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Inequality, Neighbourhoods and Variation in Prices

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Abstract

In this study we examine the link between of income inequality and wholesale price of wheat using panel data. We have weekly time series data on prices for wheat for 3 districts in Uttar Pradesh in India obtained from the Department of Economics and Statistics of the Ministry of Agriculture, Government of India (DES-MOA, GOI) for the period 2006-2011. Gini coefficient is calculated on the basis of consumption expenditure collected by National Sample Survey Organisation of India. We find that price of food grain initially increases with increase in inequality but after a point it starts declining, implying an inverted-U shape relation between the two. This relationship holds for the cross-section of societies over the period of time.

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1 Introduction

In this paper we look at the prices prevailing in the food grain market in Uttar-Pradesh, India, through the lens of inequality. The issue of increase in inequality in India is one that has been increasingly scrutinized over the past several years. This is primarily because India like many other regions in the world has experienced some increase in the level of inequality. There is strong empirical evidence showing that there has been increase inequality in the recent past; see, for instance Azam and Shariff (2011), Daumal (2010) and Chikte (2011). Apart from ethical reasons, increase in income inequality is a concern because its prevalence has lead to inequality in other dimensions like education, health etc [1]. Even more worrisome is the fact that it has marginalised people who are already poor because of its affect on how market functions.

The aim of the paper is to focus on the functional inequality by examining the relationship between inequality and price. So far, the literature on the relationship between income inequality and its cost to poor has focused on two main research topics. On one side it has looked at the increase in cost to poor because of their income constraint. Frankel and Gould (2000) summarizes the main reasons for the increase in price with increase in inequality. These reasons could be lack of storage capacity, limited budget etc. The other side like Chakrabarty, Majumder and Ray (2012) has looked at the relative increase in the cost to poor because of their different preference structure relative to rich . The focus of our paper is to look at the impact of inequality directly on the prices [2]. In this paper, we look at the impact of inequality in small neighborhoods on the prices. As the data on individual Gini coefficient is missing, all evidence collected by literature related to inequality is based on Gini coefficient across different nations. This represents a major shortcoming as researchers are not able to investigate the role of local inequality. Infact, the national level data obscures the impact of inequality in the confined neighborhood. For instance major studies like Daumal(2010), Sperling and Hansen(2012) which look at the impact of inequality on various dimensions work either at state level or national level and that too is limited to cross-sectional analysis. Thus the main aim of this research is to improve upon the existing literature on two aspects. First, we use data on regional Gini coefficient over the period of more than 20 years for three regions of Uttar Pradesh. This helps us to investigate how the

[1] Rowlingson (2011) summarises the impact of inequality on health.

[2] Broda and Romalis(2009) and Bergh and Nilsson (2012) have looked at the impact on inequality on the prices of products poor people buy.

Gini coefficient evolved over the period of time. Second, our analysis is based on the actual price data and is not inferred on the basis of expenditure, unlike in the paper by Mishra and Ray(2011). This also helps us to control for the quality.

For this reason we try to see how the price of food grains respond to inequality in the three districts in Uttar Pradesh over the period of time. As reported in Majumder, Ray and Sinha (2012), there are large and significant spatial differences in the individual's level of income in India, implying that there may lot of regional variations in inequality. In this study we are interested in measuring the consequences of the income distribution on the price of food grains. We use wholesale wheat prices of Dara quality compiled and maintained by Department of Economics and Statistics of the Ministry of Agriculture, Government of India (DES-MOA, GOI) for the purpose of our analysis. This is weekly data and is available for the period 2006-2010. Data on income distribution comes from different rounds of National Sample Surveys (NSS) collected for different state regions of India from the period 1983 to 2012. We use Kalman filter to convert the annual series to monthly series.

It is interesting to speculate how the distribution of income affects market prices. We find an inverted-U shape relationship between price and income inequality: if we compare a cross-section of societies, then initially price level increases as income gap widens but then it tapers off. The rationale is as follows; a rise in income of people raises the demand upward, and also increases the willingness to pay leading to a price rise as supply cannot respond instantaneously. Rising prices typically induce either people to shift to consumption of other varieties or increases the supply of new varieties. The supply of new varieties or other sources of consumption will make prices resettle at a new equilibrium. These price corrections over time would lead to an inverted-U shaped curve.

The rest of the paper is organized as follows. Section 2 presents an overview of the literature on the relationship between Gini coefficient and prices. Section 3 describes the the data which underlie the empirical results from panel regression and reports the main descriptive statistics. It also discusses the use of Kalman Filter to predict missing values for Gini coefficient. Section 4 presents the methodology and results based on panel regression and attempts to explore the relationship between price and inequality. Conclusions and policy discussions are presented in section 5.

2 Literature Review

There are both theoretical and empirical studies to understand market behaviour in case of income inequality. Broda and Romalis (2009) show that much of the increase in income inequality in the US has been offset by a relative decline in the prices of products that poorer consumers buy. Muellbauer (2012) has shown that relative consumer price changes in the United Kingdom since 1964 have had an inequality increasing bias. He calculated constant cost-of-living indices, where preference parameters are calculated from Linear Expenditure System of demand equations. He found that cost-of-living for the poor increases more rapidly than for the rich. Bergh and Nilsson (2012) argue that higher income inequality will often imply higher demand for products targeted towards the poor. This will increase supply of these goods and this will mitigate adverse effects of higher income inequality by its impact on the distribution of purchasing power.

Most of the theoretical literature focuses on transaction costs and shows that they are the main barriers to market integration, even for homogenous goods. In the presence of transaction costs, its the local factors like the demand and supply conditions which become more prominent in determining the prices. For instance the model by Enke (1951) which was later developed by Samuelson (1952) is elegant in explaining the systematic changes in prices of homogeneous goods across regions when they are spatially separated. Samuelson's paper also shows that the prices of homogenous goods across regions will behave according to aggregate demand and supply and in a systematic and expected pattern, subject to transportation costs. Paper by Gulati and Ray (2011) studies analytically the impact of rising inequality on the welfare of the poor. They have demonstrated striking differences in the prices of same quality product in different regions varying with their level of inequality. Mechanism through which it works is explained as follows - as income rises, individual's marginal ability to pay also increases. Firms with aim of making higher profits respond to this change by increasing prices. Transportation cost introduces horizontal differentiation, making the local demand conditions more important. As increase in income is not uniform across the society, there are some sections (depending upon where they stay), which end up paying higher prices, without participating in growth process.

This explains how the kind of neighborhood a person stays in affects their buying potential and quality of life. What individuals demand and are willing to pay in certain ways depends on their income but what people actually end up paying depends on how they

are geographically organized. Thus, the rising inequality has an externality that has feed back effect on the consumption of the poor. There have been many works like Muellbauer (1974), Ray (1985), Banks, Blundell and Lewbel (1997), Pendakur (2002), Pendakur (2009), Nicholas, Ray and Valenzuela (2010), Mishra and Ray (2011) which have established close links between different specifications of consumer preferences which is the function of their income level and distributive consequences of inflation. However, these papers do not indicate how the differential rates of inflation for different consumption baskets itself could be the function of inequality.

3 Data and Descriptive Statistics

In this study, we will focus our attention on microeconomic aspects, in particular the demand side factors like income and its distribution, in explaining the differences in price after controlling for the supply side factors [3]. For the purposes of our study, we concentrate on the state of Uttar Pradesh. Located in northern India, Uttar Pradesh is the fifth largest and the most densely populated state in India. Agriculture is the mainstay of majority of the population. It employs about two-thirds of the workforce and contributes about one-third to the state income[4]. The key question that we seek to answer here is how does wheat price change with income inequality. For the purpose of our analysis we identify 3 districts in Uttar Pradesh which are Kanpur in Central Uttar Pradesh, Varanasi in South Uttar Pradesh and Jhanshi in Western Uttar Pradesh [5]. The choice of the districts for analysis is restricted to those areas where people consume same quality of wheat. Idea is that the variation in price should not be governed by the difference in the level of quality. It also merits a mention that Uttar Pradesh is a major wheat consuming state in India, justifying looking at the wheat prices. The data used for the purpose of analysis is discussed below in detail.

3.1 Data on Gini coefficient

Uttar Pradesh like other parts of India, has reported significant growth in income over the past decade. This has been complemented with rise in income inequality captured by Gini

[3]It warrants a mention that in India, government fixes minimum support price which seeks to ensure remunerative prices to growers for their produce. This minimum support price is uniform across the country; Agriculture produce pricing policy, August(2013).

[4]Source: $http://www.undp.org$

[5]See Appendix, Figure 4.

coefficient. Paper by Pathak (2010) indicates an increasing trend in the inequality in Uttar Pradesh between 1993-94 and 2004-05. Inequality measure is constructed on the basis of monthly per capita expenditure of the household as the data on the consumer's income is not available. We use consumption data collected using 30-day recall period from 22 rounds of the NSS conducted by the Government of India (GoI) for the period 1983 and 2012. It warrants a mention that this is an annually representative data. The consumption rounds of the NSS were not collected for the years 1984, 1985, 1986, 1988, 1989, 1990, 1991, 2009 and 2011. Hence, we use the Kalman filter to estimate missing values for the years mentioned and for converting the data into monthly inequality estimates. This is justified as the change in Gini coefficient is slow relative to change in the prices. As the price is much more volatile so we use monthly estimate of price and adjust the Gini coefficient data to match the frequency.

It is important to mention here that inequality measure constructed on the basis of expenditure is biased downward as compared to the one based on income, this implies that the rise in inequality is much more than shown by these statistics as noted by Drez and Sen, (2013). However, in the absence of regular data on inequality, the Gini coefficients and other measures of interest have been frequently calculated based on the expenditure data from the NSS rounds. Many studies, for instance Himanshu (2007) and National Human Development Report (2001) have used consumption expenditure data from the NSS to evaluate the extent of increase in inequality.

In order to estimate the missing annual values and convert annual series into monthly series, we use the linear state space model to predict missing values on Gini coefficient for different months. Briefly, the state-space representation consists of two equations, a measurement equation and a state equation. The former shows how the variable we observe and wish to explain depends on unobserved variables called state variables. The latter shows how those state variables evolve through time. As the Gini coefficient follows AR(1) process, so the State-Space formulation that we use to predict the missing values of the gini is given by:

$$Gini_t^A = TGini_t^M + v_t \tag{1}$$

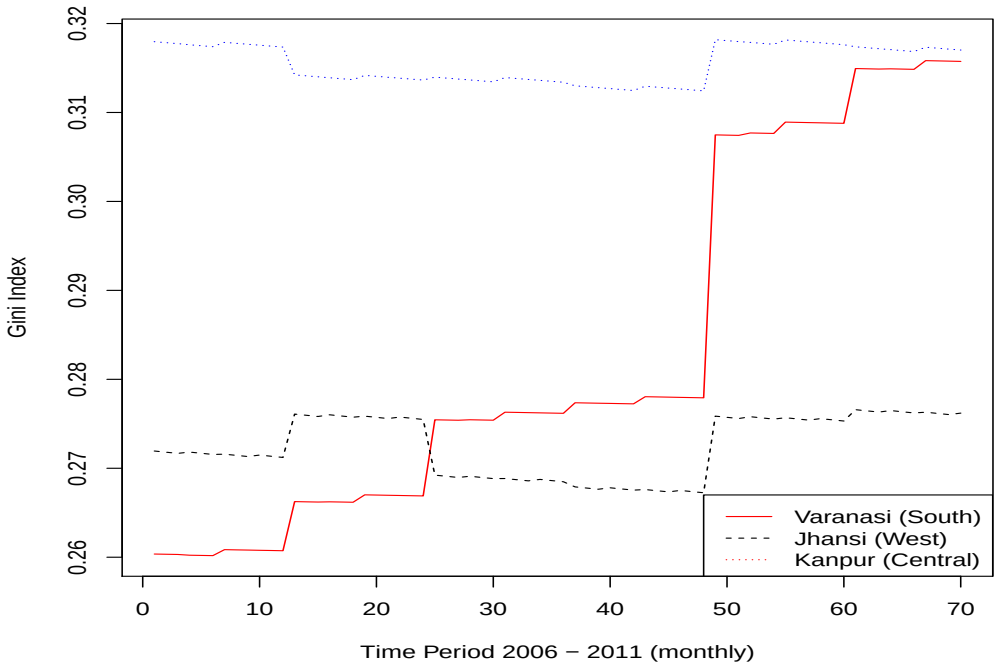
$$Gini_t^M = \delta_t + Gini_{t-1}^M + \epsilon_t \tag{2}$$

Here equation 1, is the measurement equation that relates the observed value of annual Gini coefficient to unobserved value of monthly Gini coefficient. Equation 5, describes the evolution of monthly Gini coefficient over time. Equations 4 and 5 combine to form the

state equation, v_t and ϵ_t are the random variables that represent the process and measurement noise respectively[6]. They are assumed to be independent of each other, white noise, and with normal probability distributions. In principle Kalman filter predicts the unobserved value for monthly Gini coefficient conditional on the observed value of annual Gini coefficient.

Figure 1 provides the evolution of the estimated monthly time series between 2006-2011. There seems to be a general increase in the inequality measure for all three districts. Although, there may be a number of factors affecting inequality, it is not the main interest of this paper to speculate on what might these factors be. What is important is that the data provides enough variation across time and districts to be able to test its effects on prices of food grains.

Figure 1: *Evolution of Gini Coefficient between 2006 - 2011*



It is evident from the plot above that there is lot variation in the Gini coefficient across time and over different regions. In Central Uttar-Pradesh, initial Gini coefficient is high and it continues to remain so for all the time periods. However in the Southern Uttar-Pradesh,

[6]To see examples of State-Space representations of linear models, see Hamilton (1994) Chapter 13, Harvey(1989) and Harvey et al., (1999).

Gini coefficient registers a consistent increase over the period of time.

3.2 Price

We use data on wholesale price of Dara quality of wheat from the Department of Economics and Statistics of the Ministry of Agriculture, Government of India (DES-MOA, GOI) for the period Jan 06, 2006 to Oct 14, 2011. The DES collects and compiles wholesale and retail prices, international prices and market arrivals of essential commodities on weekly/monthly basis from 700 centres and 87 centres respectively spread all over the country. This is unadjusted price data and is used for the construction of the wholesale price index. One important advantage of this paper is that it uses actual price data instead of inferring it from the consumer expenditure reported in NSS data like Ray et.al(2011).

Figure 2: *Evolution of price between 2006 - 2011*

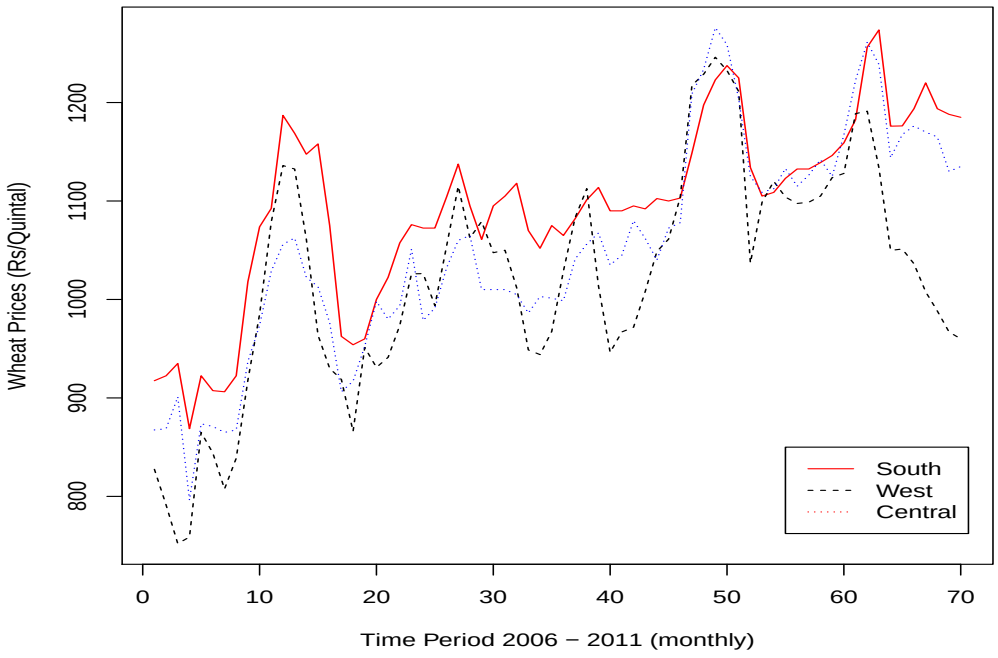
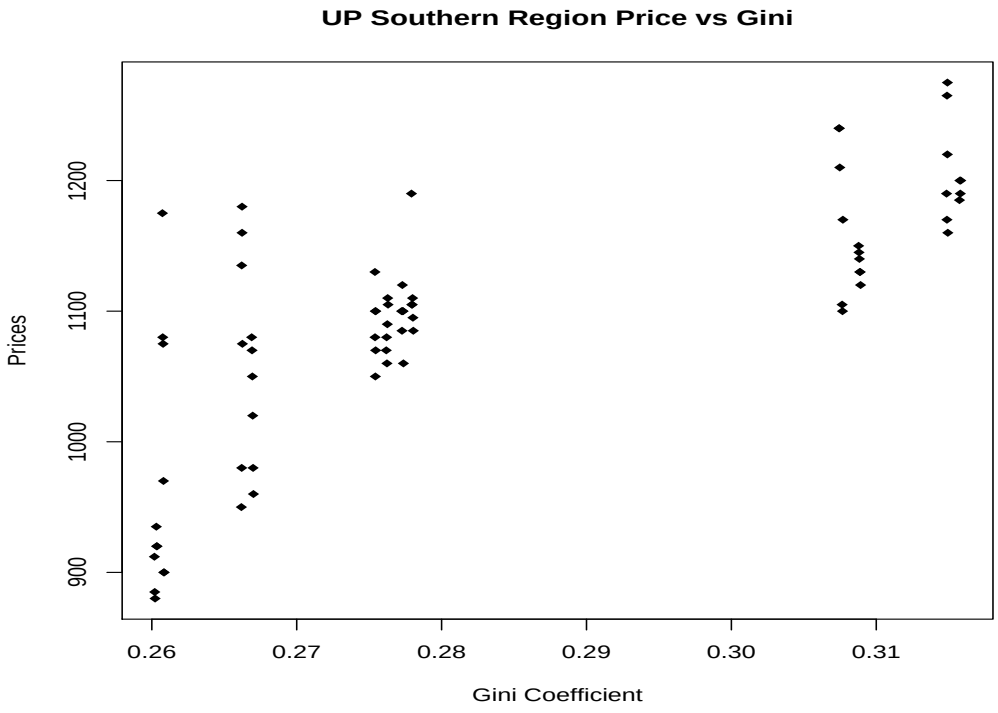


Figure 2, provide a fair idea of the pattern of variation in monthly price of wheat in Varanasi, Etawah and Kanpur districts of Uttar Pradesh for the period Jan 06, 2006 to Oct 14, 2011.

It is evident from the plot that there is a lot of variation in price over time and across districts. We observe that prices have markedly increased over the period of time in all the three regions. It also warrants a mention that prices are highest in Southern region which experienced maximum increase in inequality.

Figure 3 provides some information on the relationship between price and inequality based on the monthly data on Gini coefficient and price from 2006 to 2011 for Southern UP. More specifically it shows that even though initially price increases with rise in Gini coefficient but this relationship is not linear.

Figure 3: *Evolution of monthly prices and Gini coefficients - Southern Region*



3.3 Other variables in Panel Regression

Table I provides the summary statistics for the rest of the variables used as control for the panel regression. The variables given below will control for both demand side and supply side factors that are different in different regions so that any price affect other than inequality is accounted for.

Table I: *Summary Statistics for South Region, 2006-2011*

	Mean	Std. Dev	Minimum	Maximum
Gini	0.28	0.02	0.26	0.31
Prices (Rs per quintal)	1,094	91.87	868.75	1,256
Area (hectare)	71,150	2,488	69,323	76,433
Production (tonnes)	18,16,84	17,377	1,48,663	1,98,007
Yield (tonnes per hectare)	2.55	0.22	2.14	2.82
Rainfall (mm)	71	112	0	474
NDP Agriculture (Rs crore)	461	46	406	540
Monthly Per Capita Income (Rs)	13,210	1,671	11,592	16,077
Net District Domestic Product (Rs Crors)	4769	738	3990	6050
Population	35,02,658	1,28,798	33,51,640	37,63,176

Area is the total farm area in the district on which wheat is being cultivated. It includes land that is cultivated each year excluding land kept fallow during production. The annual level data is available from Directorate of Wheat Development, Ministry of Agriculture, Government of India (DWD-MoA, GOI).

Production is the total quantity of wheat that is cultivated annually from the districts. This variable acts as a control for the supply of wheat, assuming that the quantity of wheat is traded outside only once internal consumption needs of the district are met. The production level in the regions are also at annual levels available from DWD-MoA.

Yield is the production of wheat per unit of land cultivated. Yield provides the proxy for natural resource endowment and soil fertility that affects production costs. The yield is annual level also available from DWD-MoA.

Rainfall measures the precipitation in each district on a monthly basis. In the absence of irrigation and because of water shortages majority of Indian agriculture and thus wheat production depend on rainfall for water needs. Thus this once again denotes the supply side factors. The rainfall in at a monthly frequency available obtained from the Indian Metrological Department.

Net Domestic Product (NDP) Agriculture, Net District Domestic Product (NDDP) and Population and Per Capita Income (PCI) are all quantifiers of demand in each district in terms of income level and number of people. A combination of these variables would control for the major demand pattern shifts due to migration and other demographic related effects. These are all annual statistics available from the Directorate of Economics and Statistics, Government of India.

First Difference of the Price: One can easily conceive price at time period t being affected by the general level of inflation as the price data that we are using is not unadjusted for it. So we use first difference of the price as another control variable.

4 Methodology

In this section we report the results of the empirical analysis we have carried out. The regression analysis qualifies the relation between price and inequality shown earlier. The use of data on the three state regions together, helps us to elegantly explore and illustrate the causality from Gini coefficient to price. To this end, we use panel data framework to estimate the strength of the relationship between Gini coefficient and price for the three regions from the period 2006-2011. So the equation that we are interested in estimating is given by

$$p_{it} = \alpha_i + \beta x_{it} + \epsilon_{it}, \tag{3}$$

where, p_{it} is vector of prices which varies across different regions and over time, x_{it} is the vector of controls, α_i represents the unit effect and captures the variables that affect p_{it} other than x_{it} and ϵ_{it} is error variable.

In the pooled OLS it is assumed that there is variation in α_i across different districts. As pooled regression does not account for omitted variables and potential cross sectional dependence can thus induce omitted variable bias in case α_i is not same. In the literature for instance refer Green(2008) or Cameron and Trivedi (2011), there are two standard approaches for modeling variation in α_j: Fixed effects and Random effects. In the case of Fixed effects it is assumed that the unobserved heterogeneity is uncorrelated with x_{it}. In the Random effects model, α_i are assumed to follow a probability distribution with the parameters to be estimated from the data.

Before estimating the coefficient of Gini coefficient by panel data models, we were interested in running a pooled regression. To evaluate the impact of income distribution on price we regress price on different moments of income distribution. We also use number of demand and supply side factors reported in the section on Data as control variables. The results of the restricted model is reported Table III. As can be seen, the pooled OLS estimate suggests a strong positive and statistically significant effect of inequality on price.

To verify if a pooled or fixed panel estimation is more appropriate we conducted F test following Fixed effect estimation. The F test results reported in Table II indicates that there are significant regional effects, implying that ignoring unobserved heterogeneity can induce omitted variable bias. Next, the Breusch and Pagan LM test helps us to decide between the random effects regression and the pooled OLS regression. The null here is that there is no substantial difference across districts (i.e. no panel effect). Here we failed to reject the null and conclude that the random effect is not suitable. The test results are reported in Table II.

Table II: *Model Selection*

Pooled versus Fixed effects	F test that all $\alpha_i = 0$	F(3, 196) = 12.03
		p-value = .000
Pooled versus Random effect	Breusch and Pagan (LM) test	$\chi^2(3) =$ .63
		p-value = .4268
Fixed versus Random effect	Hausman Test	$\chi^2(3) =$ 44.25
		p-value = 0.000

Next to choose between Fixed effects and Random effects, we tried to be careful about the structure of our panel data and issues raised in literature. Clark and Linzer (2012), suggests that even though Fixed-effects gives unbiased estimates of β, their variance could be very high. This is especially true if there is an independent variable that change very gradually over time, particularly relative to changes in the dependent variable, like the Gini coefficient in our case.

Even though higher variance could be a greater problem than the bias in our sample, Hausman test suggests use of Fixed-effects. Results from the test are reported in Table II. Table IV reports the coefficients of Gini-coefficient obtained from Fixed effect regressions for

the panel data of three regions.

It is apparent from Table IV, that for the sample, the coefficient of Gini coefficient is statistically significant, thus suggesting that increase in income inequality leads to a rise in prices. Use of Gini coefficient and its square allows for the non-linear relation between inequality and price. It is important to note that though the sign Gini coefficient is positive, the sign of coefficient of squared Gini coefficient is negative. Both the coefficients are significant at 1% level. This translates to an inverted-U shaped relationship between income inequality and prices.

Table III: *Results from Pooled Regression*

Variable	*Estimators*	*Variable*	*Estimators*
Intercept	-7745^{**}	*Rainfall*	$-.1071$
	(2674)		(.0579)
Gini	62007^{**}	*PCI*	0.029^{**}
	(19420)		(.0029)
$Gini^2$	-104766^{**}	*Production*	0.002
	(33169)		(.0012)
Yield	-128.5	*Differenced Price*	0.59629^{**}
	(131)		(.1002)
Area Hectare	-0.0107^{**}		
	(.0031)		
No. of observations	207	R^2	0.529

Notes: The dependent variable is monthly wheat price. Table reports t - statistics and standard errors . '**' (*) indicates significance at 1% (5%) level of significance are reported in parentheses.

The intuition for the initial increase and then decline in the price is as follows; in the first stage price increases due increase in income [7]. This is because with increase in the average income, capacity to pay increases. This induces price increase. But higher income inequality

[7]National Sample Survey data from 2006 - 2011 for the three different state regions of Uttar - Pradesh suggests that the rise in inequality is largely because of the increase in income at the upper end and not because of a decline at the lower end. This is evident from the Figure 5, 6 and 7 in the Appendix.

allows for higher product differentiation [8] which leads to increased supply of other varieties. This leads to reduction in price as suggested by Bergh and Nilsson (2012).

Achen (2001) shows that the use of lagged dependent variable[9] can lead to inaccurate inference because of serial correlation. To address the problem of standard error inflation, we use approach suggested in Back-Katz (1996), which suggests that for small panel data sets the panel corrected standard errors should be used. So we estimated the dynamic model applying the OLS method but used panel-corrected standard errors (PCSE) to assure reliable standard errors. The results from this regression are very similar to the results from pooled OLS. The coefficients remain marginally same but the significance has improved.

Table IV: *Results from Fixed effects*

Variable	*Estimators*	*Variable*	*Estimators*
Intercept	-7737^{**}	*Rainfall*	$-.1356^{*}$
	(2762)		(.0547)
Gini	53014^{**}	*PCI*	0.0395^{**}
	(19030)		(.0053)
$Gini^2$	-94378^{**}	*Production*	$-.0014^{*}$
	(33037)		(.0003)
Yield	111.2^{**}	*Population*	0.0003^{**}
	(42.39)		(.0001)
Differenced Price	0.5899^{**}		
	(.0944)		
No. of observations	207	R^2 *overall*	0.0880
R^2 *within*	.5592	R^2 *between*	0.2828

Notes: The dependent variable is monthly wheat price. Table reports t - statistics and standard errors . '**' (*) indicates significance at 1% (5%) level of significance are reported in parentheses.

[8] Gabszewicz, J. Jaskold and J.-F. Thisse (1980), Shaked and Sutton (1982),(1983) and (1987) are the seminal papers to explore relation between income inequality and product differentiation.

[9] In our model we use first difference of the price variable to control for inflation.

5 Conclusion

In this paper we have investigated the statistical association between income inequality and and wholesale wheat prices in Uttar Pradesh, India. As apposed to earlier work on this topic, we have been able to take care of the existing heterogeneity in the small neighborhood by looking at the Gini coefficient at the state-regional level. In the first part of the paper we have used Kalman filter to make the frequency of Gini coefficient consistent with price and other data. Simple regression produced evidence of initially positive and then negative statistical significant relationship between inequality and price. We get similar results using fixed effects model. These results are partly in line with the basic intuition that initial increase in income leads to higher price but after a point competition from different varieties reduces price. Thus we have shown through our investigation that how as money looms larger in societies, affluence and its absence matters more!

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Appendices

Figure 4: *Uttar Pradesh Districts - Maps*

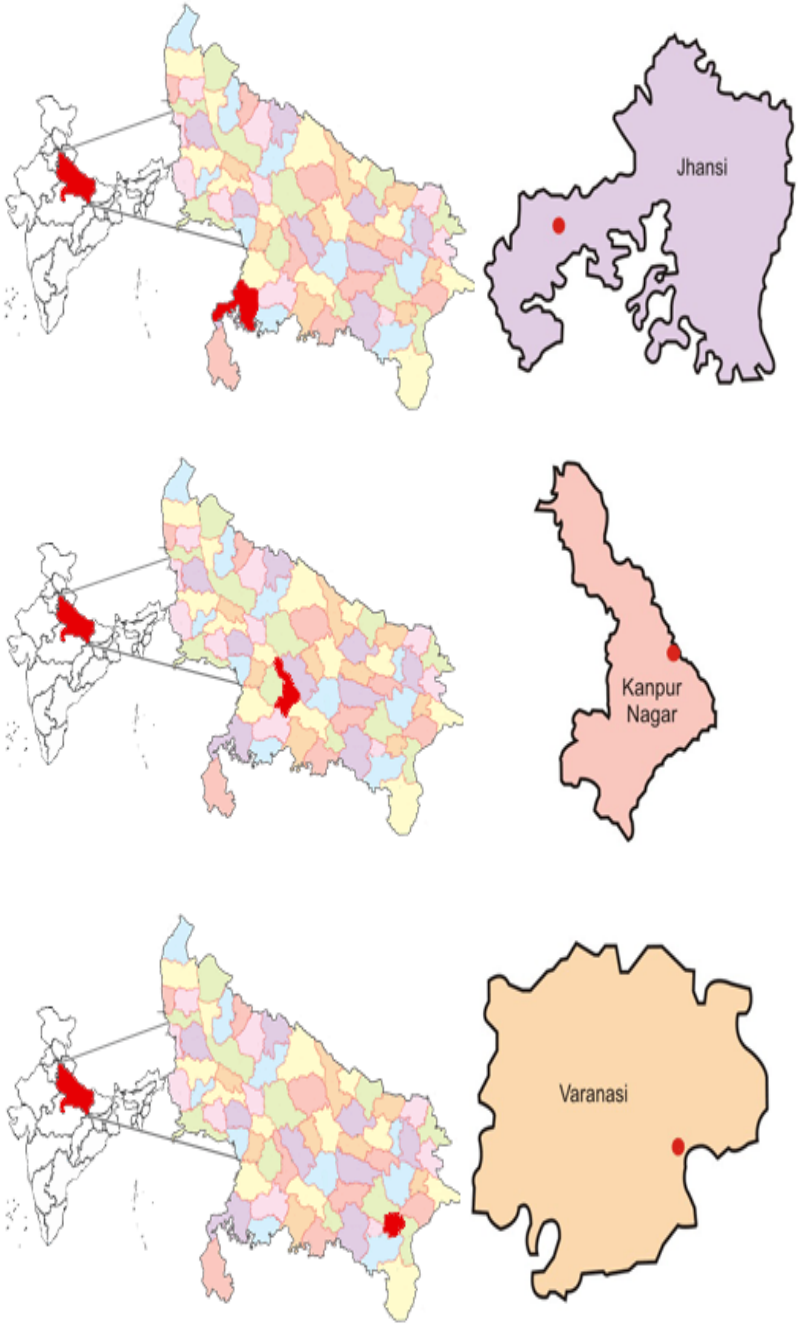

Figure 5: *Average MPCI - Jhansi (Western UP)*

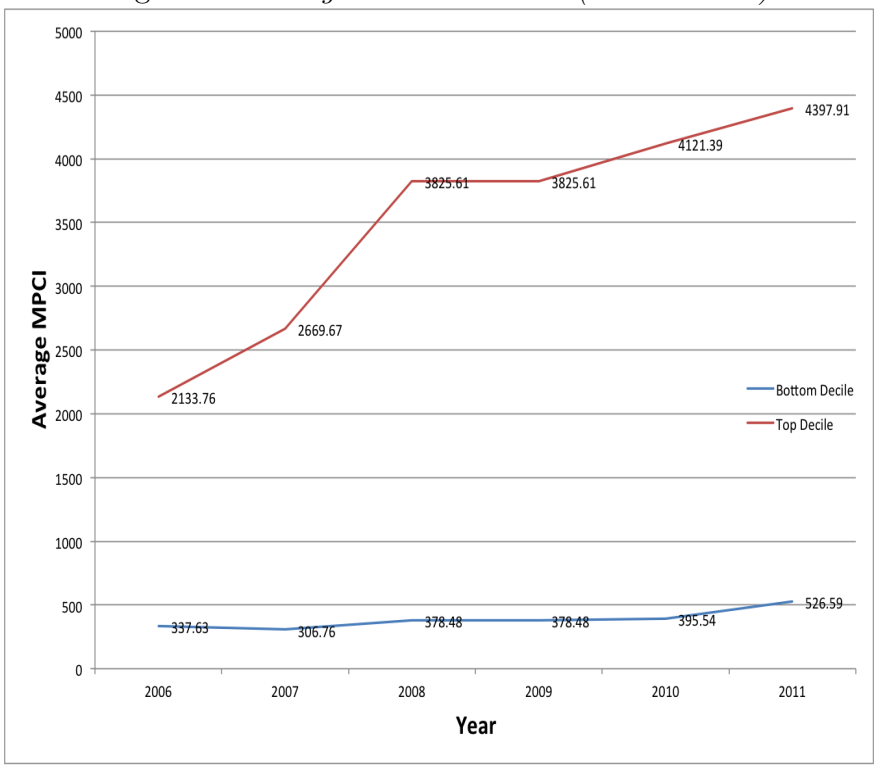

Figure 6: *Average MPCI - Kanpur (Central UP)*

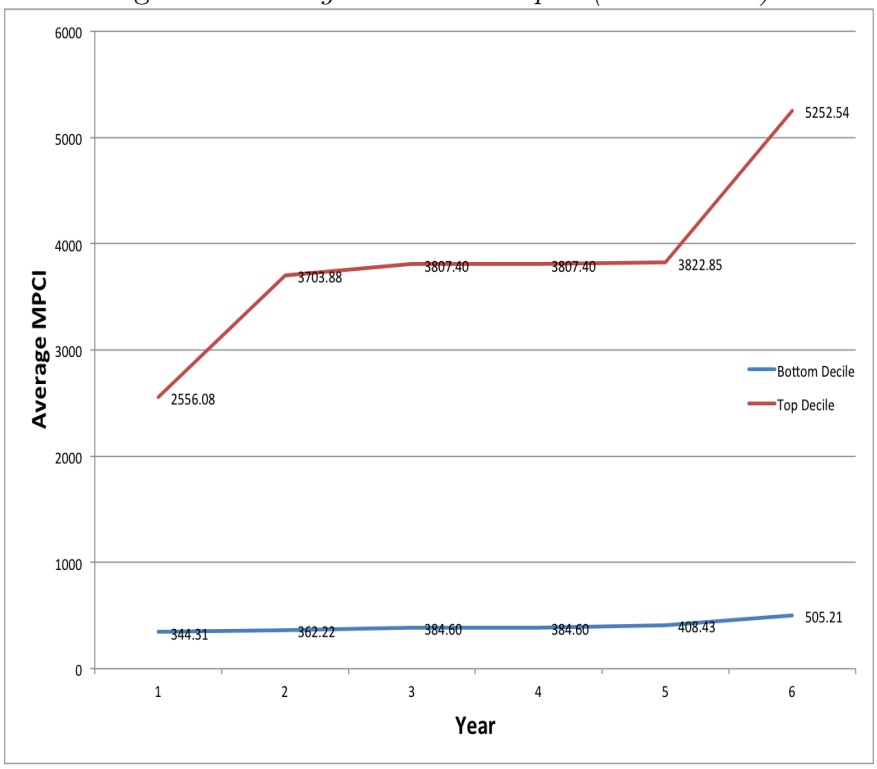

Figure 7: *Average MPCI - Varanasi (Southern UP)*