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An Empirical Investigation of Real Farm Incomes Across Indian States Between 1987-88 and 2011-12

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Abstract

Using unit-level data from various rounds of the Employment and Unemployment Survey of the National Sample Survey Organisation, we present the first consistent time series of average real farm income per cultivator for 18 major Indian states for 1987-88, 1993-94, 1999-00, 2004-05, 2007-08, 2009-10, and 2011-12. Using this data, we study two sets of issues. First, how did real farm income evolve across these 18 Indian states? Which states have high levels and growth rates of real farm incomes? Is there any evidence for convergence of real farm incomes across Indian states? We find evidence for unconditional convergence, which suggests that states with relatively lower farm incomes have, on average, grown at relatively faster rates. But the tendency towards convergence has not been strong enough to change relative rankings of states (by real farm income per cultivator) in any significant way. Second, did the market-oriented reforms of agricultural marketing systems increase real farm incomes? We find that market-oriented reforms did not increase real farm incomes.

Keywords: agricultural income, Indian states, conditional convergence, market-oriented reforms.

JEL Codes: O13; Q1.

Introduction

The glorious year-long struggle of Indian farmers, which forced the BJP-led central government to repeal three controversial farm laws in November 2021, has once again brought the issue of agriculture to the forefront of policy and political discussions in India. One of the issues that need to be thoroughly discussed regarding the agricultural sector in India relates to the question of market-oriented reform of agricultural markets.

In India, a significant part of agricultural marketing has been traditionally organized through state-controlled markets. Since the early 2000s, there has been a move to gradually allow for private capital in agricultural produce markets. One of the primary thrusts of the just-repealed

farm laws was to centrally legislate this move towards privatisation of agricultural produce markets.

Underlying such attempts to allow more space to private capital in agricultural marketing is the notion that moving away from the state-controlled marketing system, i.e. market-oriented reforms of the system, is beneficial to farmers. There is surprisingly little evidence to back this widespread notion. Part of the reason for this lack of evidence is that there does not exist any consistent time series of real farm incomes at the state-level over long periods of time (Chand et al. 2015). Addressing this gap in the literature is the first aim and contribution of this study.

Since the 1980s, Indian agriculture has been characterized by sluggish improvements in agricultural productivity and farm incomes (Foster & Rosenzweig, 2004; Kumar & Mittal, 2006). This, coupled with low rates of public capital formation, rising rural indebtedness and stagnant agricultural wages has contributed to the crisis in Indian agriculture (Chand et al., 2015; Gulati & Bathla, 2001; Narayanamoorthy, 2015; R. S. Chand, 2014). Since the economic liberalization of the 1990s, several commentators have argued that restrictions on prices due to the minimum support price (MSP), lack of competition in the AMPC mandis and restrictions on large corporations from buying directly from farmers are major determinants of rural distress in India (Chand & Singh, 2016; Gulati et al., 2020). Others have focused on the lack of crop diversification, increased reliance on subsidized factor use (primarily fertilizer and water) and the market-distorting public procurement and the Minimum Support Price (MSP) as structural impediments to rapid productivity and income growth in agriculture (Birthal et al., 2015; Joshi et al., 2016; Rao & Gulati, 1994).

Given the regulatory framework governing the sale and marketing of agricultural commodities, the role of the government in regulating the prices and market access for farmers has received considerable scrutiny in the past few years. It is argued that under the highly restrictive provisions of the Agricultural Produce and Markets Commission (APMC) Act of 1930s and the Essential Commodities Act of 1955, the ability of private players to transport, purchase, store and export food grains is stymied (Chatterjee & Kapur, 2016; Purohit et al., 2017). While these regulations were intended to ensure that farmers could be paid a high price, by restricting market access and competition, the mandi system ended up reducing mutually beneficial open market transactions which kept farm incomes depressed in many states. However, recent empirical research using secondary data and ethnographic studies on state and national level data on prices, procurement and market access has revealed the monopsonistic and spatially segregated nature of agricultural markets where the MSP and actual procurement by licensed buyers in the mandis, not only provide an income safety net for farmers but also serves as a price floor necessary for farmers to negotiate a higher price from private players outside the mandis (Chatterjee et al., 2020; Chatterjee & Krishnamurthy, 2021)

Following the farmer's protests last year, the political discourse around farm laws has focused primarily on issues of procurement, MSP, and the ability of large corporations to buy agricultural produce directly from farmers. However, reforming the agricultural sector consists of a broad range of policy recommendations including contract farming, rationalization of farm taxes and

subsidies, direct sale to private sector firms outside the mandis, excluding fruits and vegetables from the purview of the mandis and allowing e-trading of agricultural goods (Chand & Singh, 2016). Most of these reforms were outlined in the model APMC Act of 2003. Since agriculture is a state subject, the implementation of this Act was left to the states which selectively enacted provisions of this Act in the subsequent decade.¹ The Model APMC Act of 2003 provided a broad framework for states to adopt far reaching reforms aimed at increasing market access. The rationale behind these policy suggestions was that an increase in the number of *potential* buyers would generate greater competition and raise prices for the farmers (Ghosh, 2013). Further, this would also reduce the reliance of farmers on the MSP and allow them to diversify away from food crops like wheat and rice.

While farmers have objected to several provisions of these reforms, their primary opposition has been towards two proposed changes. First, farmers have opposed the deregulation of the mandis and the delicensing of commission agents in the regulated markets. Second, farmers have demanded a retention of the MSP and guarantees of procurement by the state. These provisions of the earlier farm laws were amended by the BJP government in September 2020. While the government assured farmers that the de jure provisions of the three new farm laws would not impact government procurement and MSP, farmers argued that the laws would de facto eliminate the MSP by reducing government procurement.

The farm laws and the farmer protests against them have sparked a heated debate on whether APMC mandis and public procurement at the MSP provide farmers with an income safety net or whether these regulations create inefficiencies and keep farm incomes depressed. Several commentators have argued for decades that sectors of the Indian economy like the manufacturing sector which were not sufficiently liberalized have performed worse than the services sector which were deregulated. In the context of agriculture, the existing regulatory framework of controlling prices led to created food shortages and distorted incentives (Mehta, 2013). Chand and Singh (2016) argue that lack of reforms in the agricultural sector contributed to low and cyclical growth rates and greater concentration of poverty in this sector in comparison with the reformed non-agricultural sector. However, these comparisons are not based on causally testing the impacts of reforms on the incomes and growth rates between sectors. The wide variation in state-level agricultural policies and regulatory frameworks between 1987 - 2012 provide us with a quasi-experimental setting to test whether agricultural reforms actually contributed to higher farm incomes?

Even before the new central farm laws of 2020, several states had been reforming their agricultural regulations to dilute the role of mandis as the predominant sites of wholesale trade and allowing large agribusinesses, supermarkets and other private players to buy directly from farmers outside the APMC framework. Using this variation in the timing and status of agricultural reforms between states, we can evaluate the causal impact of agricultural reforms on farm incomes. Using a new dataset of real farm incomes between 1987 - 2012, this paper analyzes

¹ The next section provides an overview of the progress in reforms across the states. For a full history of APMC Reforms see (Purohit et al., 2017; Chand, 2016).

trends in agricultural income between states and investigates whether state-level reforms impacted farm incomes in India.

In this paper, we present, to the best of our knowledge, the first consistent time series of average real farm incomes for 18 large Indian states from 1987-88 to 2011-12. Using this newly constructed data, we study the evolution of farm incomes across states, looking both at their levels and growth rates over time. To summarize the relative performance of states over the roughly two-and-a-half-decade period, 1987-88 to 2011-12, we rank states by the average level of real farm income and by growth rates. Punjab, Haryana, Kerala, West Bengal and Tamil Nadu are the 5 top states in terms of the average real farm income per cultivator in 2011-12; in terms of the average annual growth rate of real farm income per cultivator between 2004-05 and 2011-12, the top 5 states are Rajasthan, Tamil Nadu, Kerala, West Bengal and Haryana. We also investigate whether there has been any tendency for convergence of real farm incomes across states. We find that there is evidence of convergence of real farm incomes across Indian states once we condition on time-invariant state-level factors. But the tendency towards convergence has not been strong enough to change the ranking of states in terms of real farm income per cultivator drastically. States with the highest levels of real farm income per cultivator in 1987-88 were more or less the same states which had the highest level of real farm income per cultivator in 2011-12.

The second aim of this paper is to investigate whether market-oriented reforms of the state-controlled agricultural marketing system have led to an increase in real farm incomes. Our analysis uses a simple difference in difference (DD) research design. Using archival data compiled from the Annual Reports from the Ministry of Agriculture and Farmer's Welfare and academic research, we ascertain if and when each state-initiated reform of the state-controlled agricultural marketing system. All states which initiated reforms are categorized as part of the treatment group; all states that did not undertake any reforms become part of the control group. By comparing the change in average real farm income before and after reforms between treatment and control groups, we are able to estimate the effect of the reforms. Our analysis shows that market-oriented reforms did not have any positive impact on real farm incomes.

The rest of the paper is organized as follows: in the next section, we discuss our data sources and construction of key variables; in the following section, we discuss the results of our analysis; in the last section, we conclude the discussion with some thoughts about future research. In two appendix tables, we present the full time series of nominal and real farm incomes and related variables, both in aggregate and per person terms, and hope this will be of use to other researchers, commentators and policy makers. In a third appendix table, we compare our estimates at the national level with those of Chand et al (2015). Our estimates are slightly different from those in Chand et al (2015) both because of differences in our estimates of nominal incomes and our estimates of the consumer price index. In a fourth appendix, we present our estimate of an index of crop diversification for the 18 states in our sample.

Data and Methodology

The key variable for our analysis is average real farm income per cultivator at the state level. Average real farm income per cultivator gives one of the most accurate measures of the material well-being of the average farmer in a state. To construct this variable, we define farm income as the difference between value added in agriculture and the total wage bill, i.e. for any state and year, $\text{farm income} = \text{value added in agriculture} - \text{total wage bill}$. We deflate nominal farm income by the consumer price index for rural labourers (CPIRL) to get real farm income. Finally, we divide real farm income by the total number of cultivators in a state to get real farm income per cultivator in that state.

Value Added

We construct a consistent time series of state-level value added in agriculture at current prices in two steps.

First, we extract data on value added in agriculture from Table 6, Components of Net State Domestic Product at Factor Cost by Industry of Origin (at current prices) from the 2004-05 Handbook of Statistics on Indian Economy (available on the website of the Reserve Bank of India).² This table gives two value added series, an old series with base year 1980-81 and a new series with base year 1993-94. The unit of measurement is rupees crore. We take the 1980-81 base year series data for the years 1980-81 to 1993-94; we take the 1993-94 base year series data for years 1993-94 to 2004-05. For each year we compute the growth factor of value added in agriculture as the ratio of value added in a year and value added in the previous year. Thus, we get an annual growth factor series (for value added in agriculture) that runs from 1980-81 to 2004-05.

Second, we extract data on value added in agriculture from Table 6, Components of Net State Domestic Product at Factor Cost by Industry of Origin (at current prices), from the 2012-13 Handbook of Statistics on Indian Economy (available on the website of the Reserve Bank of India). This table gives value added series with base year 2004-05 in rupees billion. Data are provided for the years from 2004-05 to 2012-13 for most states; for some states, data is available till 2011-12. For these latter states, we take the figure for 2012-13 from Table 6 in the 2013-14 Handbook of Statistics on Indian Economy. The unit of measurement of this data is rupees billion. So, we multiply it by 100 to express it in crores of rupees.

Our value-added series for agriculture uses the figures with base 2004-05 for the years 2004-05 to 2012-13, and then we project the series backward from 2003-04 to 1980-81 using the growth factor series that we calculated in the first step. This gives us a consistent state-level value-added series for agriculture at current prices at an annual frequency running from 1980-81 to 2012-13.

² The reader should note that we focus on agriculture and not the agriculture and allied activities sector. The latter includes three sub-sectors: agriculture, forestry & logging, and fishing. Thus, we do not add the value added coming from forestry, and logging & fishing.

Total Wage Bill

We construct a state-level series for the total wage bill in agriculture using unit level data from the Employment and Unemployment Survey (EUS) conducted the NSSO for the 43rd round (1987-88), the 50th round (1992-93), the 55th (1999-00), the 61st round (2004-05), the 64th round (2007-08), the 66th round (2009-10) and the 68th round (2011-12). The total wage bill in a state is defined, for any EUS year, as the sum of total wages earned by agricultural laborers in a year.³ Data on average daily wage rate for agricultural workers, average number of days worked per week by agricultural workers and total number of agricultural workers is extracted from the EUS.⁴

Real Farm Income per Cultivator

We compute the state-level farm income as the difference between value added in agriculture and the total wage bill. To convert nominal farm income into real, or inflation-adjusted, farm income, we divide the nominal magnitude by the state-level consumer price index for rural labourers (CPIRL, published by the Labour Bureau of India). We divide this by the total number of cultivators to get real farm income per cultivator, where data on the total number of cultivators is extracted from the EUS.⁵

Reform Variable

Several states have been reforming their APMC Laws and agricultural policies since the early 2000s. For instance, Madhya Pradesh introduced alternative marketing channels and invested in internet-based price dissemination systems for soy farmers (Goyal, 2020). The state also allowed large private corporations like ITC to procure directly from farmers through single license yards outside the mandis (Krishnamurthy, 2021). The scale and scope of these reforms accelerated after the Model APMC Act was passed in 2003. To take another example, in 2006, Bihar completely abolished the APMC mandi system and forced farmers to sell to private buyers without any price support (Kishore et al., 2021). Similarly, Gujarat also implemented all reforms and reduced actual procurement in 2006.⁶

³ Using the weekly employment status of workers reported in the EUS Rounds of the NSS, we calculated the weekly agricultural wage bill by multiplying the average weekly wage for agricultural workers with the total number of agricultural workers. This weekly wage bill is then multiplied by 52 (number of weeks in a year) to calculate the total wage bill in a year.

⁴ In the EUS unit level data, a person is identified as an agricultural worker if she worked as a regular or casual employee in agriculture. For instance, in the 68th round of EUS, her “status” code was 31, or 51, and her “industry” code was 01.

⁵ In the EUS unit level data, a person is identified as a cultivator if she worked in a household enterprise (self-employed) in agriculture. For instance, in the 68th round of EUS, her “status” code was 11, 12 or 21, and her “industry” code was 01.

⁶ Except adopting the Model Land Lease Law which would allow land concentration and acquisition by large corporations (Ramesh Chand & Singh, 2016).

Other states like Andhra Pradesh, Assam, Karnataka, Maharashtra, Rajasthan and Haryana partially implemented the reforms where they allowed mandis to operate but also allowed farmers to sell in open markets including trading in various e-markets across the country (Aggarwal et al., 2017; Ramesh Chand & Singh, 2016; Ghosh, 2013). At the other end of the spectrum were states like Punjab, Tamil Nadu, Tripura, Kerala, and West Bengal, where none of the marketing reforms proposed by the APMC Act of 2003 were adopted. Uttar Pradesh initially adopted the reforms in 2004 but following widespread opposition from farmer organizations, the government withdrew the reforms (Ghosh, 2013).

The existing literature tracks reform progress along several parameters including contract farming, decentralizing sales by setting up of private mandis, single license for state-wide traders, rationalizing of taxes on agricultural commodities, extension of e-trading facilities and joining the e-NAM initiative by linking mandis to the national electronic trading portal (Purohit et al., 2017). Chand and Singh (2016) rank Maharashtra, Gujarat and Rajasthan as the top states implementing market friendly reforms while Jammu Kashmir, Tamil Nadu and Uttarakhand are among the worst performing states on their reform index.

Most states have made some efforts to expand e-trading and use of technology enabled price dissemination services in the last decade. The major difference between state-level policy framework exists in the role of APMC mandis as the primary site of transactions between licensed buyers and farmers. Further, the primary opposition of farmers to the September 2020 Farm Law Amendments also revolved around the role of APMC mandis, licensed agents (*arhtiyas*) and the MSP. Correspondingly, this paper focuses on state-level reforms that diversified markets for farmers and reduced the ability (dependence) of farmers to sell in APMC mandis. We construct a binary reform variable that takes the value 1 if farmers could sell to private players (either exclusively or along with APMC mandis) and 0 otherwise.

To construct this reform variable, we conducted archival research of state-level policies by analyzing various annual reports of the Ministry of Agriculture and Farmer's Welfare, academic research, and newspaper articles. There were two main objectives of this research. First, to ascertain whether farmers sold primarily in the APMC mandis or whether they were free to sell directly in the market. Second, whether the state government had reformed the previous APMC Act, and if it did, to ascertain the year in which this change took effect? The process of classifying states into reform (treatment) and non-reform (control) states is described below.

The reform status for some states was easy to infer. For instance, Bihar completely abolished the APMC system in 2006 (Kishore et al., 2021) and states like Maharashtra and Gujarat have introduced many significant policy changes to reduce the primacy of mandis and deregulate the entry of private corporations. Correspondingly, these states have scored well on all published reform indices. There is general consensus in the literature that these states are top reformers in the country. On the other hand, states like Tamil Nadu, Kerala and Jammu and Kashmir have not adopted the Model APMC reforms. Likewise states like Punjab and West Bengal have not altered their mandi system. Correspondingly, these states have been classified as states in the control group.

For other states like Uttar Pradesh, Assam, and Tripura, assigning the reform classification was not straightforward. We relied extensively on academic research, published reports, newspaper articles and ethnographic research to determine whether farmers in these states had access to mandis or not (R Chand, 2020; Ramesh Chand & Singh, 2016; Ghosh, 2013; Purohit et al., 2017). For states like Odisha, Karnataka and Madhya Pradesh which developed a hybrid marketing system we defined the reform variable based on academic studies and reports. For instance, Chatterji et al.(2020) document the pluralistic market system in Odisha which includes multiple licensing authorities, private markets, and Regulated Market Committees (RMCs). Correspondingly, mandis are not the only sites for exchange. Based on this evidence, we classified Odisha as a reform state. Similarly, the significant progress made by Karnataka in expanding market access for private corporations and linking their markets to e-NAM initiatives are well documented in the literature (Aggarwal et al., 2017). Madhya Pradesh's economic reforms, infrastructure development and robust public procurement system are identified as major drivers of its rapid agricultural growth between 2005 – 2015 (Gulati et al., 2017). Similarly, Haryana also implemented several market-oriented reforms since 2006 but continued a robust system of government procurement of both wheat and rice. Since farmers in both these states could sell in the open market and in APMC mandis we classify these as reform states in this paper.

Finally, for states that were classified as reformed, assigning the date of reform implementation was another challenge. The Annual Reports published by the Ministry of Agriculture and Farmer's Welfare since 2016 report details of reform status for most states. However, these Reports do not provide information on the timing of these reforms. In order to assign the reform year, we relied on extant literature and newspaper reports. For instance, Madhya Pradesh had allowed private corporations to buy directly from farmers since 2000 (Goyal, 2020). However, it was only by 2004 that warehouses facilitating direct sales to private buyers were established in the state. Correspondingly, we assign 2004 as the date of marketing reforms for Madhya Pradesh.⁷ Similarly, Ghosh (2013) documents a history of APMC reforms for several states which helps us assign treatment dates for Andhra Pradesh, Assam, and Himachal Pradesh.

Table 1 presents the reform status for each of the 18 states analyzed in this paper. This table also lists the major source of archival information on the reform status and timing. Our reform variable can be compared to the composite reform index constructed by Chand and Singh (2016) and Purohit et al.(2017). While these papers present an index of reform focusing on various parameters, we restrict our analysis to the reforms pertaining to market access and the functioning of AMPCs in states. Our reform variable is comparable to Chand and Singh (2016) for all states except Assam, and Odisha.

[Table 1 about here]

⁷ In 2004, APMC mandi traders organized a month-long protest to oppose the single license hubs established by ITC (Krishnamurthy, 2021). The timing of the protest suggests that the policy framework and infrastructure necessary to implement marketing reforms would have been established by 2004 which allows us to assign the treatment date for Madhya Pradesh.

The major difference relates to the actual procurement and functioning of the mandis. For instance, Assam and Odisha score only 37 and 28 on a 100-point reform scale constructed by Chand and Singh (2016). However, our research suggests that farmers in these states do not predominantly rely on APMC mandis to sell their crops and private markets have been operational in these states for over a decade. While these states have reformed their agricultural marketing system, they have not made significant progress in expanding their e-trading infrastructure and have not joined the e-NAM initiative which may account for their low scores on the composite reform index (Ramesh Chand & Singh, 2016). Since these states allow for direct sale by farmers, we are classifying them as reform (treatment) states for this analysis.

Results

In Table 2, 3 and 4, we present estimates of the level and growth rate of average annual farm income (agricultural income per cultivator) for 18 major Indian states in 1987-88, 1993-94, 1999-00, 2004-05 and 2011-12.

[Table 2 about here]

Table 2 presents estimates of the level of farm income in nominal terms (income evaluated in current prices); Table 3 presents estimates of the level of farm income in real terms (income evaluated in 2004-05 prices). Both tables have ranked states by the level of income in 2011-12. In Table 4, we present estimates of the average annual growth rate of real farm income for four periods: 1987-88 to 1993-94, 1993-94 to 1999-00, 1999-00 to 2004-05, and 2004-05 to 2011-12. States are ranked, in Table 4, by the average annual growth rate of real farm income over the period 2004-05 to 2011-12. While we provide estimates of the level of farm income in nominal terms for completeness, we will mostly comment on the level and growth rate of *real* farm income that is presented in Table 3 and 4.

Before we turn to discussing our estimates of real farm income at the state level, we would like to briefly compare our estimates with those presented in Chand et al (2015). Since Chand et al (2015) present only national-level estimates, we have computed national-level estimates of total farm income. The results are presented in Appendix Table 3. For all years, our estimate of total farm income in current prices is lower than the corresponding figure in Chand et al (2015). Our estimates of national level values of the CPIRL are also slightly different from those used in Chand et al (2015). These two differences lead to different estimates of total farm income in 2004-05 prices. For instance, Chand et al (2015) report that total real farm income at the national level was 224858 crores in 1987-88; our corresponding estimate is 254548 crores. Chand et al (2015) report that total real farm income at the national level in 2011-12 was 625536 crores; our corresponding estimate is 592629 crores. Thus, while Chand et al. (2015) estimate shows that total real farm income increased by 178% over this period, our estimates show that it increased by 133%.

There are three reasons behind the difference in our estimates from those reported in Chand et al (2015). First, our estimate of total farm income adds up farm income only over the 18 major states that we include in our sample. Chand et al (2015) add up the corresponding figure for all states. This can account for the lower figure of total nominal farm income that we report. It is not clear why our number for 1987-88 is higher than those of Chand et al (2015). Second, in a similar manner, our national-level CPIAL numbers are the average of state-level numbers, where the average is over the 18 major states in our sample. This can account for the differences in our CPIAL estimates from those of Chand et al (2015). Third, one of the older series that we use is the CPI for rural labourers, rather than agricultural labourers. This might account for a slight difference too. But, overall, our CPI series captures price movements in the same way as the CPI series in Chand et al (2015). For instance, Chand et al. (2015) note that between 1983 and 2011, inflation averaged around 6.9%. According to our data, inflation between 1987 and 2011 is (roughly) 6.5%. Thus, while it is important to keep the differences in mind, it needs to be noted that overall national-level trends reported in Chand et al (2015) are similar to what we have reported in this paper. What we add to the discussion, of course, is a consistent series of farm incomes at the state-level, something that Chand et al (2015) do not report or comment on.

Level of Real Farm Income

We now turn to discussing our results on state-level real farm incomes. From Table 3, we see that the top 5 states in terms of average real farm income in 2011-12 were Haryana, Punjab, Kerala, West Bengal and Tripura. Measured in 2004-05 rupees, the level of average farm income in these top 5 states were 158249 (Haryana), 118902 (Punjab), 86181 (Kerala), 81096 (West Bengal), and 79727 (Tripura). It is interesting to note that, other than Haryana, none of the other top states have initiated any market-oriented reforms of their agricultural marketing systems since the early 2000s. However, the FCI and the state government continued to procure both wheat and rice at the MSP from Haryana in significant proportions. For instance, according to the data from the Food Corporation of India, around 62 percent of wheat and 73 percent rice produced by the state was procured in 2011-12. This procurement by the government would have created a price floor for farmers to negotiate higher prices in the market and leverage the reforms to their advantage.

[Table 3 about here]

If we turn to the other end of the distribution, we see, from Table 3, that the bottom 5 states in terms of average real farm income in 2011-12 were Bihar United (Bihar + Jharkhand), Karnataka, Madhya Pradesh United (Madhya Pradesh + Chhattisgarh), Maharashtra and Assam. Measured in 2004-05 rupees, the level of average farm income in these bottom 5 states were 19100 (Bihar United), 26718 (Karnataka), 27564 (Madhya Pradesh United), 28277 (Maharashtra), and 30383 (Assam). Not only have these states adopted several reforms

suggested by the Model APMC Act of 2003, none of these states witnessed any significant procurement of wheat and rice in 2011-12 with the exception of Madhya Pradesh.⁸

Using the level of average real farm income in 2011-12, we can categorize these 18 states into three groups. The first group-the top group-consists of states where average real farm income in 2011-12 was more than 75,000 rupees per annum (in 2004-05 prices). This group consists of Haryana, Punjab, Kerala, West Bengal and Tripura. The second group-the middle group-consists of states where average real farm income in 2011-12 was between 35,000 and 75,000 rupees per annum (in 2004-05 prices). This group consists of Tamil Nadu, Gujarat, Andhra Pradesh, Rajasthan, Jammu & Kashmir and Himachal Pradesh. The third group-the bottom group-consists of states where average real farm income in 2011-12 was below 35,000 rupees per annum (in 2004-05 prices). The members of this group are Uttar Pradesh United, Odisha, Assam, Maharashtra, Madhya Pradesh United, Karnataka, and Bihar United.

Growth Rate of Real Farm Income

From the results presented in Table 4, we see a wide range of performance in terms of the average annual growth rate of real farm income.

[Table 4 about here]

Using the average annual growth rate of real farm income in the period from 2004-05 to 2011-12, the latest period for which we have data from NSS employment surveys, we can divide the states into three groups.

The top group of growth performers is defined as states where average real farm income increased by more than 10 percent per annum over the period from 2004-05 to 2011-12. The states which belong to this group are Haryana, Rajasthan, Tamil Nadu, Kerala, and West Bengal. It is interesting to note, much in line with the trend in terms of levels of real farm income, that other than Haryana, none of the other top states in terms of growth rates have initiated any market-oriented reforms of their agricultural marketing systems since the early 2000s.

The middle group of growth performers is defined by states which saw average real farm incomes rise between 2004-05 and 2011-12 by between 5 and 10 percent per annum. The states which belong to this group are Uttar Pradesh United, Bihar United, Gujarat, Odisha, Punjab, Andhra Pradesh, Madhya Pradesh United, Maharashtra, Himachal Pradesh, Tripura and Assam.

⁸ Authors' calculations based on data from the Food Corporation of India

The bottom group of states in terms of growth performance consists of states where average real farm incomes grew by less than 5 percent per annum between 2004-05 and 2011-12. Two states belong to this group: Karnataka and Jammu & Kashmir.

Are States Catching Up in Terms of Real Farm Income?

As we can see from Table 3 and 4, there is large variation across states in terms of both levels and growth rates of average real farm incomes per cultivator. A natural question that emerges in this context is whether there is any tendency for average real farm incomes per cultivator to converge across states. If states with relatively low real farm incomes were to grow, on average, at higher rates than states with relatively high real farm incomes, then levels of real farm incomes would converge over time.

To investigate the question of convergence of average real farm incomes across states, we borrow from the standard framework used to study beta convergence in growth economics. In panel data growth empirics using country-level data, the issue of beta convergence is studied in terms of a regression model where the dependent variable is the growth rate of per capita income over some period and the key regressor is the initial level of per capita income at the start of the period. The coefficient on the level of initial per capita income is “beta” and captures the evidence of convergence. If “beta” is negative and statistically significant, that shows that countries with relatively low levels of initial per capita income have relatively higher growth rates. Hence, countries with low levels of income will have a tendency to catch up with countries with high levels of per capita income.

Using this framework, we specify the following regression model to study convergence of real farm incomes across Indian states,

$$(1/\tau)[\log(y_{st}) - \log(y_{s,t-\tau})] = \beta * \log(y_{s,t-\tau}) + \alpha_s + \varepsilon_{st} \quad (1)$$

where y_{st} is the level of real farm income in state s in period t , so that the dependent variable is the average growth rate of real farm income between period $t - \tau$ and period t , the key regressor is the log-level of real farm income in period $t - \tau$ (initial period), α_s are state fixed effects and ε_{st} is a stochastic error term.

Our interest is in the parameter β , which will tell us if there is any evidence of convergence. If the value of β is nonnegative, then we can conclude that there is no evidence of convergence. On the other hand, if the value of β is negative and statistically significant, then it implies a tendency towards convergence. This is because a negative value of β means that states with relatively low levels of average real farm income in period $t - \tau$ (initial period) grow at relatively higher rates over the subsequent period from $t - \tau$ (initial period) to t (final period) than states with relatively low levels of real farm income in period $t - \tau$.

Table 5 presents the estimate of β for our sample of 18 (N=18) states with 7 time periods (1987-88, 1993-94, 1999-00, 2004-05, 2007-08, 2009-10, 2011-12) for three different specifications. In the first specification, the only regressor is the log level of real farm income in the initial period; we do not include state or year fixed effects. In the second specification, we add state fixed effects to condition on time invariant state-level factors; in the third specification, we add state and period fixed effects to condition on both time invariant state-level factors and period-level factors common to all states.

[Table 5 about here]

In the first specification, the estimate of β is negative but statistically insignificant. In the second specification, the estimate of β is -0.090 and statistically significant at the 5 percent level of significance. This means that, once we take account of time-invariant state-level factors like geography, institutions, history and politics, we see evidence of convergence of real farm incomes across states. In the third specification, when we, in addition, control for period fixed effects, i.e. period-specific factors that affect all states in the same way, like developments in international trade and finance or central government policies, then the evidence for convergence becomes even stronger. The coefficient in the third specification is -0.249 and statistically significant at the 0.1 percent level of significance. The evidence in Table 5 shows that, once we control for time-invariant factors, states with relatively low levels of real farm incomes have witnessed higher growth rates of real farm income. Thus, over time, there is convergence in terms of real farm incomes between states.

The positive result about the tendency for convergence of real farm income per cultivator across states and over time must be tempered by the fact that this tendency has been rather weak. The tendency towards convergence has not changed the ranking of states significantly over the years. To see this, let us look at Table 6, where states have been ranked in each year by real farm income per cultivator. From Table 6, we see that the top states in 1987-88 are more or less the same as those in 2011-12. These include Punjab, Haryana, Kerala, and West Bengal. Of course, some states like Gujarat and Karnataka, which were ranked towards the top in 1987-88 have moved down the ranked list over the years. Similarly, the group of states at the bottom of the ranked list has also remained stable, though there is more movement at the bottom than at the top. Bihar has been consistently at the bottom, but there has been some movement and change in ranking for other states at the bottom like Madhya Pradesh, Maharashtra, Uttar Pradesh and Odisha.

[Table 6 about here]

While this paper presents the first systematic analysis of growth rates in *farm incomes* between states between 1987-2012, our results can be compared with existing studies which discuss regional variation in factor productivity, agricultural growth and incomes between states. Mukherjee & Kuroda (2003) discuss trends in total factor productivity between states during 1973 – 1993. While they find no evidence of convergence between high productivity states like Haryana, Punjab and West Bengal and low productivity states like Maharashtra, Andhra

Pradesh Rajasthan, and Tamil Nadu, they predict long-run convergence as each state's productivity gap from the national average remains stationary over time. Given the complementarity between agricultural productivity and poverty reduction (Foster & Rosenzweig, 2004; Johnson, 2000), our results suggest that trends in farm income between 1987 – 2012, follow the trends in total factor productivity predicted by Mukherjee & Kuroda (2003). Similarly, analyzing long-term trends in state-level agricultural productivity Chand et al. (2007) show that low productivity states grew faster than the national average during the 1984 – 1996 period. There is evidence of convergence in per capita agricultural incomes between states during the 1967 - 2010 period (T. Chatterjee, 2017). Further factors like infrastructure development including roads and irrigation and improvements in rural literacy have contributed to spillover benefits of agricultural growth between states.

Crop Diversification

In the next section, we take up the question of the impact of reforms on farm incomes. As we have pointed out above, the existing literature on agricultural growth in India considers crop diversification an important factor that could increase farm incomes. Therefore, we will include crop diversification as an explanatory variable in our regression analysis in the next section. Since crop diversification is an important issue in its own right, we discuss this issue in this section.

As the three farm laws of September 2020 reignited the debate on the role of APMCs and the *potential* benefits of market competition in the agrarian sector, the issue of crop diversification and the over-reliance of farmers on wheat and rice has received significant attention. It is argued that farmers *overproduce* wheat and rice as these are procured by the Food Corporation of India (FCI) at the minimum support price (MSP). Since the MSP is calculated as a mark-up over the cost of production, it creates an income safety net for farmers and insulates them from the volatility of prices in domestic and foreign markets.

Existing research argues that the AMPC system and the dependence of farmers on MSP creates inefficiencies and distorts the market prices for scarce inputs like groundwater and depresses the market price of these crops. These arguments are summarized as follows. First, since wheat and paddy are the primary crops procured by the FCI, farmers overwhelmingly choose to grow these crops. Consequently, there is overproduction of these crops which depresses their market prices. Further increasing farmers' dependence on the MSP. Second, since paddy is a water intensive crop, its procurement by the state and central governments, coupled with rapidly expanding irrigation and power subsidies to farmers is resulting in rapid depletion of groundwater in states like Punjab and Haryana.⁹ Finally, the agrarian distress caused by demonetization and COVID has forced many state governments like Telangana to

⁹ Similar processes are documented for neighboring countries like Bangladesh and Sri Lanka. See Burchfield & Poterie (2018) for a discussion on the impacts of paddy cultivation and challenges faced by cultivators in diversifying in Sri Lanka.

increase procurement of paddy to support farmers. This has considerably increased the fiscal burden of procurement.

Consequently, crop diversification away from wheat and paddy has emerged as a major policy recommendation for raising agricultural incomes (Pratap S. BIRTHAL et al., 2015; Pratap Singh BIRTHAL et al., 2013; Foster & Rosenzweig, 2004; Joshi et al., 2016; Pingali & Rosegrant, 1995). Crop diversification refers to processes that help farmers diversify from paddy (as opposed to completely shifting) to other crops like cash crops (cotton, oilseeds, coffee etc.), high value commodities (vegetables and fruits) and livestock production (including fisheries). Several studies conducted by the International Food Policy Research Organization (IFPRI), World Bank (WB) and economists have investigated the effects of crop diversification on farm incomes, environmental sustainability, and livelihoods of farmers in low-income countries around the world (Kasem & Thapa, 2011; Mazunda et al., 2016; Rahman, 2009; Pellegrini & Tasciotti, 2014; Sichoongwe et al., 2014). These studies suggest that crop diversification helps increase food security but their impact on farm incomes is mediated by the presence of supporting institutions like access to credit and dissemination of technology and knowledge to small and medium farmers.

Using data on agricultural production and area under cultivation for each crop published by the Directorate of Economics and Statistics, we calculate the Herfindahl Index (HI) of Crop diversification for the period between 2000 – 2012 as follows.

$$HD = \sum_i \alpha_i^2$$

where α is the share of the area occupied by the i th crop (Rahman, 2009), i.e. the index is the sum of the squares of the area occupied by each crop in a state-year.

Appendix Table 4 presents the state-level average Herfindahl Index of Crop diversification for each state in the sample except Jammu and Kashmir). A zero value denotes perfect diversification and a value of 1 denotes perfect specialization. The table shows that the index of diversification has not changed significantly between 1999 – 00 to 2011 – 12 for any state. The relative ranking of diversity between states has also remained constant during this period.

In 2011-12, Karnataka had a HI of 0.07 making it the most diversified state in the country. Rajasthan and Maharashtra each were tied in second position at 0.12. On the other end of the spectrum, Odisha, (HI=0.89) was the least diversified state in the country. While geographical and climatic factors may explain high degree of crop specialization in northeastern states like Tripura and Assam (HD 0.86 and 0.55 respectively), states like Punjab, West Bengal and Kerala also demonstrated a high degree of specialization in 2011-12. In general, crop diversification is low in states that have high farm incomes. This suggests that in the absence of supporting infrastructure and financial incentives, farmers continue to rely on crops like wheat and rice as

these may be traded in APMC *mandis*. That is why diversification does not have any positive correlation with farm incomes.¹⁰

Did Reforms Increase Real Farm Incomes?

We turn now to the second main questions investigated in this paper. Did reforms of agricultural marketing increase real farm incomes? The three farm laws of September 2020 reignited the debate about the role of APMCs in improving the livelihoods of cultivators and farm workers. Most studies have focused on how market competition and the entry of large corporations may impact the prices received by farmers (Jodhka, 2021; Krishnamurthy, 2021) and how competition between buyers and greater flexibility in selling outside the *mandis* may benefit the farmer (S. Chatterjee & Kapur, 2016; Gulati et al., 2020).

Existing studies suggest that composite market-oriented reforms may benefit agricultural growth and production (Purohit et al., 2017). However, these impacts are driven by reductions in transaction costs and greater technology adoption. The literature suggests that variations in farm prices have been a critical determinant of agricultural growth (Mathur et al., 2003). Further, persistent variation in prices between *mandis* within a state suggests that public procurement at MSP may be an important determinant of farm incomes received by cultivators (S. Chatterjee & Kapur, 2016). However, few studies have presented a causal analysis of marketing reforms on farm incomes and this paper aims to address this lacuna.

To answer this question, we use a difference in difference (DD) research design. The DD research design compares treatment and control groups before and after some policy intervention or event and thereby comes up with a reliable estimate of the effect of the policy intervention.

For the question of interest in this study, the policy intervention in question is market-oriented reforms of state-regulated agricultural markets in the early 2000s. The treatment group consists of states where such reforms occurred; the control group consists of states where such reforms have not been undertaken. Using archival research, we have identified the year in which such reforms occurred in states which belong to the treatment group.

Our DD model has the following specification:

$$y_{st} = \beta * TREAT_s * AFTER_t + \alpha_s + \delta_t + Controls_{st} + \varepsilon_{st} \quad (2)$$

where $s = 1, 2, \dots, N$, and $t = 1, 2, \dots, T$, index states and time periods, respectively, y_{st} denotes the level of average real farm income in state s in period t , $TREAT_s * AFTER_t$ is a dummy variable that takes the value 1 for state s and period t if that state undertook market-oriented reforms in period t or before, α_s denotes stater fixed effects, δ_t denote period fixed effects, *Controls* stand for control variables and ε_{st} denotes a stochastic error term.

¹⁰ A regression of real farm incomes on the crop diversification index, after controlling for state and year fixed effects, shows that coefficient on the diversification index is positive but statistically insignificant.

Our interest is in the parameter β , which provides an estimate of the effect of market-oriented reforms on real farm incomes by comparing the change in real farm incomes before and after reforms between treatment and control groups. To be more specific, β gives us the difference in the change in real farm incomes before and after market-oriented reforms in those states which did undertake reforms (the treatment group) and in those states that did not undertake market-oriented reforms (the control group).

If β is positive, then states that undertook market-oriented reforms would have seen an increase in real farm incomes in comparison to states that did not undertake reforms. This would be evidence of the positive impact of reforms. If, on the other hand, β is nonpositive, then that would be evidence of a lack of positive impact of the reforms on real farm incomes.

This “difference-in-difference” estimator gives us a true estimate of the effect of market-oriented reforms under the assumption that the two groups of states would see similar changes in real farm incomes if reforms had not been implemented. This is the crucial parallel trends assumption and we provide some evidence below that it is satisfied in our analysis.

Results of estimating equation (2) are presented in Table 7. We present results for four different specifications. In the first specification, in addition to the treatment variable, we include state and period-specific fixed effects to control for unobserved state-specific time-invariant factors (like historical trajectories, geographical factors, deep cultural factors that change only very slowly, etc.) and period-specific factors that affect all states (like central government policies, developments in the international commodity markets, etc.). In the second specification, we add the log level of real per capita net state domestic product to control for different levels of economic development across states. In the third specification, we add the state-level tax and non-tax revenue (as a share of state-level gross domestic product), to control for the possibility that differential pre-treatment trends are driven by the fiscal capacity of states to support agricultural growth. In the final specification, we add the crop diversification index to control for possible positive effects of diversification on farm incomes, a factor that has received quite a lot of attention in policy discussions of Indian agriculture.

[Table 7 about here]

If we see the result in the first column of Table 7, we see that the coefficient on the interaction of $TREAT_s$ and $AFTER_t$ is negative (-4.437) but it is not statistically significant. This means that once we control for unobserved state-specific and period-specific factors, there is no statistically significant effect of the market-oriented reforms. If anything, the effect is negative, though that effect is not statistically distinguishable from zero. Even after we control for per capita net state domestic product, tax and nontax revenues and the degree of crop diversification, the coefficient remains negative and statistically insignificant, as can be seen from columns 2, 3 and 4 in Table 7. Taken together, the evidence for the DD research design presented in Table 7 shows that market-oriented reforms of agricultural marketing systems across Indian states did not improve real farm incomes per cultivator.

The validity of the DD research strategy rests on the parallel trends assumption, as we have noted above. Intuitively, the parallel trends assumption means that the control and treatment groups of states would see similar changes in real farm incomes if agricultural market reforms had not been implemented in the treatment group of states.

We test the parallel trends assumption following the method in Muralidharan and Prakash (2017) by estimating the following regression model:

$$y_{st} = \beta * TREND_t + \alpha_s + Controls + u_{st} \quad (3)$$

where $s = 1, 2, \dots, N$, and $t = 1, 2, \dots, T$, index states and time periods, respectively, y_{st} denotes the level of average real farm income in state s in period t , $TREND_t$ is a linear time trend, α_s denotes stater fixed effects, *Controls* stand for control variables and u_{st} denotes a stochastic error term.

[Table 8 about here]

To test the parallel trends assumption, we estimate model (3) for all pre-market reform years, i.e. for years 1987-88, 1993-94 and 1999-00. The estimate of β in model (3) can be seen in Table 8. The coefficient is -0.435 but its magnitude is statistically insignificant. Thus, once we condition on unobserved time-invariant state-level factors, state-level per capita net state domestic product and the share of tax and nontax revenue in state-level gross domestic product, we see that the evolution of real farm incomes per cultivator was no different in treatment than in control group states. This is evidence in favour of the parallel trends assumption, the key identifying assumption for the validity of the DD research design.

Conclusion

In this paper, we have presented the first consistent time series of average real farm income per cultivator for 18 major Indian states for the years 1987-88, 1993-94, 1999-00, 2004-05, 2007-08, 2009-10 and 2011-12.

In two appendix tables, we present the full time series of farm income and related variables. In appendix table 1, we present our estimates of agricultural value added, total wage bill in agriculture and total farm income in agriculture, both at current and constant (2004-05) prices. We also present data on the number of agricultural workers and cultivators. Using these data, we compute total wage bill per agricultural worker and total farm income per cultivator, both at current and constant prices. Data on these four series are presented in appendix table 2 for all the 18 states and for all the years in our sample. We hope these data will be of use to other researchers working on Indian agriculture.

Using these newly constructed data, we analyze the evolution of real farm income per cultivator across states. We find that Punjab, Haryana, Kerala, West Bengal, and Tamil Nadu are the top five states in terms of real farm income per cultivator in 2011-12. In terms of average annual growth rate of real farm income per cultivator between 2004-05 and 2011-12, the top five states are Rajasthan, Tamil Nadu, Kerala, West Bengal, and Haryana. While we do see some evidence for convergence of real farm incomes across states, this tendency has not been strong enough to change state rankings drastically, especially at the top of the ranked list of states.

Other than Haryana, none of the states at the top of the ranked list have initiated market-oriented reforms of the agricultural marketing systems. This suggests that the market-oriented reforms might not have been beneficial to the average farmers. To investigate this question more rigorously, we used a difference-in-difference research design. We compared the change in real farm incomes before and after reforms between states that did and those that did not undertake reforms. Our analysis shows that market reforms did not raise real farm incomes per cultivator.

The year-long farmer protests may have succeeded in protecting the existing APMC *mandis* and ensuring that farmers continue to sell food grains at the MSP. However, the debate over AMPC reforms is far from over. The estimates and trends in farm incomes presented in this paper suggest that structural challenges faced by India's agricultural sector need urgent attention. Table 2 shows that the average annual farm income in the top five states in 2011-12 was INR 1,04,831 in real terms. The corresponding figure for the bottom five states was only INR 26,408. Further, the results presented in this paper suggest that sweeping reforms including the abolition of AMPCs and dismantling of the price support offered by government procurement at the MSP may not raise farm incomes for cultivators. In recent months, several authors have suggested policy reforms pertaining to greater market access, infrastructure development, crop diversification to help protect farmers from price volatility inherent in agriculture. However, the evidence suggests that we need to revisit the policy framework for the rural economy.

Based on our understanding of the evidence, we would conclude with three policy recommendations emerging from this analysis. First, the MSP coupled with actual procurement is pivotal in providing farmers with a price floor necessary for price negotiations. Most states with high farm incomes like Punjab, Haryana and West Bengal have robust procurement systems. Second, the number of APMC *mandis* need to be expanded and not dismantled. This would address issues of low accessibility, storage and low farm gate prices faced by small and marginal farmers. Finally, asymmetry in the bargaining power of farmers vis-à-vis corporations should be acknowledged and addressed in any new policy reform aimed at improving farmer incomes in India.

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Table 1: Marketing Reforms Across States			
State	Marketing Reform (1=farmers can directly market produce)	Date of Reform	Primary Source
Andhra Pradesh	1	2005	Ghosh (2013)
Assam	1	2006	Ghosh(2013) and Purohit et al.(2017)
Bihar United	1	2006	Kishore et al.(2021)
Gujarat	1	2006	Ministry of Agriculture and Framer's Welfare. <i>Annual Reports</i>
Haryana	1	2006	Ministry of Agriculture and Framer's Welfare. <i>Annual Reports</i>
Himachal Pradesh	1	2005	Ghosh (2013)
Jammu & Kashmir	0		Chand (2020), Indian Express
Karnataka	1	2007	Agarwal et al.(2016)
Kerala	0		Chand (2020), Indian Express
Madhya Pradesh United	1	2004	Krishnamurthi (2012) Goyal (2020)
Maharashtra	1	2006	Ghosh (2013)
Odisha	1	2006	Chatterji et al.(2020)
Punjab	0		Chatterji et al.(2020)

Rajasthan	1	2007	Ministry of Agriculture and Framer's Welfare. <i>Annual Reports</i>
Tamil Nadu	0		Purohit at al.(2017)
Tripura	0		Chand and Singh (2016)
Uttar Pradesh United	0		Ghosh (2013)
West Bengal	0		Ghosh (2013)

Table 2. Average Annual Agricultural Income Per Cultivator (Rs, at current prices)					
State	1987-88	1993-94	1999-00	2004-05	2011-12
Punjab	20309	41848	59050	70770	235408
Haryana			48972	47685	184900
Kerala	14494	21329	33859	40019	152226
West Bengal	11205	15681	35891	38534	148005
Tamil Nadu	7124	13166	17392	24555	111538
Andhra Pradesh	7976	13062	21100	32545	102867
Gujarat	13460	16753	9448	29483	101719
Rajasthan	6729	11890	15424	19111	96434
Tripura			-11056	49952	93426
Jammu & Kashmir	7736	40946	20024	44204	71798
Uttar Pradesh United	5359	9409	13721	17116	59536
Odisha	6741	8376	9126	18292	57748
Maharashtra	6632	12707	12177	17303	57336
Assam	7925	10072	18423	20540	56502
Karnataka	10487	15086	26050	24319	55331
Madhya Pradesh United	5508	9300	8072	16844	52175
Himachal Pradesh			13991	22226	40966
Bihar United	6429	9659	5852	9929	33168
Notes. Calculated by authors from unit level data.					

Table 3. Average Annual Agricultural Income Per Cultivator (Rs, at 2004-05 prices)					
State	1987-88	1993-94	1999-00	2004-05	2011-12
Haryana			97707	47685	158249
Punjab	60390	66621	67899	70770	118902
Kerala	43841	34057	37463	40019	86181
West Bengal	33174	27160	41361	38534	81096
Tripura			-15982	49952	79727
Tamil Nadu	20848	22407	20072	24555	60709
Gujarat	41803	28580	10873	29483	55731
Andhra Pradesh	23452	22544	23886	32545	53961
Rajasthan	19719	18243	17891	19111	49491
Jammu & Kashmir	23151	71077	21732	44204	39788
Himachal Pradesh			22458	22226	36131
Uttar Pradesh United	14665	14022	16018	17116	33180
Odisha	17685	13610	9607	18292	31907
Assam	23545	16477	20002	20540	30383
Maharashtra	20287	21890	14269	17303	28277
Madhya Pradesh United	15714	14631	8833	16844	27564
Karnataka	28711	24133	28331	24319	26718
Bihar United	17183	14907	6696	9929	19100
Notes. Calculated by authors from unit level data.					

Table 4. Average Annual Growth Rate (%) of Real Agricultural Income Per Cultivator				
State	1987-88 to 1993-94	1993-94 to 1999-00	1999-00 to 2004-05	2004-05 to 2011-12
Haryana			-13.37	18.69
Rajasthan	-1.29	-0.32	1.33	14.56
Tamil Nadu	1.21	-1.82	4.11	13.80
Kerala	-4.12	1.60	1.33	11.58
West Bengal	-3.28	7.26	-1.41	11.22
Uttar Pradesh United	-0.75	2.24	1.33	9.92
Bihar United	-2.34	-12.49	8.20	9.80
Gujarat	-6.14	-14.88	22.08	9.52
Odisha	-4.27	-5.64	13.75	8.27
Punjab	1.65	0.32	0.83	7.69
Andhra Pradesh	-0.66	0.97	6.38	7.49
Madhya Pradesh United	-1.18	-8.07	13.78	7.29
Maharashtra	1.28	-6.88	3.93	7.27
Himachal Pradesh			-0.21	7.19
Tripura				6.91
Assam	-5.78	3.28	0.53	5.75
Karnataka	-2.85	2.71	-3.01	1.35
Jammu & Kashmir	20.56	-17.92	15.26	-1.49
Notes. Calculated by authors from unit level data.				

Table 5: Are Real Farm Incomes Catching Up Across States?			
	(1)	(2)	(3)
Dep Var: Growth rate of real farm income per cultivator			
Log real farm income per cultivator, 1 Lag	-0.017	-0.090*	-0.249***
	(0.012)	(0.040)	(0.037)
State fixed effects	N	Y	Y
Year fixed effects	N	N	Y
Observations	101	101	101
<p>Notes. This table reports results of a regression of the average annual growth rate of real farm income per cultivator on the initial year's real farm income per cultivator. The data set is a panel of 18 states over 6 time periods, 1993-94, 1999-00, 2004-05, 2007-08, 2009-10, 2011-12. Standard errors are clustered by state and corrected for small sample size. Significance levels: *** p<0.001, ** p<0.01, * p<0.05.</p>			

Table 6: States ranked by real farm income per cultivator					
Rank	1987-88	1993-94	1999-00	2004-05	2011-12
18			Tripura	Bihar United	Bihar United
17			Bihar United	Madhya Pradesh United	Karnataka
16			Madhya Pradesh United	Uttar Pradesh United	Madhya Pradesh United
15	Uttar Pradesh United	Odisha	Odisha	Maharashtra	Maharashtra
14	Madhya Pradesh United	Uttar Pradesh United	Gujarat	Odisha	Assam
13	Bihar United	Madhya Pradesh United	Maharashtra	Rajasthan	Odisha
12	Odisha	Bihar United	Uttar Pradesh United	Assam	Uttar Pradesh United
11	Rajasthan	Assam	Rajasthan	Himachal Pradesh	Himachal Pradesh
10	Maharashtra	Rajasthan	Assam	Karnataka	Jammu & Kashmir
9	Tamil Nadu	Maharashtra	Tamil Nadu	Tamil Nadu	Rajasthan
8	Jammu & Kashmir	Tamil Nadu	Jammu & Kashmir	Gujarat	Andhra Pradesh
7	Andhra Pradesh	Andhra Pradesh	Himachal Pradesh	Andhra Pradesh	Gujarat
6	Assam	Karnataka	Andhra Pradesh	West Bengal	Tamil Nadu
5	Karnataka	West Bengal	Karnataka	Kerala	Tripura
4	West Bengal	Gujarat	Kerala	Jammu & Kashmir	West Bengal
3	Gujarat	Kerala	West Bengal	Haryana	Kerala
2	Kerala	Punjab	Punjab	Tripura	Punjab
1	Punjab	Jammu & Kashmir	Haryana	Punjab	Haryana
Notes. The ranking is based on data available in appendix table 2.					

Table 7. Results from a Difference in Difference Model				
	(1)	(2)	(3)	(4)
TREAT x AFTER	-4.437	-3.301	-1.014	-1.265
	(7.569)	(7.662)	(5.597)	(7.151)
State FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Log PCNSDP	N	Y	Y	Y
Tax + NonTax Revenue (% of NSDP)	N	N	Y	Y
Crop Diversification Index	N	N	N	N
Observations	119	116	100	66
Notes. This table reports results of estimating model (2). Standard errors, which appear in parentheses below parameter estimates, are clustered by state and corrected for small sample size. The data set is an unbalanced state-level panel: N=18, T=4-7, total observations (N x T)=119. PCNSDP is per capita net state domestic product at 2004-05 prices; Tax + NonTax is the sum of tax and nontax revenue as a proportion of state level gross domestic product. Significance levels: *** p<0.001, ** p<0.01, * p<0.05.				

Table 8. Testing for Parallel Trends	
Dep Var: Real agricultural income per cultivator	
TREAT x Linear Time Trend	-0.435
	(0.356)
State Fixed Effect	Y
Log PCNSDP	Y
Tax + NonTax	Y
Observations	46
Notes. This table reports results of estimating the model in (3) for the sub-sample with years 1987-88, 1993-94 and 1999-00. The sample is an unbalanced panel with N=17, T=1-3, and total observations (NxT) of 47. All other details are the same as in Table 5. *** p<0.001, ** p<0.01, * p<0.05.	

Appendix Table 1: Value Added, Wage Bill, Farm Income, Agricultural Workers and Cultivators in Indian States									
		Current Prices (rupees crore)			Constant 2004-05 Prices (rupees crore)				
Year	State	Value Added	Wage Bill	Farm Income	Value Added	Wage Bill	Farm Income	Agri Workers	Cultivators
1988	Andhra Pradesh	8475	572	7903	24919	1681	23237	8190261	9908419
1994	Andhra Pradesh	20291	4999	15291	35022	8629	26393	10661723	11707091
2000	Andhra Pradesh	36517	10404	26113	41339	11778	29561	11323996	12375779
2005	Andhra Pradesh	48400	10133	38267	48400	10133	38267	10341967	11758033
2008	Andhra Pradesh	81272	18541	62731	64505	14716	49789	11061928	10738072
2010	Andhra Pradesh	111061	26976	84085	70118	17031	53086	10078155	8921845
2012	Andhra Pradesh	140141	39175	100967	73514	20550	52964	9230195	9815286
1988	Assam	2180	33	2147	6476	97	6379	1527987	2709301
1994	Assam	5731	1708	4023	9376	2794	6582	2203270	3994590
2000	Assam	8945	2214	6732	9712	2404	7309	1849754	3653967
2005	Assam	13216	2661	10556	13216	2661	10556	1556274	5139176
2008	Assam	16485	3288	13197	13405	2673	10732	1463725	4545805
2010	Assam	24154	3354	20800	15474	2149	13325	1348963	5035202
2012	Assam	27465	3692	23773	14769	1985	12784	969794	4207514
1988	Bihar United	7573	624	6949	20240	1667	18573	8031511	10808899
1994	Bihar United	14343	4339	10005	22138	6696	15441	8779344	10358246
2000	Bihar United	19280	11035	8245	22060	12626	9434	11479384	14089114

2005	Bihar United	25307	9209	16098	25307	9209	16098	7619597	16213419
2008	Bihar United	44757	13529	31229	34860	10537	24323	8634614	13784911
2010	Bihar United	53905	19295	34609	34869	12482	22388	7762713	10882824
2012	Bihar United	76381	34339	42042	43985	19775	24210	7642250	12675465
1988	Gujarat	6126	208	5918	19026	647	18380	2856509	4396714
1994	Gujarat	14983	2834	12149	25560	4835	20725	4965051	7251597
2000	Gujarat	14077	4787	9291	16199	5508	10691	4955465	9832954
2005	Gujarat	33141	5847	27294	33141	5847	27294	5142618	9257383
2008	Gujarat	46865	7361	39504	38501	6047	32453	4445609	7954392
2010	Gujarat	90626	9075	81551	57821	5790	52031	4302261	8197739
2012	Gujarat	91193	13122	78071	49964	7189	42774	4124795	7675205
2000	Haryana	16697	1556	15141	33314	3104	30209	762784	3091810
2005	Haryana	20511	1492	19019	20511	1492	19019	662079	3988551
2008	Haryana	38203	2119	36084	50263	2788	47474	658640	3573672
2010	Haryana	48928	2570	46358	48928	2570	46358	687545	3264156
2012	Haryana	58806	3027	55779	50330	2591	47739	459791	3016724
2000	Himachal Pradesh	2842	127	2715	4562	205	4358	47460	1940449
2005	Himachal Pradesh	4635	167	4468	4635	167	4468	57374	2010397
2008	Himachal Pradesh	5130	268	4862	6250	326	5924	72541	1846871
2010	Himachal Pradesh	6151	223	5929	6151	223	5929	32452	1886938
2012	Himachal Pradesh	8049	314	7735	7099	277	6822	26808	1888117
1988	Jammu & Kashmir	906	41	864	2710	124	2586	107094	1117016

1994	Jammu & Kashmir	2245	31	2214	3898	54	3843	23483	540746
2000	Jammu & Kashmir	3740	338	3402	4059	367	3692	99886	1698881
2005	Jammu & Kashmir	5658	269	5389	5658	269	5389	56693	1219107
2008	Jammu & Kashmir	6371	469	5902	5242	386	4856	105519	1644777
2010	Jammu & Kashmir	8050	768	7283	5189	495	4694	93731	1368580
2012	Jammu & Kashmir	10359	827	9532	5741	458	5282	77049	1327638
1988	Karnataka	6793	366	6427	18597	1001	17596	5034262	6128575
1994	Karnataka	16210	2834	13376	25932	4534	21398	5819651	8866493
2000	Karnataka	29912	7303	22610	32532	7942	24590	7113781	8679343
2005	Karnataka	30346	7890	22456	30346	7890	22456	7565996	9234004
2008	Karnataka	37445	10878	26567	29418	8546	20872	6730265	7469736
2010	Karnataka	53535	16108	37428	32507	9781	22726	6692785	7007216
2012	Karnataka	61485	18159	43326	29690	8768	20921	4769517	7830374
1988	Kerala	3239	278	2961	9796	840	8956	1985744	2042879
1994	Kerala	8437	2234	6204	13472	3567	9906	2122824	2908561
2000	Kerala	11680	3870	7810	12924	4282	8641	1946029	2306656
2005	Kerala	15114	3679	11435	15114	3679	11435	1478059	2857293
2008	Kerala	21316	5254	16062	17409	4291	13118	1547910	2011773
2010	Kerala	28292	5916	22376	18844	3940	14903	1355559	2188358
2012	Kerala	35230	7413	27817	19945	4197	15749	1039491	1827379
1988	Madhya Pradesh United	8463	918	7545	24147	2620	21527	5597472	13699056

1994	Madhya Pradesh United	18074	3288	14786	28434	5173	23261	6435320	15898193
2000	Madhya Pradesh United	20488	7086	13402	22419	7754	14665	8469941	16602567
2005	Madhya Pradesh United	36410	6559	29851	36410	6559	29851	7137717	17721868
2008	Madhya Pradesh United	52581	10299	42282	41279	8085	33194	8049631	16982588
2010	Madhya Pradesh United	70078	20895	49183	43693	13028	30665	10344746	14742128
2012	Madhya Pradesh United	102612	17715	84896	54211	9359	44852	5732972	16271603
1988	Maharashtra	7713	654	7059	23596	2002	21594	7633348	10644259
1994	Maharashtra	19448	3979	15469	33502	6854	26648	8755850	12173251
2000	Maharashtra	27918	11258	16660	32713	13191	19522	11848180	13681361
2005	Maharashtra	36191	9248	26943	36191	9248	26943	9519878	15571182
2008	Maharashtra	55204	14071	41133	43559	11103	32456	9912295	13787705
2010	Maharashtra	107415	19853	87562	65709	12144	53564	9689717	13110283
2012	Maharashtra	108174	30077	78097	53348	14833	38515	8776522	13620831
1988	Odisha	3378	112	3266	8862	294	8568	3130107	4844824
1994	Odisha	6567	1461	5105	10671	2375	8296	3346934	6095663
2000	Odisha	8784	3556	5229	9247	3743	5504	4759094	5729081
2005	Odisha	14709	3494	11215	14709	3494	11215	3393039	6131167
2008	Odisha	25070	4040	21030	19517	3145	16372	3221549	6142714
2010	Odisha	29567	5621	23946	18638	3543	15095	2761561	5561498

2012	Odisha	41837	5965	35871	23115	3296	19820	1942473	6211758
1988	Punjab	5430	447	4983	16148	1330	14818	1065739	2453751
1994	Punjab	13745	1736	12008	21881	2764	19117	1243755	2869472
2000	Punjab	23842	2357	21485	27415	2710	24705	1092762	3638439
2005	Punjab	31041	2331	28710	31041	2331	28710	1136088	4056867
2008	Punjab	49514	3461	46053	37940	2652	35288	1188400	3328619
2010	Punjab	59656	3960	55696	35728	2372	33357	947441	3221206
2012	Punjab	72206	5080	67125	36470	2566	33904	803172	2851449
1988	Rajasthan	6363	66	6297	18645	194	18451	967385	9357092
1994	Rajasthan	14267	971	13296	21890	1490	20400	1139629	11182497
2000	Rajasthan	19452	1482	17970	22561	1718	20843	977025	11650315
2005	Rajasthan	26718	1646	25072	26718	1646	25072	954546	13119093
2008	Rajasthan	44203	2633	41570	34494	2055	32439	1113335	12886665
2010	Rajasthan	73702	3303	70399	45219	2027	43193	947771	12152229
2012	Rajasthan	112865	3711	109154	57924	1905	56019	880982	11319018
1988	Tamil Nadu	4784	302	4482	13998	883	13116	5582815	6290940
1994	Tamil Nadu	14271	4070	10201	24287	6927	17360	8194918	7747717
2000	Tamil Nadu	20169	9415	10755	23277	10865	12412	8927711	6183587
2005	Tamil Nadu	23494	7623	15872	23494	7623	15872	6636163	6463838
2008	Tamil Nadu	37394	12302	25091	30234	9947	20287	7097436	5202564
2010	Tamil Nadu	60261	18954	41307	39075	12290	26785	7488079	5111921
2012	Tamil Nadu	70016	24438	45578	38109	13301	24808	5934489	4086334

2000	Tripura	0	236	-236	0	341	-341	141948	213619
2005	Tripura	1905	160	1745	1905	160	1745	100082	349276
2008	Tripura	2168	329	1839	2517	382	2135	135504	310223
2010	Tripura	2571	260	2311	2571	260	2311	94804	236437
2012	Tripura	3026	341	2686	2583	291	2292	89253	287452
1988	Uttar Pradesh United	14646	264	14382	40081	723	39358	5874085	26837792
1994	Uttar Pradesh United	32195	3808	28387	47977	5674	42302	6429696	30169402
2000	Uttar Pradesh United	53293	7816	45477	62217	9125	53092	7049734	33144354
2005	Uttar Pradesh United	74869	6707	68162	74869	6707	68162	5274973	39823300
2008	Uttar Pradesh United	113695	11992	101702	88709	9357	79352	6691817	31804568
2010	Uttar Pradesh United	144913	12162	132750	92879	7795	85084	4941018	29497008
2012	Uttar Pradesh United	191425	15588	175837	106684	8687	97997	4973209	29534656
1988	West Bengal	7535	304	7231	22310	901	21409	5040661	6453490
1994	West Bengal	16732	3227	13505	28981	5590	23392	5247970	8612533
2000	West Bengal	32702	8060	24642	37686	9288	28398	6946476	6865848
2005	West Bengal	42832	7846	34986	42832	7846	34986	6720595	9079405
2008	West Bengal	57898	12483	45415	47139	10163	36976	7673526	6626474
2010	West Bengal	84296	18641	65655	52716	11657	41059	7856660	6043341
2012	West Bengal	109083.4	26633.55	82449.82	59769.49	14593.18	45176.31	7578717	5570746

Notes. Computed by authors from unit-level data.

Appendix Table 2: Nominal and Real Income Per Person					
		Current prices (rupees)		Constant 2004-05 prices (rupees)	
Year	State	Wage bill per agricultural worker	Farm income per cultivator	Wage bill per agricultural worker	Farm income per cultivator
1988	Andhra Pradesh	698	7976	2053	23452
1994	Andhra Pradesh	4689	13062	8093	22544
2000	Andhra Pradesh	9187	21100	10401	23886
2005	Andhra Pradesh	9798	32545	9798	32545
2008	Andhra Pradesh	16761	58419	13303	46367
2010	Andhra Pradesh	26767	94246	16899	59502
2012	Andhra Pradesh	42442	102867	22264	53961
1988	Assam	214	7925	635	23545
1994	Assam	7752	10072	12681	16477
2000	Assam	11968	18423	12994	20002
2005	Assam	17097	20540	17097	20540
2008	Assam	22460	29031	18264	23608
2010	Assam	24865	41308	15930	26464
2012	Assam	38065	56502	20469	30383
1988	Bihar United	776	6429	2075	17183
1994	Bihar United	4942	9659	7627	14907

2000	Bihar United	9613	5852	10999	6696
2005	Bihar United	12086	9929	12086	9929
2008	Bihar United	15668	22654	12203	17645
2010	Bihar United	24856	31802	16079	20572
2012	Bihar United	44933	33168	25875	19100
1988	Gujarat	729	13460	2265	41803
1994	Gujarat	5708	16753	9737	28580
2000	Gujarat	9659	9448	11115	10873
2005	Gujarat	11371	29483	11371	29483
2008	Gujarat	16558	49663	13603	40799
2010	Gujarat	21093	99480	13458	63470
2012	Gujarat	31812	101719	17430	55731
2000	Haryana	20398	48972	40698	97707
2005	Haryana	22535	47685	22535	47685
2008	Haryana	32176	100971	42333	132845
2010	Haryana	37377	142021	37377	142021
2012	Haryana	65832	184900	56343	158249
2000	Himachal Pradesh	26864	13991	43121	22458
2005	Himachal Pradesh	29106	22226	29106	22226
2008	Himachal Pradesh	36931	26325	44997	32074
2010	Himachal Pradesh	68648	31420	68648	31420
2012	Himachal Pradesh	117125	40966	103301	36131

1988	Jammu & Kashmir	3868	7736	11574	23151
1994	Jammu & Kashmir	13335	40946	23148	71077
2000	Jammu & Kashmir	33858	20024	36746	21732
2005	Jammu & Kashmir	47507	44204	47507	44204
2008	Jammu & Kashmir	44453	35882	36578	29526
2010	Jammu & Kashmir	81890	53213	52783	34299
2012	Jammu & Kashmir	107314	71798	59469	39788
1988	Karnataka	726	10487	1988	28711
1994	Karnataka	4870	15086	7791	24133
2000	Karnataka	10266	26050	11165	28331
2005	Karnataka	10429	24319	10429	24319
2008	Karnataka	16162	35566	12698	27943
2010	Karnataka	24067	53413	14614	32433
2012	Karnataka	38073	55331	18384	26718
1988	Kerala	1399	14494	4230	43841
1994	Kerala	10522	21329	16801	34057
2000	Kerala	19889	33859	22006	37463
2005	Kerala	24894	40019	24894	40019
2008	Kerala	33942	79841	27721	65208
2010	Kerala	43641	102252	29067	68103
2012	Kerala	71309	152226	40371	86181
1988	Madhya Pradesh United	1641	5508	4681	15714

1994	Madhya Pradesh United	5110	9300	8039	14631
2000	Madhya Pradesh United	8366	8072	9155	8833
2005	Madhya Pradesh United	9190	16844	9190	16844
2008	Madhya Pradesh United	12794	24897	10044	19546
2010	Madhya Pradesh United	20198	33362	12594	20801
2012	Madhya Pradesh United	30901	52175	16325	27564
1988	Maharashtra	857	6632	2623	20287
1994	Maharashtra	4544	12707	7828	21890
2000	Maharashtra	9501	12177	11133	14269
2005	Maharashtra	9715	17303	9715	17303
2008	Maharashtra	14196	29833	11201	23540
2010	Maharashtra	20488	66789	12533	40857
2012	Maharashtra	34270	57336	16901	28277
1988	Odisha	358	6741	939	17685
1994	Odisha	4366	8376	7095	13610
2000	Odisha	7471	9126	7865	9607
2005	Odisha	10298	18292	10298	18292
2008	Odisha	12540	34236	9762	26653
2010	Odisha	20355	43056	12831	27141

2012	Odisha	30709	57748	16967	31907
1988	Punjab	4196	20309	12479	60390
1994	Punjab	13961	41848	22225	66621
2000	Punjab	21568	59050	24800	67899
2005	Punjab	20518	70770	20518	70770
2008	Punjab	29122	138356	22314	106013
2010	Punjab	41800	172905	25034	103553
2012	Punjab	63255	235408	31950	118902
1988	Rajasthan	685	6729	2007	19719
1994	Rajasthan	8523	11890	13077	18243
2000	Rajasthan	15165	15424	17589	17891
2005	Rajasthan	17241	19111	17241	19111
2008	Rajasthan	23651	32258	18456	25173
2010	Rajasthan	34855	57931	21385	35543
2012	Rajasthan	42127	96434	21620	49491
1988	Tamil Nadu	540	7124	1581	20848
1994	Tamil Nadu	4967	13166	8452	22407
2000	Tamil Nadu	10546	17392	12171	20072
2005	Tamil Nadu	11486	24555	11486	24555
2008	Tamil Nadu	17334	48229	14015	38994
2010	Tamil Nadu	25312	80805	16413	52397
2012	Tamil Nadu	41180	111538	22414	60709

2000	Tripura	16639	-11056	24051	-15982
2005	Tripura	16022	49952	16022	49952
2008	Tripura	24289	59288	28197	68827
2010	Tripura	27386	97759	27386	97759
2012	Tripura	38190	93426	32590	79727
1988	Uttar Pradesh United	450	5359	1230	14665
1994	Uttar Pradesh United	5922	9409	8825	14022
2000	Uttar Pradesh United	11087	13721	12943	16018
2005	Uttar Pradesh United	12715	17116	12715	17116
2008	Uttar Pradesh United	17921	31977	13983	24950
2010	Uttar Pradesh United	24615	45005	15776	28845
2012	Uttar Pradesh United	31343	59536	17468	33180
1988	West Bengal	604	11205	1787	33174
1994	West Bengal	6149	15681	10651	27160
2000	West Bengal	11603	35891	13371	41361
2005	West Bengal	11674	38534	11674	38534
2008	West Bengal	16267	68535	13245	55800
2010	West Bengal	23726	108641	14837	67940
2012	West Bengal	35142.56	148005	19255.48	81095.61
Notes. Computed by authors from unit-level data.					

Appendix Table 3. Comparison our estimates with Chand et al (2015)						
Year	Farm-Income (current prices), Rs crore		Consumer Price Index for Agricultural Labourers		Farm-Income (2004-05 prices), Rs crore	
	Our Estimate	Chand et al (2015)	Our Estimate	Chand et al (2015)	Our Estimate	Chand et al (2015)
1987-88	88415	74638	34.56	33.19	254548	224858
1993-94	176019	177954	61.33	58.57	285063	303814
1999-00	257440	335631	84.16	90.00	307282	372923
2004-05	397537	434130	100.00	100.00	397537	434160
2007-08	602253		118.36		498042	
2009-10	869228		148.80		566552	
2011-12	1070737	1144363	175.33	182.94	592629	625536
Notes. We have computed our estimates from unit-level data; the estimates for Chand et al (2015) are from Table 2 in that paper.						

Appendix Table 4: Herfindahl Index of Crop diversification					
State	1999-00	2004-05	2007-08	2009-10	2011-12
Karnataka	0.07	0.07	0.07	0.07	0.07
Rajasthan	0.13	0.12	0.12	0.11	0.12
Maharashtra	0.12	0.12	0.12	0.11	0.12
Gujarat	0.12	0.12	0.13	0.12	0.13
Andhra Pradesh	0.16	0.15	0.17	0.18	0.16
Uttar Pradesh	0.23	0.26	0.24	0.23	0.23
Haryana	0.25	0.23	0.26	0.26	0.24
Tamil Nadu	0.15	0.18	0.18	0.3	0.26
Bihar United	0.3	0.3	0.31	0.29	0.31
Himachal Pradesh	0.33	0.32	0.33	0.33	0.33
Madhya Pradesh United	0.33	0.31	0.33	0.33	0.34
Kerala	0.29	0.29	0.31	0.33	0.35
Punjab	0.39	0.39	0.41	0.41	0.4
West Bengal	0.49	0.51	0.51	0.48	0.49
Assam	0.57	0.56	0.58	0.57	0.55
Tripura	0.88	0.86	0.89	0.87	0.86

Source: Authors calculations based on the data on area under each crop from the Directorate of Economics and Statistics, Government of India. The Herfindahl Index of Crop diversification measures the extent of crop diversification in the state. A zero value denotes perfect diversification and a value of 1 denotes perfect specialization.