Inequality, Neighbourhoods and Variation in Prices

Abhimanyu Dadu (Indira Gandhi Institute of Development Research)

Namrata Gulati (Indira Gandhi Institute of Development Research)

Paper Prepared for the IARIW-IBGE Conference
on Income, Wealth and Well-Being in Latin America

Rio de Janeiro, Brazil, September 11-14, 2013

Session 13: Distributions in Space

Time: Friday, September 13, 4:00-5:30

Inequality, Neighbourhoods and Variation in Prices*

Abhimanyu Dadu† Namrata Gulati‡

This draft: 25th August 2013

Abstract

In this study we examine the link between of income distribution and prices of grain. We have weekly time series data on prices for wheat for 3 districts in Uttar-Pradesh obtained from the Department of Economics and Statistics of the Ministry of Agriculture, Government of India (DES-MOA, GOI) for the period 2006-2011. Data on Gini comes from National Sample Survey of India. We use Kalman filter to predict for the missing observations of gini for different months to make it consistent with time series data on price. We use Vector Error Correction model to check the significance of relationship between inequality and price. To lend further support to our analysis we run panel regression controlling for the per capita income. We find that there is inverted-U shape relation between inequality and level of price for food grains: if we compare a cross-section of societies, then price of food grain initially increases with increase in inequality and starts declining as inequality increases. The result is important as it holds even when the good is not differentiated on the basis of quality.

1 Introduction

The world over has seen dramatic increase in the income inequality. This makes it important to look at its implication on the price level and the purchasing power, especially of the poor.

*For helpful discussions and suggestions we thank Prof. Tucker McElroy. We are also thankful to Prof. Chandrasekhar and Andaleeb Rahman for sharing the data.

†Department of Economics , IGIDR Gen. A.K.Vaidya Marg, Goregaon (E),Mumbai - 400 065 (INDIA). Email: abhimanyu@igidr.ac.in

‡Department of Economics, IGIDR, Gen. A.K.Vaidya Marg, Goregaon (E),Mumbai - 400 065 (INDIA). Email: namrata@igidr.ac.in

On one side, 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. 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. The other side of the argument is that increase in income inequality may compound the disadvantage and exclusion of those who do not participate in the growth process. Mechanism through which it works is explained as follows - as income rises their marginal ability to pay also increases. Firms with aim of making higher profit respond to this change by increasing prices. This is especially true of commodities, where the quality difference is not so high. As increase in income is not uniform across the society, there are sections of the society which end up paying higher prices, without participating in growth process. For instance paper by Gulati and Ray (2012) 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. Similarly, 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.

This very much explains how the kind of neighborhood a person stays in affects their buying potential and quality of life. So 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 link between different specification of consumer preferences and distributive consequences of inflation.

In this paper, we examine how the regional prices of food grains respond to the level of inequality. For this we see how the price of food grains change over time for districts with different levels of inequality. As reported in Majumder, Ray and Sinha (2012), there

are large and significant spatial differences in the individual's level of income, implying that there are lot of regional variations in inequality. In this study we are interested in measuring functional consequences of these differences on the price of food grains. The data for this analysis are the wheat prices compiled and maintained by Department of Economics and Statistics of the Ministry of Agriculture, Government of India (DES-MOA, GOI). This is weekly data and is available for the period 2006-2010. Data on income distribution comes from different rounds of National Sample Surveys collected for different state regions of India from the period 1983 to 2012. This is annual data there fore we apply Kalman Filter to predict the missing values. We have this price and gini data available for three different state regions of Uttar-Pradesh which are Central, Southern and Eastern UP.

We find that the price responds to both the difference in the actual income level between individuals in a region and also on the proportion of poor as compared to rich. Taking both the effect together 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. The large 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 induces either people to shift to consumption of other varieties or increases the supply. The supply of new varieties or other sources of consumption will make prices resettle at a new equilibrium. Thus, there are price corrections over time.

The rest of the paper is organized as follows. Section II describes the NSS data from 1983 to 2011 on expenditure used to calculate level of inequality and also presents the data on prices which underlie the empirical results from panel regression. Section III presents the results based on Vector Error Correction model. To lend further support to analysis above section IV presents the results based on panel regression and attempts to quantify the price change component due to change in in-equality. Conclusions and policy discussions are presented in section V.

2 The Data

There are mainly two types of data sets that we use. We have time series data on gini - coefficient based on consumption expenditure for different regions of Uttar-Pradesh. This

data is useful to see how the gini evolves over time and also to see how does it vary across different regions. For further statistical analysis we use time series data on price of wheat. The choice of the district for analysis is restricted to those areas for which the data on price is available for the entire range of period and where people consume same quality of wheat. Idea is that the variation in price should not governed by the difference in the level of quality. We were able to identify 3 districts in Uttar - Pradesh which satisfy above criteria of selection which are Kanpur in central Uttar Pradesh, Varanasi in South Uttar Pradesh and Janshi in Eastern Uttar- Pradesh. It also merits a mention that Uttar-Pradesh is the major wheat consuming state in India, justifying looking at the wheat prices. Both the data are discussed in detail below.

2.1 Gini Distribution

Uttar-Pradesh like other parts of India, has reported significant growth in income over the past decade. But this has been complemented with rise in income inequality captured by gini-coefficient. 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 National Sample Survey conducted by the Government of India for the period 1983 and 2011. So this is the annual data that we have available for the said period. Many studies, for instance Himanshu (2007) and National Human Development Report (2001) have used consumption expenditure data from the National Sample Survey (NSS) to evaluate the extent of increase in inequality.

Gini data is available for relatively shorter duration. Which is understandable as conducting such large surveys is not easy. Also one does not expect gini to change a lot over small time period. In order to make data of Gini coefficient consistent with the time series data on price we use state-space models 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. On the basis of the available data and other diagnostics it turns out that gini follows AR(1) process. So the State-Space formulation that

we use to predict the missing values of the gini is given by:

$$G_t = y_t + v_t \tag{1}$$

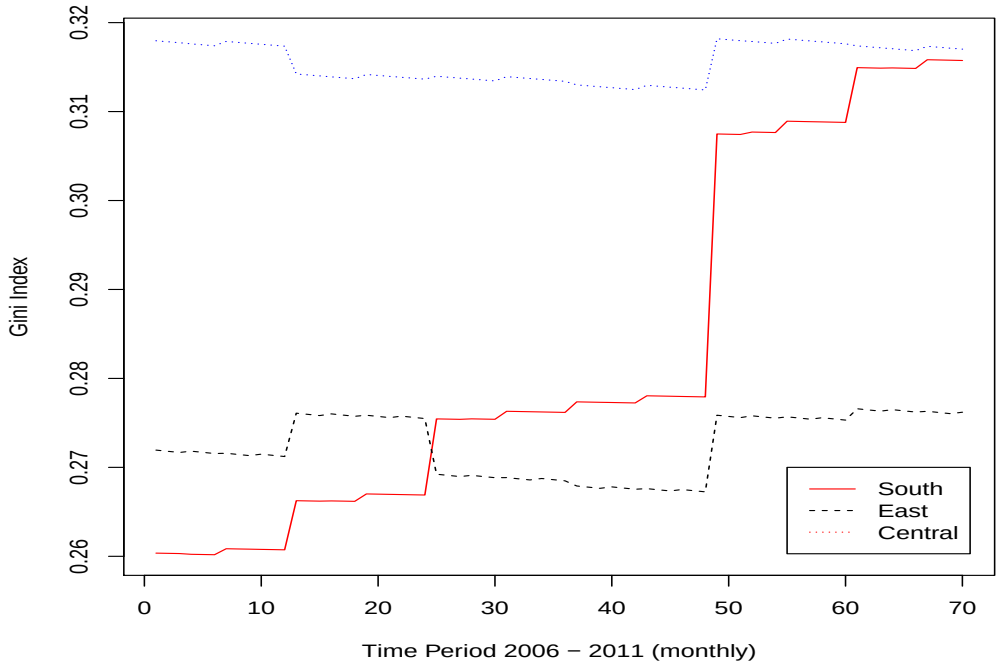
$$y_t = \delta_t + \phi * y_{t-1} + \epsilon_t \tag{2}$$

Here equation 1, is the measurement equation and equations 1 and 2 combined to form the state equation. v_t and ϵ_t are the random variables that represent the process and measurement noise respectively. They are assumed to be independent of each other, white noise, and with normal probability distributions.

Literature on evolution of inequality suggest that it has been increasing over time especially in the developing countries. It is affected by host of factors like migration, growth etc. For the particular districts that we have considered this seems to be the case.

In order to gain some understanding of dynamics of gini coefficient over time Figure 1 represents time series data for Southern, Eastern and Central regions of Uttar-Pradesh.

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



It is evident from the plot above that there is lot variation in the gini across time and over different regions. In Central UP initial gini is high and it continues to remain so for all

the time periods. However in the Southern Uttar Pradesh gini registers a consistent increase over the period of time.

Also the initial investigation of the data suggests presence of stochastic trend and the same is confirmed by the Augmented Dickey Fuller (ADF) test. The results from the test are reported in table 3 in Appendix. This general upswing can be attributed to the expected general growth of the economy and population. In light of above results it will be interesting to look at the price dynamics in the above districts.

2.2 Price

We have unpublished price data 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. One important advantage of the 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).

As an illustration for the price variation, Figure 2 shows the plot of 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 lot of variation in price over time and across districts. We observe that price 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.

For the purpose of analysis we first study the properties of individual series to asses presence of unit root under the assumption that the error terms are correlated overtime. We employ the Augmented Dickey Fuller (ADF) test for the same and test the null hypothesis of unit root. In particular the following model was specified for the test:

$$p_t = \alpha_0 + \rho p_{t-1} + \sum_{i=1}^{p-1} \phi_i \Delta p_{t-i} \tag{3}$$

Figure 2: *Wheat price series for 3 districts in Uttar Pradesh*

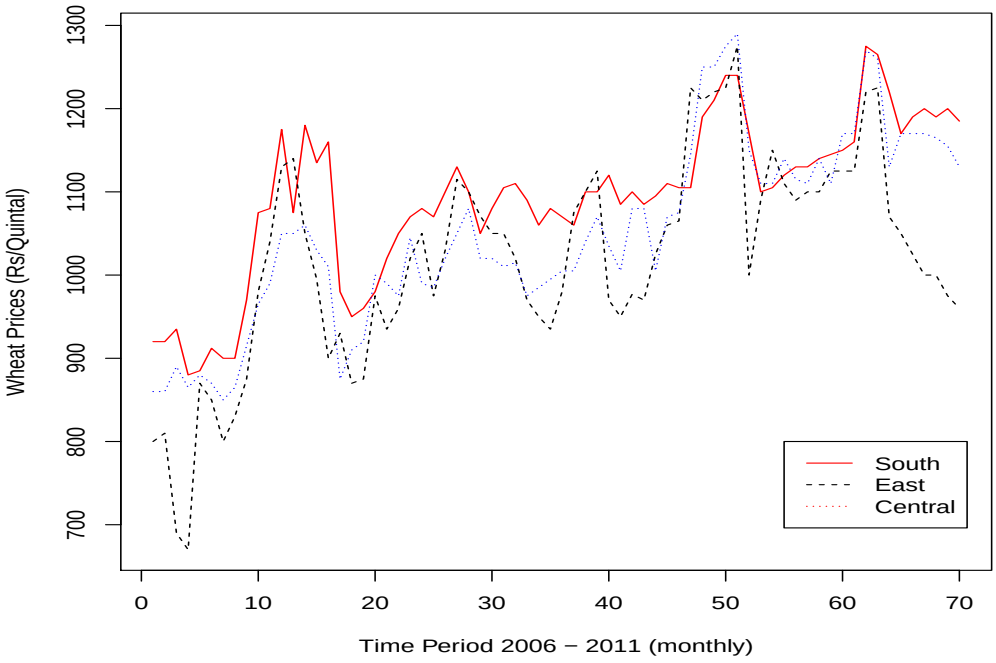
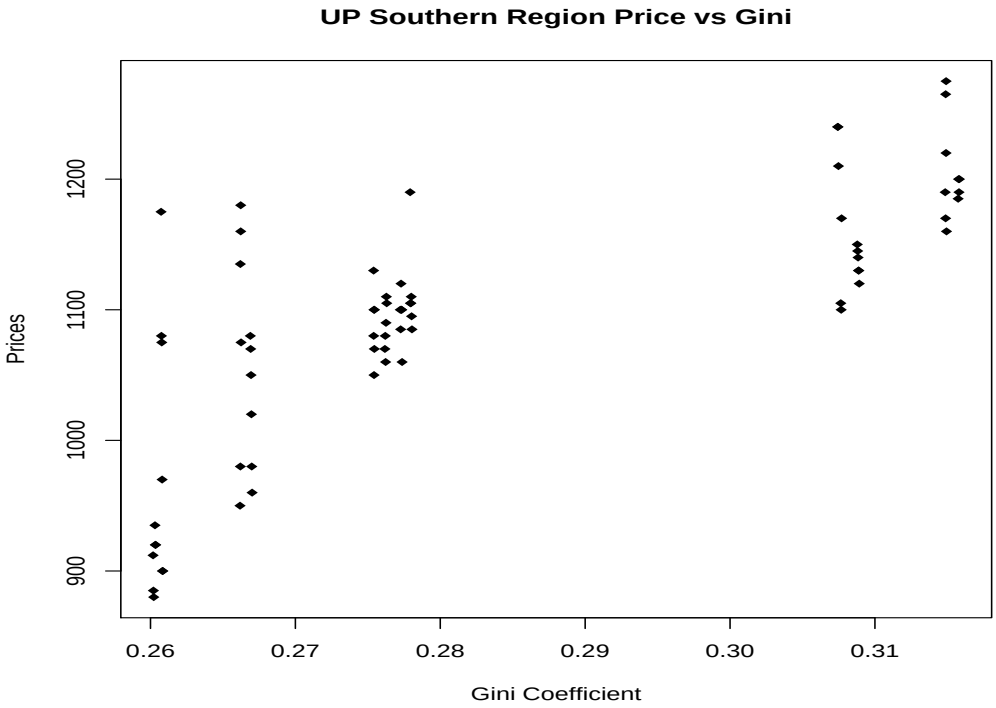


Figure 3: *Evolution of monthly prices and Gini-coefficients*



The lag terms on the differenced price series was determined using the BIC criteria. The results of the unit root test are given in table 4 in the Appendix. Tests confirmed that the null of unit root cannot be rejected for 2 series at 5% level of significance.

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

3 Results from the Error Correction Model

The key idea here is to see how the interaction of market mechanism with existing level of inequality affect price level. Two groups of data described above are employed to test the causal relationship between income inequality and prices. The basic descriptive analyses presented in the previous sections are useful for our further analysis. We find that both the series are not stationary and have unit root but they are cointegrated i.e. they have same long run equilibrium relationships. The results from the cointegration test are reported in table 5 in Appendix. So we use error correction model to check for cointegrating relationships and the short term dynamics given by the following equations.

$$\begin{aligned} \Delta gini_t &= \alpha_1(p_{t-1} - \beta gini_{t-1}) + \gamma_{11}\Delta gini_{t-1} + \gamma_{12}\Delta p_{t-1} + \epsilon_{1t} \\ \Delta p_t &= \alpha_2(p_{t-1} - \beta gini_{t-1}) + \gamma_{21}\Delta gini_{t-1} + \gamma_{22}\Delta p_{t-1} + \epsilon_{2t} \end{aligned}$$

In table 1 we report the results of Vector Error Correction model for Southern UP.

The result shows that the gini has a statistically significant positive effect on price behaviour. Also it warrants a mention that this causality does not run in the opposite direction. This suggests that gini effect contributes to the income effect in increasing the level of price.

Table 1: Results from VEC

	Coef.	Std. Err.	z	$P > \|z\|$
D_pr_var_s_L1.	-0.27	0.08	-3.21	0.00*
pr_var_s_fir_LD.	0.08	0.12	0.66	0.51
gini_south_LD.	2684.93	1360.64	1.97	0.04*
_cons	0.00	5.32	0	1
D_gini_south_L1.	0.00	0.00	1.44	0.15
pr_var_s_fir_LD.	0.00	0.00	1.47	0.14
gini_south_LD.	-0.05	0.11	-0.5	0.61
_cons	0.00	0.00	1.83	0.06

* denotes 5% level of significance

4 Results from the Panel Regression

The regression analysis in this section aims to give further support to the main feature of the relation between price and inequality. Also, the use of data on the three state regions together helps us to more elegantly explore and illustrate the causality from gini to price. To this end, we use panel data framework to estimate the strength of the relationship between gini and price for the three regions from the period 2006-2011. So the equation that we are interested in estimating is given by;

$$p_{it} = \alpha + \beta X_{it} + U_{it},$$

Where p_{it} is vector of prices which varies across different regions and over time and X_i is the vector of controls and U_{it} is error variable. To evaluate the impact of income distribution on price we regress price on different moments of income distribution. We use gini and gini square to allow for the non linear relation between inequality and price. In order to capture the level effect we use monthly per capita income expenditure as a proxy for GDP at the state regional level. We use fixed effect model to control for unobserved heterogeneity. The results from the panel regression are reported below.

It is evident from the table above that with increase in gini price initially increases and then it starts to taper off. The results lend credence to intuition that as inequality increases with increase in growth price in economy generally increase, but after a point with increase in supply of the differentiated goods prices start to fall down, thus explaining the inverted-U

Table 2: Results from Panel Regression

	model 1	model 2	model 3
_const	697.26*	-7441.08*	
Gini	1226.71*	57243.12*	-55955*
Gini squared		-95851.69*	89926*
MPCE			0.8647

* denotes 5% level of significance

shape relation between income inequality and price.

5 Conclusion

The issue of increase in inequality is one of increasing scrutiny over the past several years. This is primarily because India like many other regions in the world has experienced dramatic increase in the level of inequality. In this paper we show how as money looms larger in societies, affluence and its absence matters more. If the main advantage of affluence were the ability to afford fancy vacations, inequality would matter less than it does today. But as money comes to adversely affect prices of essential commodities especially food, life becomes harder for those with modest means. We show that the marketization of everything sharpens the sting of inequality as it exasperates the existing level of inequality by further increasing the prices initially. Later on price tapers-off as inequality increases. This implies that the role played by the economic ghettos in explaining an individual's well-being could be striking. The policy implication of such change is profound. It requires a fiscal policy that focuses not only on efficiency, but also on equity. Targeted distribution of accumulated fiscal surpluses to needy households is clearly needed. In the light of above results it will be interesting to approach the debate that India has been facing recently on the distribution of basic food items like rice, wheat and course grain. One of the ironies that India faces is in food grain sector - it has large stocks of food grains which are not being utilized and on the other hand there is large size of population which is malnourished. And all this is against the backdrop of obstinately high consumer prices, which rose 9.64% in July from a year earlier. But this increase in prices is not uniform in all the regions and significantly depends on the level of inequality. So there is curious paradox on display where one people shine is glare for others!

Appendix

Table 3: ADF test for Gini

	Estimate	Std. Error	t value	$Pr(>\|t\|)$
(Intercept)	0.00	0.00	0.43	0.66
z.lag.1	-0.01	0.02	-0.31	0.76
z.diff.lag	-0.04	0.12	-0.34	0.73

* denotes 5% level of significance

	1pct	5pct	10pct
tau2	-3.51	-2.89	-2.58
phi1	6.7	4.71	3.86

Value of test statistic -0.30 and 1.63

Table 4: ADF test for Prices

	Estimate	Std. Error	t value	$Pr(>\|t\|)$
(Intercept)	154.72	65.11	2.37	0.02*
z.lag.1	-0.13	0.05	-2.32	0.02*
z.diff.lag	-0.01	0.12	-0.05	0.96

* denotes 5% level of significance

	1pct	5pct	10pct
tau2	-3.51	-2.89	-2.58
phi1	6.7	4.71	3.86

Value of test statistic -2.32 and 2.98

Table 5: Results from Cointigration between Prices and Gini

	Estimate	Std. Error	t value	$Pr > \|t\|$
(Intercept)	32.72	11.46	2.85	0.00*
z.lag.1	-0.28	0.09	-3.10	0.00*
z.diff.lag	-0.05	0.12	-0.41	0.67

* denotes 5% level of significance

	1pct	5pct	10pct
tau2	-3.51	-2.89	-2.58
phi1	6.70	4.71	3.86

Value of test statistic -3.10 and 4.84

References

[1] Banks, J., Blundell, R. and Lewbel, A. (1997), "Quadratic Engel Curves and Consumer Demand" *Review of Economics and Statistics*, vol 79, 527-539.

[2] Bergh, A. and Nilsson, T. (2012), "When More Poor Means Less Poverty: On Income Inequality and Purchasing Power" Working Papers 2012:2, Lund University, Department of Economics.

[3] Broda, C. and Romalis, J. (2009), "The Welfare Implications of Rising Price Dispersion" Working Papers, Graduate School of Business, University of Chicago.

[4] Carvalho, V.M. and Harvey, A.C., (2005), "Growth, cycles and convergence in US regional time series" *International Journal of Forecasting*, vol. 21(4), pp. 667-686.

[5] Dev, M., (2011), "Rising Food Crisis and Financial Crisis in India: Impact on Women and Children and Ways of Tackling the Problem" IGIDR, WP-2011-003.

[6] Government of India (2001), "National Human Development Report of India, 2001" Planning Commission, Government of India, New Delhi.

[7] Gulati, N., and Ray, T., (2011), "Inequality, Neighbourhoods and Welfare of the Poor" Discussion Paper 11-07, Indian Statistical Institute, Delhi.

[8] Hamilton, J.D., (1994), "Time Series Analysis" *Princeton University Press*, 1994.

[9] Harrison, P.J. and Stevens, C.F. (1976), "Bayesian Forecasting" *Journal of the Royal Statistical Society*, series B 38, pp. 205-247.

[10] Harvey, A., (2006), "Forecasting with Unobserved Components Time Series Models" in G. Elliott and C. Granger and A. Timmermann, eds., *Handbook of Economic Forecasting*, 2006, vol 1, Elsevier, pp. 327-412.

[11] Himanshu (2007), "Recent Trends in Poverty and Inequality: Some Preliminary Results" *Economic and Political Weekly*, vol 42, pp. 497-508.

[12] Karagiannis, E. and Kovacevic, M., (2000), "A Method to Calculate the Jacknife Variance Estimator for the Gini Coefficient" *Oxford Bulletin of Economics and Statistics*, Vol 62, pp. 119-122

[13] Koopman, S. J., Harvey, A. C., Doornik, J. A., and Shephard, N., (1999a), "*Structural Time Series Analysis, Modelling, and Prediction using STAMP*" London: Timberlake Consultants Press

[14] Majumder, A., Ray, R., and Sinha, K., (2012), "Spatial Comparisons of Prices and Expenditure in a Heterogeneous Country: Methodology with Application to India" Monash Economics Working Papers 19-12, Department of Economics, Monash University.

[15] Mishra, A. and Ray, R. (2011), "Prices, Inequality and Poverty: Methodology and Indian Evidence" *Review of Income and Wealth*, vol. 57(3), 428-448.

[16] Motiram, S. and Naraparaju, K. (2012), "Growth and Deprivation in India: What Does Recent Data Say?" IGIDR Working Paper WP-2013-005, IGIDR, Mumbai.

[17] Muellbauer, J. (2012), "Prices and Inequality: The United Kingdom Experience" *The Economic Journal*, vol 84, pp. 32-55.

[18] Muellbauer, J. (1974), "Household composition, Engel curves and welfare comparisons between households : A duality approach" *European Economic Review*, vol. 5(2), pp. 103-122.

[19] Nicholas, A., Ray, R. and Valenzuela, M. R. (2010), "Evaluating the Distributional Implications of Price Movements: Methodology, Application and Australian Evidence" *Economic Record*, vol 86 (274), 352- 366.

[20] Pendakur, K. (2002), "Taking Prices Seriously in the Measurement of Inequality" *Journal of Public Economics*, vol 86, pp. 47-69.

[21] Pendakur, K. (2009), "EASI made Easier", in D. Slottje, eds., *Quantifying Consumer Preferences: Contributions in Economic Analysis Series*, 2009, London: Emerald Group Publishing, pp 179-206.

[22] Ray, R. (1985) "Prices, Children and Inequality: Further Evidence for the U.K., 1965-82" *Economic Journal*, vol. 95, pp. 1069-1077.