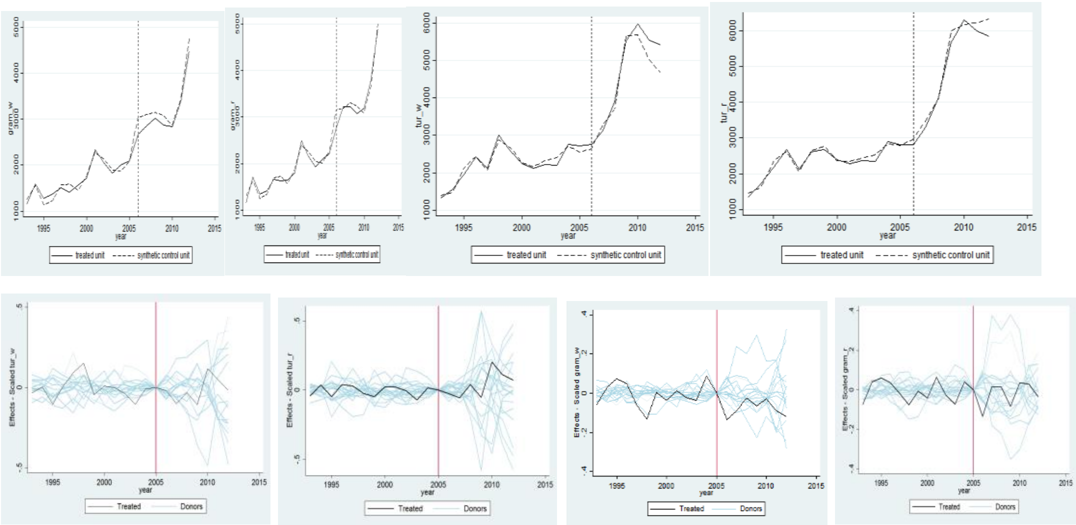


Table 3: test statistics for SCM for tur wholesale and retail prices

Crop: Tur/Arhar	Test statistics (Wholesale)		Test statistics (Retail)	
post/pre RMSPE ratio	1.21	12.5	2.89	11.84
Post/pre RANK	17th/17		12th/ 19	
Probability*	0.88		0.44	

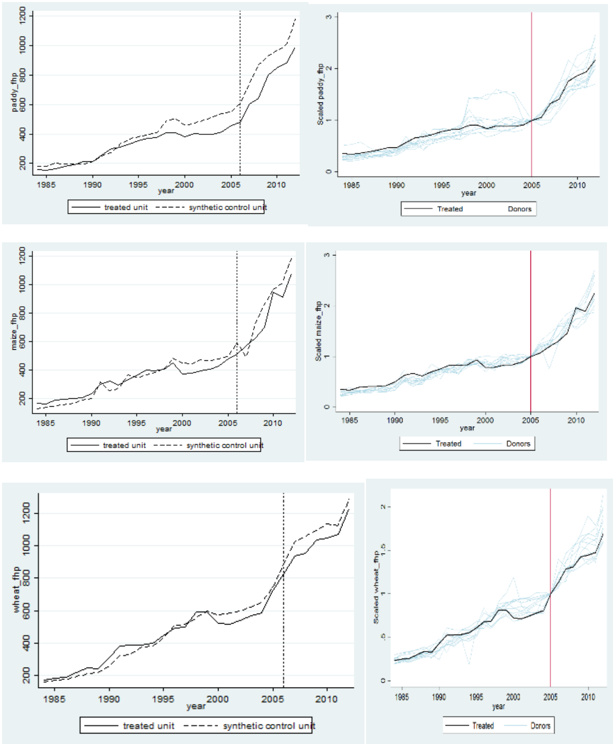
Note: * Probability of this is happening by chance in the first post period

Table 4:Test statistics for SCM on gram prices

Crop: Gram	Test statistics (wholesale price)		Test statistics (retail price)	
post/pre RMSPE ratio	1.64	8.614	1.4	8.101
Post/pre rank	17th/17		18th/ 19	
Probability*	0		0.06	

Note :* Probability of this is happening by chance in the first post period

Figure 12: SCM estimates of price impacts of paddy, wheat, and maize



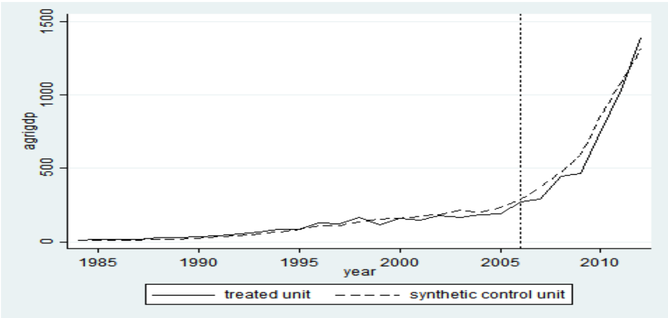
The same finding is there for rice and wheat. Neither the wholesale price nor the retail price of rice, wheat or pulses seem to be causally impacted by the repeal of APMC in Bihar in any significant way. The behavior of prices is not dissimilar to the patterns for other states, in particular the weighted average of comparable states (the donor pool) that makes for a counterfactual Bihar. Traditionally pulses have been considered important elements of cropping systems in Bihar, but advancement of agricultural technology and government support for cereals with improved irrigation infrastructure in past has moved these crops to marginal land.

Bihar ranks 9th in terms of production with a contribution of 0.52 million tons to the national pulse pool but shares only 7.06 per cent of total area, with productivity 897 kg/ha in 2013-14. One of the major constraints for farmers in Bihar have traditionally faced is access to the market due to poor physical and electronic connectivity, unfavorable terms of trade in market and exploitation by middleman. Market arrival had been very low nearly 3 percent and 5 percent of total production of gram and tur in 2006-07 (Agmarknet).

Wholesale and retail prices show slight divergence between treated and synthetic unit starting from year 2005 but repeal was in 2006. This may be due to expectation of repeal by stakeholder of market but very soon it damped with its actual treated unit.

Overall, we also wanted to check if agricultural GDP of Bihar was impacted in causal way by the APMC repeal. Figure 13 plots the comparison of Bihar with synthetic Bihar. Synthetic Bihar closely tracks the trajectory of agricultural GDP for entire pretreatment period. Hence, this provides good approximation to the agricultural GDP that would have been attained in the absence of APMC Act repeal. But the estimate is not statistically significant based on placebo tests. Post intervention there is no significant difference between actual and synthetic Bihar implying that APMC repeal does not seem to have any significant impact on agricultural GDP of Bihar.

Figure 13: Agri. GDP: Bihar vs. synthetic Bihar



Statistical tests establish the validity of the result whether the evidence of no effect is driven by chance or it is a real difference created after the intervention. To assess the significance of our estimates, we conducted a series of placebo test by iteratively applying the synthetic control method as fake intervention to every state in the donor pool. The estimated gap for Bihar from 2006 onwards did not diverge relative to the distribution of the gaps for the states in the donor pool. In each iteration, we reassign our data to give similar policy intervention to every state of the donor pool and shifting Bihar to the donor pool. This iterative procedure provides us with a distribution of estimated gaps for the states where no intervention took place.

The blue lines represent the gap associated with each of the runs of the test for donor pool. That is, the blue lines show the difference in outcomes between each state in the donor pool and its respective synthetic version. The black line denotes the gap estimated for Bihar. As the figure makes apparent, the estimated gap for Bihar from 2006 onwards did not diverge relative to the distribution of the gaps for the states in the donor pool. Treated unit Bihar ranked 23rd out of 27 states in donor pool which further provided confidence that there is no significant change after the repeal of APMC Act. For robustness test, alternate set of predictors were used to construct Synthetic Bihar. Results are robust to that perturbation.

Farmer level analysis of the impact of repeal of APMC: Difference in difference analysis

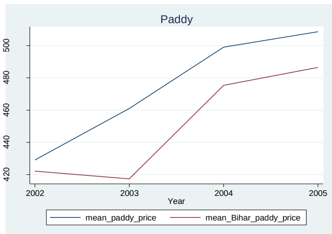
MOTIVATING SUMMARY STATISTICS OF FARMER /PLOT LEVEL DATA FROM CACP DATA ABOUT HERE

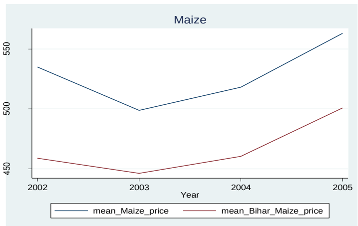
We created a farmer level panel dataset on farm harvest prices (FHP) of paddy and maize from Bihar and other states of India, for years immediately before and after the repeal of APMC Act in Bihar in 2006, using cost of cultivation data collected by the Commission on Agricultural Cost and Prices (CACP). The CACP data is representative at the state level. Therefore, we can draw conclusions about the population using this data. This dataset also allows us to control for time-invariant characteristics of farmers, like their ability, entrepreneurship. Since CACP collects data from same set of farmers for three years, our analysis compares price realizations for same set of farmers before and after APMC abolition.

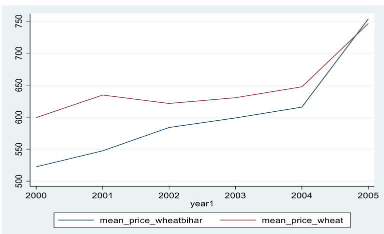
We applied difference-in-difference (DID) method to this data for causal estimation of the impact of repeal of APMC on FHP. The DID method compares treated unit (Bihar) with control states (other paddy and maize growing states of India) before and after the policy shock. The double difference between treatment and control units, before and after the policy change, is taken to be the impact of the policy change. We apply the DID model to the full sample of farmers and to the sub-samples of medium & large farmers and marginal farmers separately to test if the policy change had a differential effect on smallholders.

Figure 14: Non-parametric tests for parallel trends in paddy

Figure 15: parallel trends in maize







To test the assumption of parallel trend we plot the average price of various crops in Bihar vis-à-vis average price of crops in control states for the year 2001 to 2005 (period prior to intervention) and we perform an additional DID estimation. As already noted, a key assumption of DID estimation is the trends in outcome of interest would have been the same in both groups (Bihar and other control states) in the case where Bihar would have not repealed its APMC Act. (Figure 14). We test that the preintervention time trends for the control and treatment state are not different by estimation a slightly modified version of equation 1. We use only the observations of the control and the treatment in the preintervention period. In particular, we use the same data for the year 2001-2005 for parallel trends. For parametric test of parallel trends, we regress FHPs of paddy and maize against time and an interaction term between the time and the treated unit (i.e., Bihar). This regression basically tests if the slope of the FHP for Bihar and other states of India are significantly different from each other. If the slopes are not different, that is the interaction term in the regression (Table 5) is statistically not significant, then we have evidence for parallel trends in the dependent variable.

Table 5: **Test for Parallel trends**

Variable	(1) **Paddy Price**	(3) **Maize Price**
Post	9.4980***	42.8571
	(1.1870)	(70.2358)
Treat	-23.7151***	-15.7781
	(2.3413)	(57.5781)
Parallel trends	**1.5934**	**11.2997**
	(3.0641)	**(70.5789)**
_cons	499.0806***	457.1429***
	(0.8428)	(57.3473)
N	14189	278

Standard errors in parentheses
SE clustered at state level
"* p<0.10 ** p<0.05 *** p<0.01

The test for parallel trends that we report in Table 5 is essentially a falsification test using a fake treatment. Thus, we use preintervention data to estimate DID using the same treatment and comparison group states. Note that in parallel trend DID estimates, standard errors are clustered at the state level, as the district identifiers are not available in the data set before 2005.

Difference in difference estimation results

Table 6: **Impact of APMC Repeal on Maize and Paddy Prices**

Variable	(1) Paddy_price	(2) Maize_price
post treatment 2006-07	146.9280***	-47.8539
	(7.8547)	(34.5887)
treatment-Bihar	0	0
γ_{DID}	**-43.6421*** **	**105.5245*** **
	(16.0558)	**(34.2656)**
constant	536.4167***	533.1959***
	(5.4601)	(17.4725)
Farmer fixed effects	Yes	Yes
N	10967	362
R-sq	0.7518	0.1709

Other controls include Drought-less, medium and severe
SE clustered at district level and is robust
"* p<0.10 ** p<0.05 *** p<0.01"

We present the estimation results of equation 1 for paddy price and rabi maize price after the repeal of APMC act in Bihar. Column 1 reports the model results for paddy prices and column 2 reports the results for maize prices (Table 6). The treatment term is zero as it perfectly correlated with farmer-fixed effect. We find that repealing the APMC act from Bihar has reduced the farm price with about Rs 43/Qtl for paddy and has increased the farm price of rabi maize with about Rs 105/Qtl. Since we are controlling for farmer fixed effects we only controlled for droughts at the district level as it is time varying and was available through IMD data.

We tried to investigate further and see, how this would have impact different farmers with different land holding sizes. So, replicating DID estimates for small and large farmers we find that large farmers have lower price compression in paddy and larger price increases in case of maize and visa-versa in case of smaller farmers even though results are not significant for maize due to very small number of observations (Table 7). This is expected as marginal farmers have smaller producer surplus, lower bargaining power and higher transactions costs of marketing their produce.

Table 7: Impacts on farmgate prices by farm size

	Small Farmers		Large farmers	
Variable	Paddy price	Maize price	Paddy price	Maize price
post treatment 2006-07	148.5756***	0.0000	137.8294***	-50.0000
	(2.4991)	(95.3762)	(2.2083)	(72.4680)
treatment-Bihar				
γ_{DID}	**-54.4381*** **	**40.0**	**-35.5755*** **	**118.0**
	(5.7797)	**(114.6279)**	**(5.9667)**	**(74.8447)**

_cons	533.4680***	549.7194***	542.6133***	539.8244***
	(2.3287)	(58.8598)	(2.0817)	(17.0948)
N	1341	42	1290	52
R-sq	0.8187	0.1149	0.8042	0.4022

Standard errors in parentheses
="* p<0.10 ** p<0.05 *** p<0.01

Also, we tried looking at possible long-term effect of repeal of APMC in Bihar. Regression results show the impact of abolition of APMC in the triennium 2008-09 to 2010-11—three to five years after the policy change. We look at longer term impact of the policy change to test if, with time, farmers had adapted or adjusted to the new policy regime to mitigate its negative effects on price realization in case of paddy. Our analysis shows that the negative effect of abolition of APMC on FHP of paddy increased over the years (from Rs. 43 to Rs. 100/quintal). On the other hand, the positive effect on FHP of maize shrank from Rs. 105/quintal to Rs. 15/quintal.

We also see that farmers continue to get lower prices in case of paddy, but maize prices remain comparatively high. Note that the data set is a rolling panel of 3 years that starts from 2005, so earlier estimates have farmer panel, but from 2008 to 2010 the villages have changes and so does the farmer so cannot control for the farmer fixed effects, so we ran the ordinary least squares for these estimates. Our analysis shows that the abolition of APMC in Bihar had very different effects on farm-harvest prices of paddy and maize. Abolition of APMC lowered farm harvest prices of paddy in Bihar by Rs. 43/quintal but led to a small increase in FHP of maize by Rs. 105/quintal.

In case of maize also, larger farmers seem to have gained more than the marginal farmers, but the coefficients on the *DID-Impact* are statistically not significant. We get insignificant coefficients in case of maize because CACP has a small sample of maize growers. Splitting the sample increases standard errors and the coefficients on the *DID-Impact* become statistically insignificant.

To summarize our results, abolition of APMC in Bihar led to lowered farm harvest prices of paddy and the smallholders suffered more than the large landowners. Furthermore, the negative effect on FHP of paddy became bigger with years. In case of maize, farmers benefited from abolition of APMC and we have weak evidence that smallholders gained less than the large farmers. The impacts of deregulation seem to taper off with time.

Table 8: Longer term impact of repeal of APMC in Bihar

	2008-2010 Panel	
	Average Paddy price	Average Maize price
post-Average of 2008-2010 Panel	363.6149***	195.8510***
	(2.8867)	(3.0337)
treatment-Bihar	-41.9335***	-75.6828***

	(5.9232)	(5.6610)
γ_{DID}	**-100.7702*** **	**15.0752** **
	(6.8962)	**(7.3764)**
Constant	585.5614***	658.6085***
	(2.6835)	(2.7463)
N	41690	4946
R-sq	0.3329	0.5617

Standard errors in parentheses
="* p<0.10 ** p<0.05 *** p<0.01"

Discussion

Despite several reform initiatives undertaken including the repeal of APMC, in states like Bihar, inadequate and poor infrastructure in the regulated markets along with high transportation costs discourage farmers going to the mandis. The repeal of APMC was aimed to create new markets and attract private investment and players to improve the efficiency in agricultural marketing and infrastructure by essentially removing the entry barrier of the old APMC Act, by abolishing old mandis. Little entry and private markets emerged in Bihar. In one of the districts of Bihar i.e. Samastipur which is exceptional in the number of privately run mandis in operation, Chatterjee et al (2020) show that many of these mandis were functional before the repeal of the APMC Act in 2006. The main reason for their emergence was widespread growth in horticultural production that predated the repeal of APMC. Even in the absence of formal state regulation, these markets have standard procedures that govern processes like weighment, quality assessment, price determination, payments, and dispute resolution. This is the result of senior commission agents and traders taking a lead in organizing and regulating market affairs to keep the marketplace active and functional. Now in Bihar farmer can only sell to private players as there in no government agency which formally buys farmer's produce. The nature of impacts that we see with the repeal of APMC act can be understood by the agricultural context of Bihar.

In states where MSP based procurement takes place like in wheat basket or rice bowl states like Punjab and Haryana, most transactions occur inside an APMC mandi, while in Bihar, given the overwhelming share of smallholders and no procurement of wheat and limited procurement of rice, the majority of transactions in Bihar in paddy and wheat are being conducted either at the farmgate or informal local markets. In Bihar in cereals for small farmers, the total output has been so small that they have not been participating in the wholesale market, APMC or no APMC. In effect, the repeal of APMC act brought in no material difference. Chatterjee et al (2020) show that auctions are virtually completely absent in Bihar, and transactions are either settled via negotiations or buyers make take-it-or-leave-it offers, which farmers accept or reject. It is the same system that prevailed in the pre repeal period. Rice in limited quantity (1 million ton) is procured either directly or through a levy system in Bihar. How the limited public procurement in rice and none in wheat in Bihar and the levy system in rice interacted with repeal of APMC act remains an important area of research.[3],[4]Another effect of repeal of APMC that has been analyzed by several researchers (Purohit 2016, Chatterjee et al 2020) is the issue of infrastructural degradation after the repeal of the APMC Act that would further affect market efficiency and functioning of the markets.

The exceptional case of maize in Bihar

While paddy is cultivated majorly for self-consumption in Bihar with less quantity available for procurement. Bihar had emerged as a maize hub even before abolition of APMC Act. Private sector procured maize from Bihar to export it to other states of India and other countries of South and South-East Asia. As marketing restrictions went away with abolition of APMC, alternate channels of maize procurement opened and more firms entered the maize sector resulting in increased competition among buyers and better price realization for farmers.

Maize is now becoming a major cash crop exported to markets, to other states such as Andhra Pradesh, Karnataka, Tamil Nadu and parts of south east Asia including Nepal and Myanmar. The geographical location and climatic condition of eastern part of Bihar namely Purnea, Katihar, Samsatipur, Saharasa districts are favorable for cultivation of maize. Bihar is the third largest producer of maize in the country after Andhra Pradesh and Karnataka and accounts for about 10% of national output. Cultivation of maize provides livelihood to about 1.3 million farmers in Bihar, majority of whom are marginal and small farmers. As per the figures of 2005–06, Bihar produced 1.7 million tonnes of maize valued at Rs. 10.6 billion (at MSP of Rs. 620/quintal).

The stretch from Purnia, Katihar and Bhagalpur to Madhepura, Saharsa, Khagaria and Samastipur – north of the Ganges and on either side of the Kosi river – has emerged as a corn belt where many farmers, harvested 50 quintals or more per acre i.e. comparable to the 180-200 bushel yields in the US Midwest heartland of Illinois, Iowa, and Indiana (one bushel equals 25.4 kg) (Figure 16). In the flood-prone areas of Khagaria, Saharsa, Samastipur and Katihar, rabi maize became the major and, in some cases, the only crop. Notably, maize is the only crop in Bihar where productivity is higher than the national average. As maize is grown in most districts of Bihar, there is not much movement of the maize within the state.

[3]Under the levy system, government procures rice from local millers, who are expected to procure paddy from farmers at MSP, and then give the government a fraction of that (the "levy") as milled rice.

[4] The Bihar Rice and Paddy Procurement (Levy) Order, 2005, required the rice millers to sell at least 40% of the rice produced out of the paddy purchased by them from farmers at MSP. In 2009, the percentage of rice required to be sold by the millers to the state was fixed at 50% (see Chatterjee et al 2020).

In 2012-13, Bihar's maize exports annually had crossed 1 million tons – 0.6 million to South-East Asia and the rest to Bangladesh and Nepal. In this year when world corn prices peaked, the costs at Indonesia's Cigading or Malaysia's Klang ports averaged about $ 310-315 a ton. Rabi maize from Bihar was $10-15 cheaper, leveraging both its location advantage and the nearly two-month-long time gap for South American shipment arrivals. The export boom also benefited Bihar's farmers, who saw their price realizations increase from Rs 400 to Rs 1,200 per quintal between 2005 and 2012.

Unlike maize, Bihar is not a hub for paddy. Much of the paddy produced in the state is consumed locally. Although Bihar government has sought to continuously expand its procurement operations since 2011 (the period outside our dataset), paddy procurement has usually been short of procurement targets. The little public procurement that Bihar does not seem to matter in influencing the actual organization of farmers' sale; these continue to remain overwhelmingly between farmers and private traders at the village level. Even in 2019 Chatterjee et al (2020) report only 5.5% of all farmers in Bihar selling to government agencies. Kapur and Krishnamurthy (2014) based on fieldwork conducted in the markets of Ara and Bhiya in Bhojpur district in Bihar revealed that most of the farmers in nearby villages did not even know that the APMC Act in Bihar had been revoked and the state-regulated mandi disbanded. This is because, both before and after the abolition of the APMC, farmers continued to sell their surplus wheat and paddy to village traders, who then made sales in Ara.

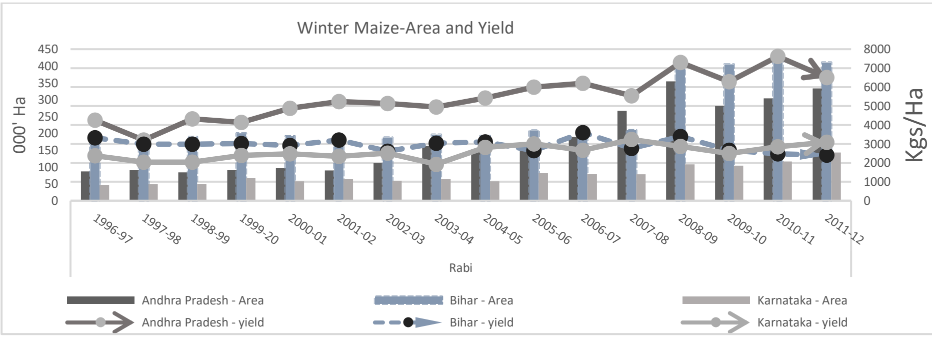
Instead, it was found that mandis in this region—both state-regulated APMCs when they existed and privately-owned and managed markets—featured secondary, trader-to-trader transactions (between buyers, traders, and commission agents), but have not facilitated direct participation of farmers. The effect of markets on paddy sector particularly in terms of price realization remains very limited. As regulated markets disappeared with repeal of APMC, new buyers did not enter the market in Bihar.

Disappearance of regulated markets might have led to market fragmentation, reduced competition among grain buyers and increased cost of price discovery for smallholders. Transaction costs of selling paddy might have increased for some farmers in Bihar, especially the smallholders. Chatterjee et al (2020) state that agricultural market reforms in Bihar assumed that the critical bottleneck impeding greater competition and better price realization for farmers is monopolistic state-regulated market sites (APMC mandis). This assumption is however conditional on taking MSP and government procurement to have a real presence on the ground which is certainly not the case in Bihar.

Differential outcomes of abolition of APMC in cases of paddy and maize thus shows that complete deregulation of wholesale primary markets may benefit farmers only if it brings in new players and attracts private investments. Otherwise, in commodities or regions, where private sector is less interested or sees few opportunities, removing public marketing system might end up hurting farmers and smallholders suffer more from such policies.

While the area under cultivation, maize production and yield have increased during 1977 to 2007, there are only 8-10 maize processing units in Bihar. They are mainly into milling of flour and production poultry feed. In absence of adequate processing facility, the marketable surplus of Bihar, especially in rabi season depends completely on other states for purchase. Over the last several years, Gulabbagh (the mandi from Purnea district and hub of maize sales) maize contract has been listed on NCDEX, there has been increasing dynamism in the maize trade. The Gulabbagh mandi attracts a number of large multinational corporations (MNCs) every season like Skylark, Cargill, Roquette, and Louis Dreyfus (Chatterjee et al 2020). These MNCs manage their own supply chains and have invested in warehousing, research and development, and input markets. Also a growing number of smaller traders from different parts of India visit market like Gulabbagh during the peak maize harvesting and marketing season and set up offices there. Such changes have been possible only with repeal of APMC in 2006.

Figure 16: Rabi maize area and yield



Conclusions

A priori, it is very hard to tell whether repeal of APMC Act in Bihar, is favorable for the farmer or not, repeal of APMC Act is essentially removal of an entry barrier to the agriculture markets and was done to open markets to private players both locally and from outside. For paddy, the Bihar presents the usual story of the state in terms of comparatively low yields, production and quality relative to the country average that makes the demand and creation of newer markets for Bihar paddy in other states a difficult task. Whereas Bihar winter maize, has been directly competing in yields and production with best performing states such as Andhra

Pradesh and Karnataka since late 1990's but it is the demand surge for feeding cattle and poultry in other states and countries that would have mattered for Bihar success in maize. The pro- and anti-APMC policy debate has generally failed to engage with the tremendous diversity, complexity and dynamism that define agricultural markets on the ground, not taking into account variations in market structure, institutions, relations and practices that have evolved across and within different regions and commodity systems (Krishnamurthy and Kapur 2014). These factors determine the ways in which agricultural markets actually work, determine who gains and who loses from commodity exchange and market participation. The production and marketing relationships are also critical and influence the possibilities and limitations of reform itself.

In some states, farmers face high APMC charges that may add up to 10-15% of the value of the produce. The combined effect of regulatory restrictions, intermediaries' cartels, high market fees has resulted in low share of farmers in consumers' price, specially, for high-value perishable commodities. These restrictions have also discouraged private investments in market infrastructure, growth of contract farming and development of direct marketing channels. Small and marginal farmers suffer the most because they have high transaction costs and low bargaining power. Several states would mimic the Bihar reality in that context. Yet there are important differences between Bihar and other states. The number of wholesale markets in Bihar for instance has been subpar as around 400 sq. km area in the state is served by one wholesale market against 156 sq. km. in Punjab and 318 sq. km. in West Bengal.

For paddy, the Bihar complies with the usual story of lower yields, production, and quality relative to the country average that makes the demand and creation of newer markets for Bihar paddy in other states difficult. Whereas Bihar winter maize, has been directly competing in yields and production with best performing states such as Andhra Pradesh and Karnataka since late 1990's and has huge demand in these states for feeding cattle and poultry. Overall, we find two contrasting results on prices due to repeal of APMC Act in Bihar. This result is even though we have farmer, plot level panel controls for farmer level heterogeneity in calculating farm harvest prices.

There has been this difference in maize and paddy due to their nature and availability of a steady market and demand for rabi maize in other states and neighboring countries. While paddy in Bihar is grown for self-consumption and does not really have a market or demand outside Bihar, rabi maize of Bihar is competing with major players like Andhra Pradesh and Karnataka for maize in rabi season. While paddy in Bihar is grown for self-consumption and does not really have a market or demand outside Bihar, rabi maize of Bihar is competing with major players like Andhra Pradesh and Karnataka for maize in rabi season.

In spite of repeal of APMC Act in Sept 2006, we do not find evidence for impact on agricultural GDP and prices of agricultural commodities including measure of market efficiency captured as wedge between wholesale and retail prices or the wedge between farm harvest prices and wholesale prices. Except in maize, the small-scale farmers in Bihar, may have been left with fewer options post reform even if they were not using APMC market yards to any substantial extent. The channels of marketing remained the same for most Bihari farmers i.e. to use the current trader dominated system (Intodia, 2011).

The scant literature on agricultural market reforms from different contexts does show potential benefits. Agricultural market reforms in Mali for instance substantially reduced the government budgetary costs and led to an influx of new entrants and a greater reliance on the open market. This also increased competition, combined with better market information leading to lower marketing margins, which benefitted both consumers and producers (Dembele and Staatz ,1999). Yet, the deregulation of dairy market in south Africa increased uncertainty, reduced milk producer profitability and increased exit rates of producers from the industry due to declining real net local prices relative to real total costs over the period (Toit and Ortmann, 2009).

There are various factors that affect the outcomes from agricultural marketing reforms such as fragmentation in marketing channels, infrastructure and policy distortions (Chand, 2012). These also include scale economies in transport and storage, that tend to produce oligopolistic cartels of middleman that provide these services. Irrespective of the marketing reforms, Bihar still has low road and market density in comparison to other states of India. Farmer still relies on the traditional arrangement of a long vertical chain of intermediaries also due to interlinked markets for credit and insurance. Farmers sell their produce to local middleman (kachaarhatiyas/village banias) who resells to wholesale traders, who in turn sell in large mandies to wholesale buyers and retailers. Share of output sold to local private traders in Bihar has dominated all categories of farmers (NSS Situation Assessment Survey of Agricultural Households, 2012). A new regulatory framework and creation of supporting market institution would probably be needed to realize the full benefits of agricultural marketing reforms in Bihar. When it comes to alternative procurement channels and marketing platforms outside the APMC/mandi system, it is worth noting that these new private investments are most likely to come up and remain viable where market development has reached a certain stage of maturity and where basic infrastructure is in place (Chatterjee et al 2020).

Further, for farmers to benefit most from these alternative channels, the presence of strong markets and ideally, a dynamic marketing system with assured demand is vital. This is because alternative procurement platforms, while competing with preexisting mandis, at the same time, peg their transactions to local wholesale prices, infrastructure, and processes (Kapoor and Krishnamurthy 2014). It is for this reason that multi-buyer physical spot markets, especially those where auctions are conducted for farmers' produce, are particularly important for price-setting and discovery. The best option for farmers could be when both the state and private players operate in the market and provide viable options to the farmers responding to the various constraints that farmers face by size, location, and crop choices.

Evidence from Bihar shows that complete withdrawal of state from primary wholesale markets may not help farmers unless it leads to increased private investment and competition. In commodities like paddy, where private sector is less interested in procurement from Bihar, the state withdrawal might even have a small negative effect on farmers' price realization. Understanding the actual structure of agricultural markets in Bihar might help in explaining the limited developmental gains in spite of sustained agricultural growth and deregulation of markets. If actually selling in the mandi is not an option for most Bihari farmers, price information would not enable them to negotiate a better price with the local, village-level traders with whom farmers have long-term bilateral trading relationships (Chatterjee et al 2020).