INDIAN INSTITUTE OF TECHNOLOGY

KANPUR

SOLAR RADIATION OVER INDIA

PANEL ANALYSIS

ECO342A: APPLIED ECONOMETRICS

SUBMITTED TO

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SUBMITTED BY

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INTRODUCTION & MOTIVATION

Estimation of solar radiation finds an importance in the wide domain of fields, from agriculture, construction to renewable energy to heating and cooling situations. Though the temperature, pressure and wind speed data are accurately available for the usage, solar radiation data is not available for every location and is required to be estimated. The accurate predictions of solar radiation holds a strong significance as it can help in overcoming the intermittency involved in solar power. There is a strong impetus given to renewable sources of energy especially solar energy. The main focus areas have been South Asia especially India and China. The demand is called for due to various environmental reasons and overcoming the dependence of oil and coal deficient countries like India on oil-coal imports.

Talking about the environmental concern, the major contributors to pollution are carbon dioxide emissions from automobiles and power sector. Talking about Power generation, electricity is an important ingredient in making development a reality. Generating electricity is the leading cause of pollution, emission of CO2 in the environment is causing the problem of toxic pollutants in the air as well as chronic global warming. Nearly 80% of all Coal power plant emits carbon dioxide which is a Greenhouse gas. Considering the case of US will give a picture of impact coal has on the environment. Coal power plants produce less than half of the electricity in the USA but account for nearly 80% of power plant carbon emissions. The case though discusses the USA but is also relevant to the case of Asia. the rise of Asia was marked from the dawn of the 1990s with GDP of Asia becoming the largest in the world and incidentally, also became the largest emitter of Carbon. CO2 emissions today from human activities today are higher than ever in human history.

Global CO2 were 150 times more in 2011 than in 1850. This huge shift can be attributed to rapid economic development initiated by Europe and North America followed by Asia and Latin America. The concentration effect of emissions can be seen from the fact that top 10 emitters contribute 78% of global emissions, all of which are large economies with large population and energy consumption. As per reports suggested too much dependence on industries for economic development leads to exploitation of the resources. However, there is always a dichotomy between environment and economic development. Saving one side will give an impact on the other.

Thus, to maintain balance between economic development and environmental sustainabiliy, it becomes imperative to employ renewable resources of energy for power needs. India has been focus of my study as much work is needed to be done in the context of India and due to the geographical advantage India holds in terms of solar power. Since Independence, the focus of India has been on development. Although it has brought many benefits to India by boosting our economic growth, it is clear that we are far away from achieving the basic objectives of any society i.e. security of water, health and food. Over the last seventy years, India’s strong growth has been able to pull out much of our population from the poverty by increasing employment opportunities but this has resulted in degrading our environment too. Rapid economic development has led to growing scarcity of our natural resources. Poverty and the degraded environment are closely interrelated because a major chunk of our society depends on the environment and its degradation has seriously affected our development in the long term. The impact of past industrialization and exploitation of environment shattered our dream to become an eco-friendly nation. Mrs. Indira Gandhi in the Stockholm Declaration of 1972 discussed the doctrine of "Sustainable Development". Thereafter, in 1987 a report was issued by the World Commission on Environment and Development in which they tried to link environment protection and economic development. Also, the Rio Declaration 1992 structured the principles of Sustainable Development. The main purpose of economic development is to provide a quality standard of living since industrial development creates more jobs than any other field which in turn increases the possibility of its adverse effects on the environment. Dust, smoke, and toxic gases originating from thermal power plants, mines and other factories make this environment hazardous to live. The United Nations Conference on Sustainable Development in 2012 issued 17 Sustainable Goals (SDGs) to tackle environmental economic and political challenges. Thus, India is an emerging economy have to maintain a strong balance between economic development and environment sustainability and to counter the intermittency of renewable sources of energy, accurate predictions are required not only for a particular location but an accurate estimate which can be applied PAN-India. Various measures have be taken by the government in this direction. India has launched Jawaharlal Nehru National Solar Mission with the target of generating 20,000 MW of Solar Power by 2022

This requires the data which is available for every location in India and also gives fairly accurate values to gain feasibility.

The literature suggests that the majority of work has been done by people of engineering background and I was unable to find any work on estimation by an econometrician, though it involves linear regression, Autoregressive processes, etc. This motivated me to choose this topic and apply my econometric tools. Another major factor for choosing the domain is that there has been work in time series and stationary aspects of the data but not in terms of panel analysis. I was not able to find any work with special focus on panel effects. This called for applying the panel data analysis which is performed by this paper.

OBJECTIVE

The objective is to estimate diffuse solar radiation over India by using panel data analysis The analysis involves data for 15 years from 2000-2014 on monthly basis. Thus, there are 180 time values available for each location. The analysis involve 23 locations all over India over which the data is available. The locations covers all the geographies of the country for which the data was accurately available. The wide range of locations include Srinagar in upmost North to Shillong in the most eastern parts to Ahmedabad in West to places like Thiruvananthapuram and Chennai in the south. Data has also been used for island states of Andaman and Nicobar (Port Blair) and Lakshadweep (Minicoy). As India is a land of such wide geographies, the work can be used to extend to multiple places in the world. Thus, this variation would be the ideal sample for the panel data analysis. The raw data was present for every hour for 15 years. Such an accurate prediction of hourly basis is better performed under the domain of Machine Learning and Time series and is very time consuming to get a cross sectional and time trend. Thus, the data was used which is month based which turns out to clearly satisfy the required goals.

DATA SET

· NSRDB (National Solar Radiation Data Base), a part of international activities of NREL (National Renewable Energy Lab, USA)
https://www.nrel.gov/international/ra_india.html
· MNRE (Ministry of New & Renewable Energy)
http://mnre.gov.in/file-manager/UserFiles/solar_radiant_energy_over_India.pdf

As the data from Indian Meteorological Departments is very expensive, I will employ the data from NREL which claims that the data have been collected at a sufficient number of locations and temporal and spatial scales to accurately represent regional solar radiation climates. The majority of work done in Indian context is through the data of MNRE (Ministry of New and renewable Energy) but it includes monthly average data for one representative year which was chosen to account for variations for atleast 15 years, thus the data is not rich enough. The NREL data consists of variation of most required parameters for 15 years on 30 min difference which is required for our estimations and predictions. As the work is based on engineering and geographical domain, I will try to briefly explain the content of relevance and will include the appendix for details, if required.

LITERATURE REVIEW

There was no literature available for the panel analysis of solar radiation over India or any other place. Though, while searching for it, I got to learn much about the whole domain and found the basis of my understanding and current work, thus suiting to the definition of literature review.

The research paper "**Predicting monthly mean daily diffuse radiation for India**" by Indira Karakoti , Prasun Kumar Das and S.K. Singh formed the very basis of my work. The paper is called the base of my work as it highlights the importance of my work as "The resource assessment is the most important exercise toward project evaluation. Due to intermittent nature of renewable energy sources, the resource assessment makes major impact on the overall viability of the project. Long term solar radiation and meteorological data (especially in Typical Meteorological Year format) is the most preferred data in large scale solar energy projects. Due to unavailability of long term measured data of solar radiation and other climatic parameters in India; the project developers are facing lots of problem towards financial closure of the projects and impact of uncertainty of re source on bankability of the projects." The monthly average daily

diffuse transmittance (ratio of diffuse-to-extraterrestrial solar radiation) which is the diffuse radiation predicted in my work. It was found to be correlated with sunshine fraction, temperature and relative humidity through the linear and quadratic equations for India. The data for sunshine fraction was not free and hence, I could not employ that factor but used other factors like solar zenith angle to counter to the deficiency.
The data of 18 stations among the 23 stations are combined and employed pooled OLS for the estimation of diffuse radiation. This should be kept in mind that they have taken the monthly average values for one particular representative year. Thus, they used only 12 values for one location while I employed 180 locations for each location, thus creating a richer data set.

Second paper of interest, "Time series analysis of hourly global horizontal solar radiation" by J.M. Gordon and T.A. Reddy, focussed on time series of analysis. I used a dynamic panel to get the approximate effect but the paper provided insight into the time trend of global horizontal solar radiation while I employed to work on diffuse horizontal radiation. The paper discussed sequential and stationary characteristics which focuses on hour-to-hour variation and individual dependent effects respectively. Thus, the paper also tried to get a cross sectional and time trend implications which I captured through panel analysis.
Accurate information on sequential and stationary properties of hourly solar radiation for systems with memory (small power backups for solar energy generating systems with buffer, certain solar absorption AC systems, certain control problems in solar building).
The aim of the paper to determine an analytical model, otherwise these things are done with large scale calculations. The paper was interesting in the sense that very few considered sequential of hourly data like this paper but majority of papers focus on longer time frames of daily, monthly etc. The paper includes many interesting implications, for example, sequential characteristics of wind speed, air temperature, relative humidity have strong correlation at the one-hour time lag. The database covered climatic condition from tropical to temperate which is also true in my work too. The objective behind discussing sequential properties was to generate and examine hour-to-hour variation in solar radiation, persistent times and persistence strengths. One may want to have different auto-correlational relations for different hours of the day, but it was found not to vary much. So, can ignore hour-to-hour variation in rho(d) and use the mean of all hours of the day. Though it seems that the whole day hours have impact, but they may be due to 1 hour lag effect using partial autocorrelation function. Though in majority, lag 2 can be ignored but not in 0.05 significance.

Finally, the third paper that I particularly want to mention is "Improved statistical procedures for the evaluation of solar radiation estimation models" by R.J. Stone. The majority of the statistical work done in the field of solar radiation estimation depends on Root Mean Square Error (RMSE) and Mean Bias Error (MBE) as defined below:

$$RMSE = \left(\frac{1}{n} \sum_{i=1}^{n} {d_i}^2 \right)^{\frac{1}{2}}$$

$$MBE = \left(\frac{1}{n} \sum_{i=1}^{n} d_i \right)$$

Where d_i is the difference between true and predicted value

The paper discusses the use of RMSE and MBE and also introduce the t statistics, its significance and how it can be related to MBE and RMSE to get better gauge for models. RMSE is used to check for short time performance performance of error but suffer from some drawbacks like (i) few large errors in the RMSE expression can produce a significant increase in RMSE, (ii) does not differentiate between under and over-estimation as it is the whole square of errors. MBE is used to gauge the long term performance of the model but suffers from the fact that overestimation of one is cancelled by underestimation of other is it doesn't involve absolute terms and is sought to work like a moving average. There are also drawbacks in their combined use as they are conflicting values to each other which calls for requirement of other instruments which is a subjective and time consuming process. Second issue is that RMSE and MBE have dimensional values. The solution came out by applying T statistic which can be defined in terms of RMSE and MBE as follows:

$$t = \left(\frac{(n-1)MBE^2}{RMSE^2 - MBE^2} \right)^{\frac{1}{2}}$$

Smaller the value of t-statistic better is the performance.

Though I have mentioned only 3 particular papers in literature review, these are not the only papers I considered but just the most important papers. The comprehensive list is given in references.

WORKING MODEL

$$(H_D/H_0)_{it} = \alpha + \beta_1 T_{it} + \beta_2 P_{it} + \beta_3 (R_h)_{it} + \beta_4 (W_s)_{it} + \beta_5 (W_D)_{it} + \beta_6 (\theta_z)_{it} + \beta_7 D_{it} + \beta_8 (T^2)_{it} + \beta_9 (P^2)_{it} + \beta_{10} (R^2{}_h)_{it} + \beta_{11} (W^2{}_s)_{it} + \beta_{12} (W^2{}_D)_{it} + \beta_{13} (\theta_z{}^2)_{it} + \beta_{14} D^2{}_{it} + \beta_{15} Lat_i + \beta_{16} Long_i + \varepsilon_{it}$$

where

H_D is diffuse solar radiation

H_0 is the global extraterrestrial radiation

T_{it} is the temperature

P_{it} is the pressure

$(R_h)_{it}$ is the relative humidity

$(W_s)_{it}$ is the wind speed

$(W_D)_{it}$ is the wind direction

$(\theta_z)_{it}$ is the solar azimuth angle which is the angle made by the horizontal projection of Sun from the North-South line

D_{it} is the dew point

Lat_i is the longitude of the location

$Long_i$ is the longitude of the location

I sequentially worked on the models of estimation, starting with pooled OLS and then to Fixed Effect and Random effect which gave Fixed Effect model using Hausman Test. Then, I checked for time-fixed effects, i.e. whether the time dummies for all years are required by using the null hypothesis that all time dummy terms are zero which came was rejected. Then, I checked for dynamic panel which came out to be the case but upto lag 1. So, I used dynamic panel model and used Arellano-Bover estimation. To check for Adjusted R Square, I stored the predicted rel_dhi and regressed it on dependent variable. Thus, I got an adjusted R Square of **0.93**. The procedure have been explained in detail in Methodology.

METHODOLOGY & EMPIRICAL RESULTS

The data comprises for 23 locations in India and has been assigned a number as follows:

Ahmedabad	1	Jodhpur	9	Pune	17
Bangalore	2	Kolkata	10	Ranchi	18
Bhavnagar	3	Minicoy	11	Shillong	19
Bhopal	4	Mumbai	12	Srinagar	20
Chennai	5	Nagpur	13	Thiruvananthapuram	21
Goa	6	New Delhi	14	Varanasi	22
Hyderabad	7	Patna	15	Visakhapatnam	23
Jaipur	8	Port Blair	16		

The data is monthly wise for 15 years from year 2000 to 2014, thus 180 values for each location for each variable.

I first tried to check between the Fixed Effect, Random Effect and Pooled OLS. So, I followed the technique taught in the course ECO342A as shown in figure 1.

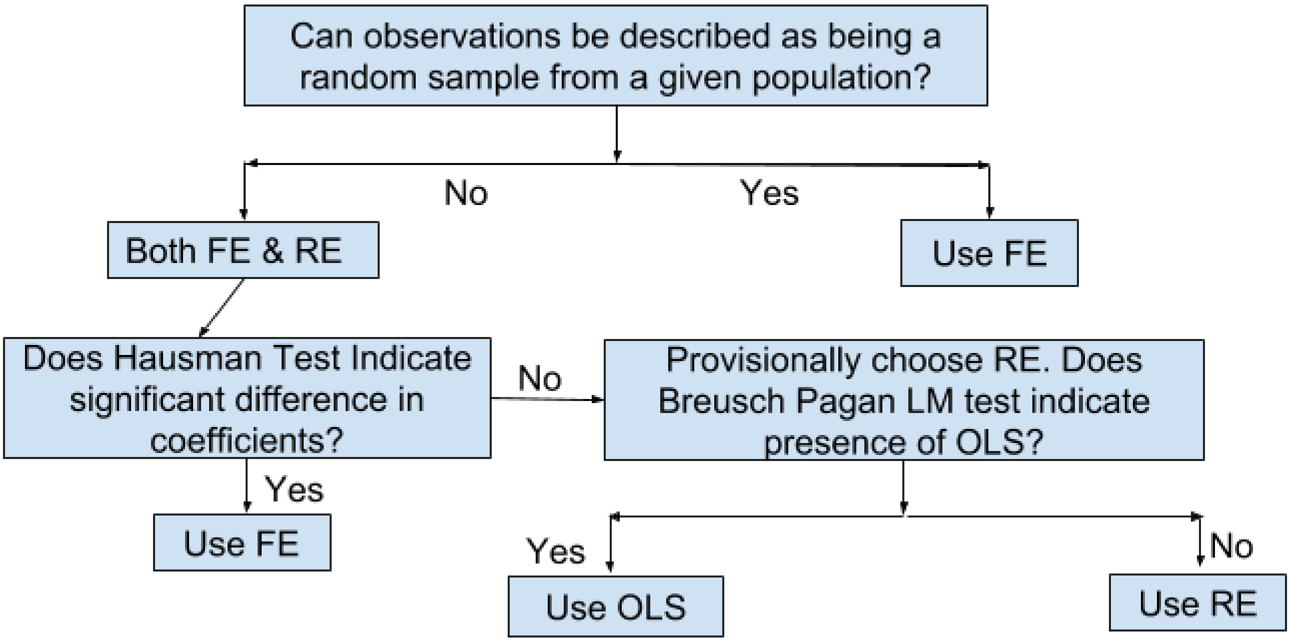

Figure 1

Hausman Test gave fixed effect with P> chi2 = 0.0000. Thus, we checked later between Fixed effect and pooled OLS using F test in which Prob > F = 0.0000. Thus, Fixed effect was used.
Next step was to check for time fixed effects.
To test for time fixed effects, I run the fixed effect estimate but this time include time dummy variables as covariates. Then, I employed the f test to determine if all the dummies for time are simultaneously zero using the command **testparm**. Thus, I ran the command **testparm i.time** after the fixed effect regression and found that Prob > F = 0.0000. Thus, we need to include time effects. Also, the thing remained now was to think about the dynamic nature of panel. Thus, to get an idea of some possible correlation of diffuse radiation with its past values, I checked the correlation with lagged 1 and lagged 2 values and found out to be 0.8293 and 0.6192 respectively.This hinted towards dynamic panel as a result, I ran Arellano Bover estimates. I stored the estimate as rel_yhat and checked the fit with our dependent variable, rel_dhi using regression command:
Regress rel_dhi rel_yhat
This gave a high adjusted R square of 0.9297. I checked Arellano-Bover estimates for lag 2 also but the lag 2 term came out to be insignificant.

Thus, we employed Arellano Bover estimate to the model which gave a good fit with adjusted R^2 of 0.93.

The coefficients of explanatory variables are given in the table:

Variable	Coefficient	Standard Error	P > |z|
L1.rel_dhi (lag of dependent variable)	.1822735	.0092349	0.000
Lat (latitude)	.2031326	.0537415	0.000
D (longitude)	.1822497	.0634645	0.004
Monthly_dew (monthly average of dew point)	-2.382772	.1565837	0.000
Monthly_pre (monthly average of pressure)	.3228634	.1408564	0.022
Monthly_tem (monthly average of temperature)	-2.636447	.1814493	0.000
Monthly_wsd (monthly average of wind speed)	-6.09804	.5843516	0.000
Monthly_rhd (monthly average of relative humidity)	.5239126	.1057516	0.000
Monthly_sza (monthly average of solar azimuth angle)	8.860246	.681355	0.000
Monthly_wdn (monthly average of wind direction[angle])	-.0580452	.0114129	0.000
Monthly_dew_sq (square of monthly average of dew point)	.0304323	.0016646	0.000
Monthly_pre_sq (square of monthly average of pressure)	-.0001455	.0000799	0.069
Monthly_tem_sq (square of monthly average of temperature)	.0290083	.0018772	0.000
Monthly_wsd_sq (square of monthly average of wind speed)	.7849555	.0740541	0.000
Monthly_rhd_sq (square of monthly average of relative humidity)	-.0048812	.0005422	0.000
Monthly_sza_sq (square of monthly average of solar azimuth angle)	-.0565826	.0038498	0.000
Monthly_wdn_sq (square of monthly average of wind direction[angle])	.0002445	.0000302	0.000
_cons (constant term)	-433.266	68.56696	0.000

Figure 2 helps us to understand the fit of values.

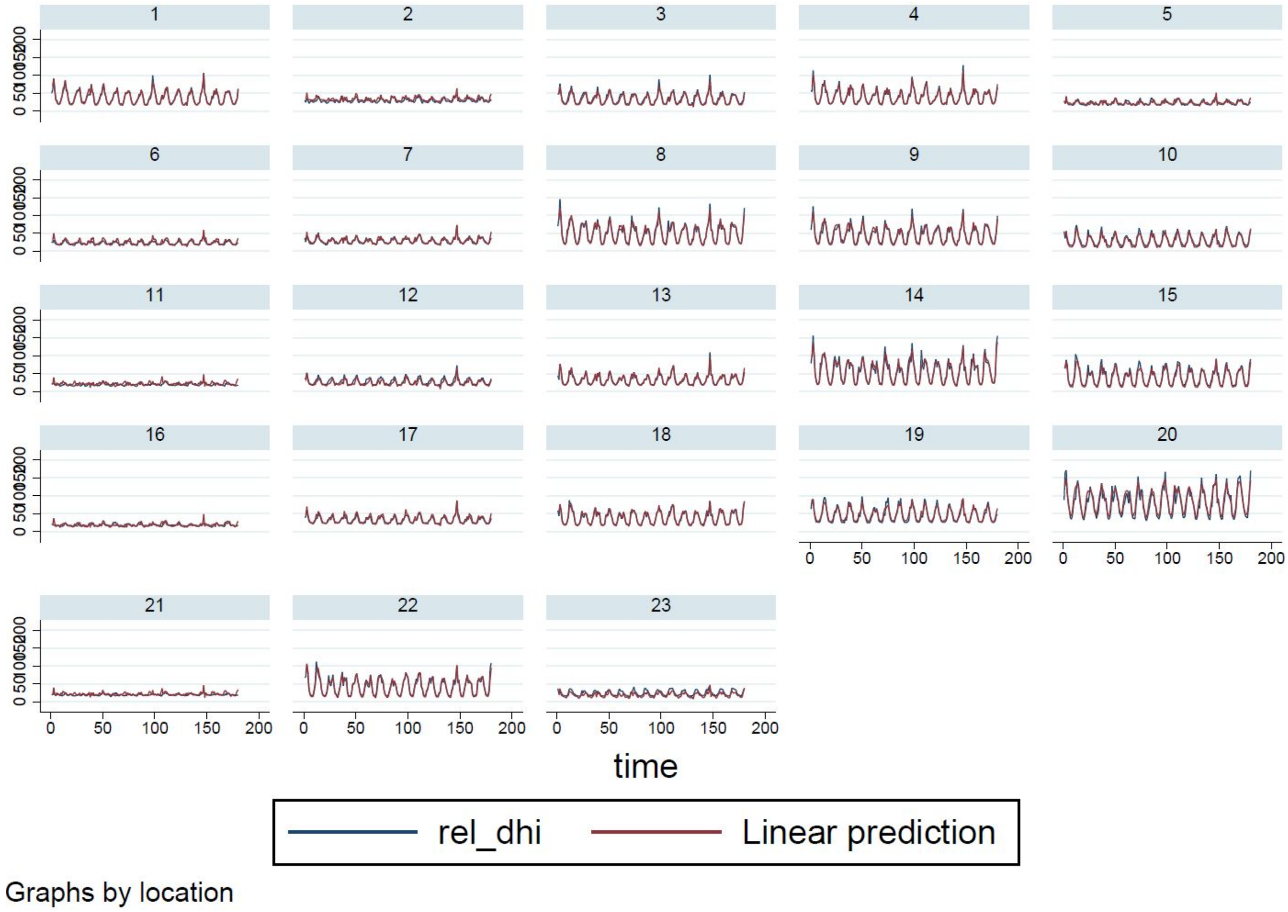

Figure 2

Scatter plot is shown in figure 3. To see the fit for a single year, we checked the fir for year 2000 (in-sample) to get an idea as shown in figure 4.

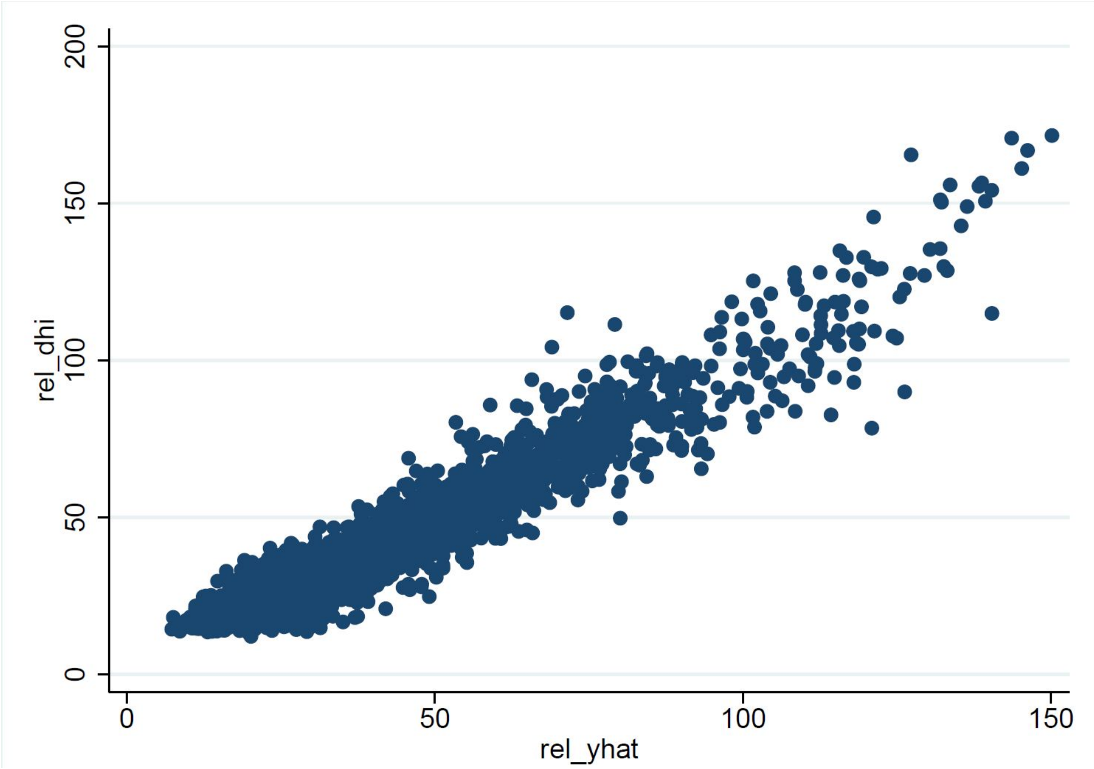

Figure 3

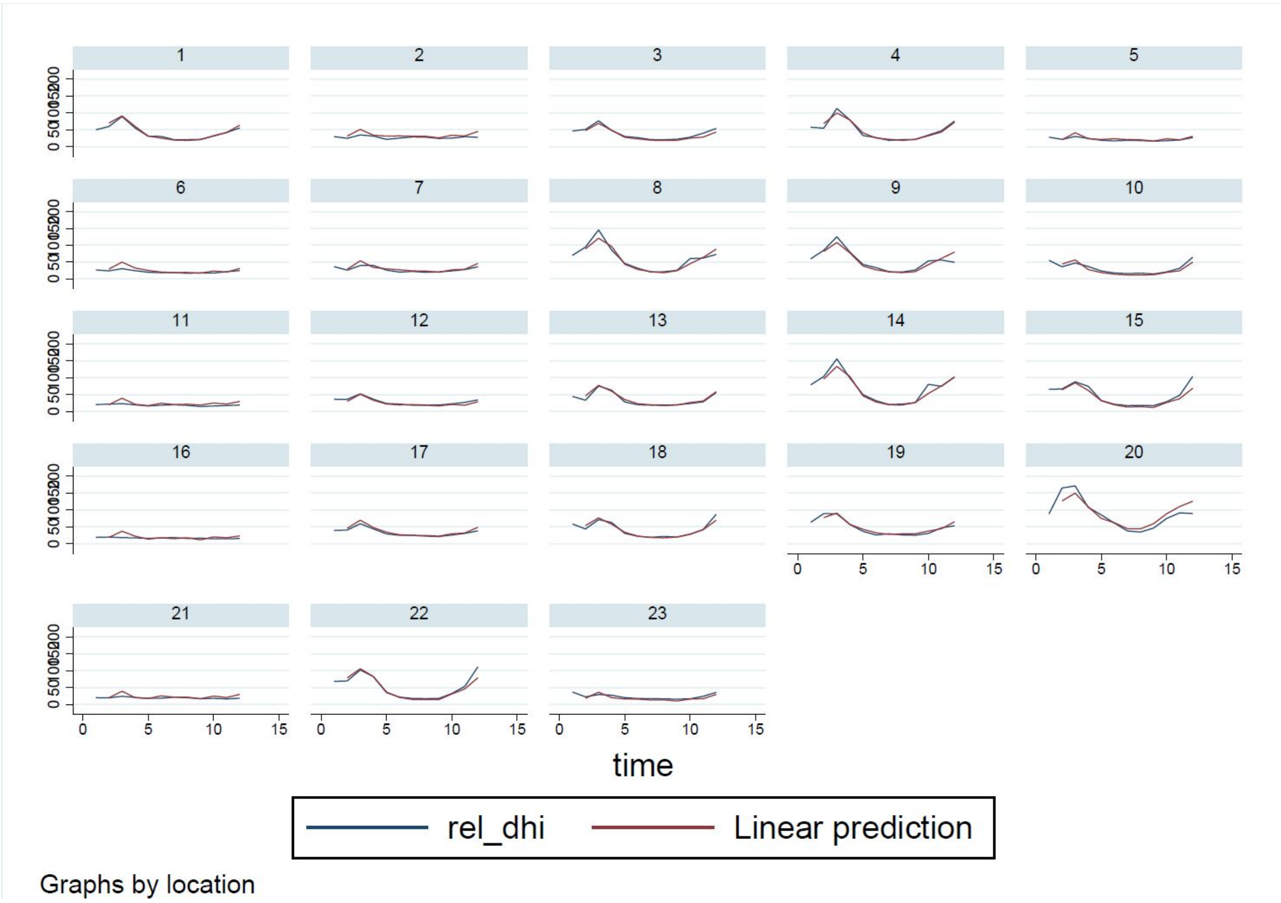

Figure 4

CONCLUSION

In this paper, I tried to work on estimation of solar radiation over India through panel data approach. I worked from the most basic model and gradually turned to more advanced models, inculcating various features and assumptions like checking for time-fixed effects, stationary or dynamic panel analysis, etc. At the end, the model is able to give a good fit with adjusted R^2 of 0.93 which is quite how. As per my knowledge goes, this is the first ever work done on solar radiation estimation using panel data and gives a great direction to further explore the field owing to its feasibility. The data used in the model is readily available for every location and thus is universal. The model covered various climate zones and other variations in geography. Also, the period of testing is also quite significant with rich monthly based data for every year. Though the results seem encouraging, the work can be extended to work further, including more assumptions and features, checking for various other issues and employing the use of Neural networks or Bayesian methods for estimation which is the inherent motive behind this work.

References

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- Cameron A. and Trivedi P.K. 2009. “Microeconometrics using STATA”. Stata Press

- Course Curriculum: ECO342A, Indian Institute of Technology, Kanpur

Appendix

The STATA codes for whatever simulation is done:

```
. import excel "E:\Monthly_new\monthly_only_loc_new_sq.xlsx", sheet("com") firstrow

. destring time, replace

. xtset location time

. xtreg rel_dhi lat D monthly_dew monthly_pre monthly_tem monthly_wsd monthly_rhd monthly_sza monthly_wdn monthly_dew_sq monthly_pre_sq monthly_tem_sq monthly_

> wsd_sq monthly_rhd_sq monthly_sza_sq monthly_wdn_sq, fe

. estimates store FE

. xtreg rel_dhi lat D monthly_dew monthly_pre monthly_tem monthly_wsd monthly_rhd monthly_sza monthly_wdn monthly_dew_sq monthly_pre_sq monthly_tem_sq monthly_

> wsd_sq monthly_rhd_sq monthly_sza_sq monthly_wdn_sq, re

. estimates store RE

. hausman FE RE

* use FE

* FE vs OLS

* generating dummies

. tabulate location, generate(l)

. regress rel_dhi lat D monthly_dew monthly_pre monthly_tem monthly_wsd monthly_rhd monthly_sza monthly_wdn monthly_dew_sq monthly_pre_sq monthly_tem_sq monthl

> y_wsd_sq monthly_rhd_sq monthly_sza_sq monthly_wdn_sq l1 l2 l3 l4 l5 l6 l7 l8 l9 l10 l11 l12 l13 l14 l15 l16 l17 l18 l19 l20 l21 l22 l23

. test  l1 l2 l3 l4 l5 l6 l7 l8 l9 l10 l11 l12 l13 l14 l15 l16 l17 l18 l19 l20 l21 l22 l23

* use FE

** testing for time fixed effects

. ** fe with time dummies

. xtreg rel_dhi i.time lat D monthly_dew monthly_pre monthly_tem monthly_wsd monthly_rhd monthly_sza monthly_wdn monthly_dew_sq monthly_pre_sq monthly_tem_sq m

> onthly_wsd_sq monthly_rhd_sq monthly_sza_sq monthly_wdn_sq, fe

. testparm i.time
```

* time effects are needed

. xttest3

* presence of heteroscedasticity

** checking for the dynamic panel by running arellano bover estimates with time dummies

** taking the idea of dynamic by using correlate

. correlate rel_dhi L.rel_dhi

. correlate rel_dhi L2.rel_dhi

** switch to next data for getting arellano bover estimates and other procedures

. clear

. import excel "C:\Users\Anshul Goel\Downloads\data_prashast.xlsx", sheet("Sheet1") firstrow

. xtset location time

. ** arellano bover estimate is rel_yhat

. regress rel_dhi rel_yhat

. xtline rel_dhi rel_yhat

. xtline rel_dhi rel_yhat if time < 13

. ** for 1 year

Please find the attached STATA outputs for whole process.

```
                                                      ___  ____  ____  ____  ____(R)
                                                     /__    /   ____/   /   ____/
                                                    ___/   /   /___/   /   /___/
                                                      Statistics/Data Analysis


  ___  ____  ____  ____  ____ (R)
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/   13.0   Copyright 1985-2013 StataCorp LP
  Statistics/Data Analysis            StataCorp
                                      4905 Lakeway Drive
     MP - Parallel Edition            College Station, Texas 77845 USA
                                      800-STATA-PC        http://www.stata.com
                                      979-696-4600        stata@stata.com
                                      979-696-4601 (fax)

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       Serial number:  501306208483
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                       IDRE-UCLA

Notes:
      1.  (/v# option or -set maxvar-) 5000 maximum variables

Checking for updates...
(contacting http://www.stata.com)
bad serial number
unable to check for update; verify Internet settings are correct.

1 . import excel "C:\Users\PJ\Desktop\IITK\monthly_only_loc_new_sq.xlsx", sheet("com") firstrow

2 . xtset location
       panel variable:  location (balanced)

3 .
4 . destring time, replace
time has all characters numeric; replaced as int

5 . xtset location time
       panel variable:  location (strongly balanced)
        time variable:  time, 1 to 180
                delta:  1 unit

6 .
7 . xi: xtdpdsys rel_dhi lat D monthly_dew monthly_pre monthly_tem monthly_wsd monthly_rhd monthly_s
> q monthly_tem_sq monthly_wsd_sq monthly_rhd_sq monthly_sza_sq monthly_wdn_sq i.time, lags(1) art
i.time            _Itime_1-180        (naturally coded; _Itime_1 omitted)
note: lat dropped from div() because of collinearity
note: D dropped from div() because of collinearity
note: _Itime_79 dropped because of collinearity

System dynamic panel-data estimation         Number of obs         =      4117
Group variable: location                     Number of groups      =        23
Time variable: time
                                             Obs per group:    min =       179
                                                               avg =       179
                                                               max =       179

Number of instruments =   4.1e+03            Wald chi2(195)        =  78989.29
                                             Prob > chi2           =    0.0000
One-step results
```

rel_dhi	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
rel_dhi						
L1.	.1822735	.0092349	19.74	0.000	.1641734	.2003736
lat	.2031326	.0537415	3.78	0.000	.0978012	.3084641
D	.1822497	.0634645	2.87	0.004	.0578617	.3066378
monthly_dew	-2.382772	.1565837	-15.22	0.000	-2.689671	-2.075874
monthly_pre	.3228634	.1408564	2.29	0.022	.0467899	.5989369
monthly_tem	-2.636447	.1814493	-14.53	0.000	-2.992082	-2.280813

monthly_wsd	-6.09804	.5843516	-10.44	0.000	-7.243348	-4.952732
monthly_rhd	.5239126	.1057516	4.95	0.000	.3166432	.731182
monthly_sza	8.860246	.681355	13.00	0.000	7.524815	10.19568
monthly_wdn	-.0580452	.0114129	-5.09	0.000	-.080414	-.0356764
monthly_dew_sq	.0304323	.0016646	18.28	0.000	.0271698	.0336949
monthly_pre_sq	-.0001455	.0000799	-1.82	0.069	-.0003022	.0000111
monthly_tem_sq	.0290083	.0018772	15.45	0.000	.0253291	.0326875
monthly_wsd_sq	.7849555	.0740541	10.60	0.000	.6398121	.9300989
monthly_rhd_sq	-.0048812	.0005422	-9.00	0.000	-.0059439	-.0038185
monthly_sza_sq	-.0565826	.0038498	-14.70	0.000	-.0641281	-.0490371
monthly_wdn_sq	.0002445	.0000302	8.09	0.000	.0001853	.0003037
_Itime_2	10.65668	1.799202	5.92	0.000	7.130307	14.18305
_Itime_3	24.65099	1.683046	14.65	0.000	21.35228	27.9497
_Itime_4	4.715025	1.476267	3.19	0.001	1.821595	7.608456
_Itime_5	.0730226	1.232164	0.06	0.953	-2.341975	2.48802
_Itime_6	.6718511	1.127756	0.60	0.551	-1.538511	2.882213
_Itime_7	-1.766299	1.159295	-1.52	0.128	-4.038476	.5058783
_Itime_8	-.0165119	1.269803	-0.01	0.990	-2.50528	2.472257
_Itime_9	2.472411	1.497226	1.65	0.099	-.4620978	5.40692
_Itime_10	15.26812	1.72998	8.83	0.000	11.87743	18.65882
_Itime_11	18.39161	1.853221	9.92	0.000	14.75936	22.02386
_Itime_12	24.60376	1.89316	13.00	0.000	20.89324	28.31429
_Itime_13	18.95617	1.868901	10.14	0.000	15.29319	22.61914
_Itime_14	16.89912	1.805439	9.36	0.000	13.36052	20.43771
_Itime_15	6.611231	1.667166	3.97	0.000	3.343647	9.878816
_Itime_16	3.733002	1.389683	2.69	0.007	1.009273	6.456731
_Itime_17	2.142013	1.239202	1.73	0.084	-.2867784	4.570805
_Itime_18	-1.275143	1.13459	-1.12	0.261	-3.498899	.9486128
_Itime_19	-.4089206	1.138533	-0.36	0.719	-2.640403	1.822562
_Itime_20	-.4409074	1.257458	-0.35	0.726	-2.90548	2.023666
_Itime_21	2.728331	1.492805	1.83	0.068	-.1975131	5.654176
_Itime_22	13.00591	1.733527	7.50	0.000	9.608263	16.40356
_Itime_23	23.2009	1.8706	12.40	0.000	19.53459	26.86721
_Itime_24	12.8011	1.822964	7.02	0.000	9.228154	16.37404
_Itime_25	12.58971	1.856403	6.78	0.000	8.951226	16.22819
_Itime_26	8.727691	1.801161	4.85	0.000	5.197481	12.2579
_Itime_27	8.875219	1.672378	5.31	0.000	5.597419	12.15302
_Itime_28	8.946033	1.475788	6.06	0.000	6.053543	11.83852
_Itime_29	4.991642	1.360421	3.67	0.000	2.325265	7.658018
_Itime_30	-1.771132	1.156697	-1.53	0.126	-4.038217	.4959526
_Itime_31	2.269206	1.130585	2.01	0.045	.0533006	4.485111
_Itime_32	-.222989	1.310309	-0.17	0.865	-2.791148	2.34517
_Itime_33	2.062011	1.428677	1.44	0.149	-.7381434	4.862166
_Itime_34	12.88078	1.737727	7.41	0.000	9.4749	16.28666
_Itime_35	17.64712	1.850699	9.54	0.000	14.01982	21.27442
_Itime_36	11.65011	1.801065	6.47	0.000	8.120084	15.18013
_Itime_37	19.85734	1.831837	10.84	0.000	16.267	23.44767
_Itime_38	4.884749	1.781125	2.74	0.006	1.393808	8.375691
_Itime_39	13.52649	1.567734	8.63	0.000	10.45378	16.59919
_Itime_40	4.447988	1.402677	3.17	0.002	1.698792	7.197184
_Itime_41	10.71921	1.196006	8.96	0.000	8.375082	13.06334
_Itime_42	-2.394912	1.280892	-1.87	0.062	-4.905414	.1155908
_Itime_43	-1.130628	1.1086	-1.02	0.308	-3.303443	1.042188
_Itime_44	.1422101	1.250427	0.11	0.909	-2.308583	2.593003
_Itime_45	3.607831	1.529836	2.36	0.018	.6094075	6.606254
_Itime_46	13.38538	1.745365	7.67	0.000	9.964531	16.80624
_Itime_47	23.71266	1.840517	12.88	0.000	20.10532	27.32001
_Itime_48	8.749635	1.852643	4.72	0.000	5.11852	12.38075
_Itime_49	14.36578	1.923744	7.47	0.000	10.59531	18.13625
_Itime_50	21.24051	1.766764	12.02	0.000	17.77772	24.70331
_Itime_51	14.94049	1.58999	9.40	0.000	11.82416	18.05681
_Itime_52	4.360019	1.527486	2.85	0.004	1.366201	7.353836
_Itime_53	5.120181	1.170439	4.37	0.000	2.826163	7.414198
_Itime_54	.2409914	1.107892	0.22	0.828	-1.930436	2.412419
_Itime_55	.1556973	1.157347	0.13	0.893	-2.11266	2.424055
_Itime_56	-.3848901	1.192794	-0.32	0.747	-2.722724	1.952944
_Itime_57	2.63775	1.491992	1.77	0.077	-.2865001	5.561999

_Itime_58	13.15728	1.740128	7.56	0.000	9.74669	16.56787
_Itime_59	19.18169	1.841272	10.42	0.000	15.57286	22.79051
_Itime_60	20.7122	1.931868	10.72	0.000	16.9258	24.49859
_Itime_61	12.38872	1.803604	6.87	0.000	8.85372	15.92372
_Itime_62	6.24903	1.793982	3.48	0.000	2.73289	9.765169
_Itime_63	4.524855	1.635987	2.77	0.006	1.31838	7.73133
_Itime_64	9.01097	1.500221	6.01	0.000	6.070591	11.95135
_Itime_65	2.667309	1.315644	2.03	0.043	.0886936	5.245925
_Itime_66	-3.013816	1.167722	-2.58	0.010	-5.302509	-.725123
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_Itime_69	2.571452	1.474081	1.74	0.081	-.3176942	5.460598
_Itime_70	14.23603	1.606817	8.86	0.000	11.08673	17.38533
_Itime_71	23.75927	1.840611	12.91	0.000	20.15174	27.3668
_Itime_72	18.23752	1.808354	10.09	0.000	14.69321	21.78183
_Itime_73	10.85684	1.882358	5.77	0.000	7.167487	14.54619
_Itime_74	15.27595	1.8397	8.30	0.000	11.6702	18.88169
_Itime_75	5.683003	1.671197	3.40	0.001	2.407517	8.958488
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_Itime_78	-.8322373	1.143335	-0.73	0.467	-3.073132	1.408658
_Itime_80	.0493469	1.308016	0.04	0.970	-2.514318	2.613011
_Itime_81	3.266828	1.440064	2.27	0.023	.4443536	6.089302
_Itime_82	13.72874	1.74962	7.85	0.000	10.29955	17.15793
_Itime_83	17.52525	1.838948	9.53	0.000	13.92098	21.12952
_Itime_84	12.96378	1.818051	7.13	0.000	9.400462	16.52709
_Itime_85	17.72076	1.80747	9.80	0.000	14.17818	21.26333
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_Itime_90	-1.39759	1.116611	-1.25	0.211	-3.586108	.7909278
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_Itime_92	.9608769	1.346736	0.71	0.476	-1.678678	3.600431
_Itime_93	3.805123	1.494421	2.55	0.011	.8761117	6.734135
_Itime_94	15.00686	1.732917	8.66	0.000	11.6104	18.40331
_Itime_95	25.1623	1.860557	13.52	0.000	21.51568	28.80893
_Itime_96	15.14018	1.828521	8.28	0.000	11.55635	18.72402
_Itime_97	13.33643	1.857375	7.18	0.000	9.696047	16.97682
_Itime_98	23.49126	1.774229	13.24	0.000	20.01383	26.96868
_Itime_99	10.08504	1.676993	6.01	0.000	6.79819	13.37188
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_Itime_101	4.202823	1.27205	3.30	0.001	1.709651	6.695996
_Itime_102	-1.27773	1.124247	-1.14	0.256	-3.481213	.9257539
_Itime_103	.7928312	1.122217	0.71	0.480	-1.406673	2.992336
_Itime_104	.3253886	1.206257	0.27	0.787	-2.038831	2.689608
_Itime_105	3.338447	1.464194	2.28	0.023	.4686795	6.208215
_Itime_106	18.24845	1.712053	10.66	0.000	14.89289	21.60402
_Itime_107	32.5517	1.859709	17.50	0.000	28.90674	36.19666
_Itime_108	18.31992	1.979129	9.26	0.000	14.44089	22.19894
_Itime_109	17.44557	1.945963	8.97	0.000	13.63155	21.25958
_Itime_110	18.55071	1.766436	10.50	0.000	15.08855	22.01286
_Itime_111	14.69571	1.571944	9.35	0.000	11.61475	17.77666
_Itime_112	11.26672	1.511678	7.45	0.000	8.303882	14.22955
_Itime_113	3.528822	1.355906	2.60	0.009	.8712949	6.18635
_Itime_114	-.1282454	1.14737	-0.11	0.911	-2.377049	2.120559
_Itime_115	-.758727	1.10357	-0.69	0.492	-2.921685	1.404231
_Itime_116	1.196306	1.261054	0.95	0.343	-1.275315	3.667927
_Itime_117	3.695888	1.509571	2.45	0.014	.7371834	6.654593
_Itime_118	12.5121	1.741262	7.19	0.000	9.099287	15.92491
_Itime_119	17.3936	1.832704	9.49	0.000	13.80156	20.98563
_Itime_120	13.10379	1.878914	6.97	0.000	9.421191	16.7864
_Itime_121	18.29844	1.836015	9.97	0.000	14.69992	21.89697
_Itime_122	9.807077	1.726571	5.68	0.000	6.42306	13.19109
_Itime_123	14.07729	1.675396	8.40	0.000	10.79358	17.36101
_Itime_124	7.298161	1.443901	5.05	0.000	4.468167	10.12815
_Itime_125	6.069461	1.264402	4.80	0.000	3.591279	8.547644

_Itime_126	-.5036327	1.153142	-0.44	0.662	-2.763749	1.756484
_Itime_127	-1.144342	1.116993	-1.02	0.306	-3.333607	1.044924
_Itime_128	.1648263	1.267687	0.13	0.897	-2.319794	2.649447
_Itime_129	3.778858	1.428759	2.64	0.008	.9785423	6.579173
_Itime_130	13.99704	1.736284	8.06	0.000	10.59399	17.40009
_Itime_131	14.84284	1.879094	7.90	0.000	11.15989	18.5258
_Itime_132	15.44857	1.874462	8.24	0.000	11.77469	19.12244
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_Itime_134	11.75828	1.74748	6.73	0.000	8.333279	15.18328
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_Itime_136	4.778626	1.457805	3.28	0.001	1.92138	7.635872
_Itime_137	3.452949	1.182612	2.92	0.004	1.135073	5.770825
_Itime_138	1.427311	1.155428	1.24	0.217	-.8372856	3.691908
_Itime_139	-.0681585	1.118031	-0.06	0.951	-2.25946	2.123143
_Itime_140	.5301287	1.25613	0.42	0.673	-1.931842	2.992099
_Itime_141	2.351458	1.439635	1.63	0.102	-.4701735	5.17309
_Itime_142	13.38626	1.751753	7.64	0.000	9.952886	16.81963
_Itime_143	19.17755	1.879999	10.20	0.000	15.49282	22.86228
_Itime_144	18.66684	1.804968	10.34	0.000	15.12917	22.20451
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_Itime_146	15.59171	1.805362	8.64	0.000	12.05326	19.13015
_Itime_147	32.11245	1.56111	20.57	0.000	29.05273	35.17217
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_Itime_149	7.83421	1.200358	6.53	0.000	5.481553	10.18687
_Itime_150	-.725568	1.318488	-0.55	0.582	-3.309758	1.858622
_Itime_151	-.4230381	1.110749	-0.38	0.703	-2.600067	1.753991
_Itime_152	.2166698	1.23438	0.18	0.861	-2.202671	2.63601
_Itime_153	2.625475	1.467673	1.79	0.074	-.2511102	5.502061
_Itime_154	14.13514	1.700475	8.31	0.000	10.80227	17.46801
_Itime_155	23.18764	1.831975	12.66	0.000	19.59703	26.77824
_Itime_156	21.15275	1.917045	11.03	0.000	17.39541	24.91009
_Itime_157	21.14678	1.886465	11.21	0.000	17.44937	24.84418
_Itime_158	8.058907	1.734567	4.65	0.000	4.659219	11.4586
_Itime_159	11.05035	1.584143	6.98	0.000	7.945487	14.15521
_Itime_160	3.736339	1.397775	2.67	0.008	.9967505	6.475927
_Itime_161	6.699512	1.195585	5.60	0.000	4.356208	9.042817
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_Itime_163	-.4403203	1.134234	-0.39	0.698	-2.663379	1.782738
_Itime_164	-.0083783	1.287803	-0.01	0.995	-2.532426	2.515669
_Itime_165	3.433945	1.505351	2.28	0.023	.4835117	6.384379
_Itime_166	12.81836	1.754593	7.31	0.000	9.37942	16.2573
_Itime_167	26.7736	1.85145	14.46	0.000	23.14482	30.40237
_Itime_168	20.10735	1.821535	11.04	0.000	16.53721	23.67749
_Itime_169	18.1825	1.868684	9.73	0.000	14.51994	21.84505
_Itime_170	12.19019	1.760085	6.93	0.000	8.740482	15.63989
_Itime_171	9.70218	1.640952	5.91	0.000	6.485973	12.91839
_Itime_172	5.557415	1.534073	3.62	0.000	2.550686	8.564143
_Itime_173	1.538334	1.328984	1.16	0.247	-1.066428	4.143095
_Itime_174	2.049822	1.129788	1.81	0.070	-.1645225	4.264166
_Itime_175	-1.399393	1.130023	-1.24	0.216	-3.614198	.8154125
_Itime_176	.6405287	1.216534	0.53	0.599	-1.743834	3.024891
_Itime_177	2.913748	1.45157	2.01	0.045	.0687231	5.758774
_Itime_178	14.05397	1.728648	8.13	0.000	10.66588	17.44206
_Itime_179	27.43063	1.813097	15.13	0.000	23.87703	30.98424
_Itime_180	25.09089	1.829336	13.72	0.000	21.50546	28.67632
_cons	-433.266	68.56696	-6.32	0.000	-567.6548	-298.8772

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Instruments for differenced equation
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                  D.monthly_rhd D.monthly_sza D.monthly_wdn D.monthly_dew_sq
                  D.monthly_pre_sq D.monthly_tem_sq D.monthly_wsd_sq
                  D.monthly_rhd_sq D.monthly_sza_sq D.monthly_wdn_sq
                  D._Itime_2 D._Itime_3 D._Itime_4 D._Itime_5 D._Itime_6
                  D._Itime_7 D._Itime_8 D._Itime_9 D._Itime_10 D._Itime_11
                  D._Itime_12 D._Itime_13 D._Itime_14 D._Itime_15 D._Itime_16
                  D._Itime_17 D._Itime_18 D._Itime_19 D._Itime_20 D._Itime_21
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                   D._Itime_22 D._Itime_23 D._Itime_24 D._Itime_25 D._Itime_26
                   D._Itime_27 D._Itime_28 D._Itime_29 D._Itime_30 D._Itime_31
                   D._Itime_32 D._Itime_33 D._Itime_34 D._Itime_35 D._Itime_36
                   D._Itime_37 D._Itime_38 D._Itime_39 D._Itime_40 D._Itime_41
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                   D._Itime_47 D._Itime_48 D._Itime_49 D._Itime_50 D._Itime_51
                   D._Itime_52 D._Itime_53 D._Itime_54 D._Itime_55 D._Itime_56
                   D._Itime_57 D._Itime_58 D._Itime_59 D._Itime_60 D._Itime_61
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                   D._Itime_67 D._Itime_68 D._Itime_69 D._Itime_70 D._Itime_71
                   D._Itime_72 D._Itime_73 D._Itime_74 D._Itime_75 D._Itime_76
                   D._Itime_77 D._Itime_78 D._Itime_79 D._Itime_80 D._Itime_81
                   D._Itime_82 D._Itime_83 D._Itime_84 D._Itime_85 D._Itime_86
                   D._Itime_87 D._Itime_88 D._Itime_89 D._Itime_90 D._Itime_91
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                   D._Itime_169 D._Itime_170 D._Itime_171 D._Itime_172
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  Instruments for level equation
         GMM-type: LD.rel_dhi
         Standard: _cons

8 .
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                                                ___/   /   /___/   /   /___/
                                                  Statistics/Data Analysis

                                                    User: Anshul Goel
                                                 Project: ECO342A

  ___  ____  ____  ____  ____ (R)
 /__    /   ____/   /   ____/
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Notes:
      1.  (/v# option or -set maxvar-) 5000 maximum variables

 1 . do "C:\Users\Anshul Goel\AppData\Local\Temp\STi04000002.tmp"

 2 . !!T!!Title2!!!!aaH)

 3 . XT xtline    [XT] xtline -- Panel-data line plots,(a!!36!!!36!)) syntaxSyntax2
   > )!!!11(    Graph by panel1!!   Gran!©©;<=p3varlistifin$1xtline##panel        x
   > tline varlist [if] [in] [, panel_options]"#$121©!!arlist!!!3-!11(    Overlaid
   > panels1!!   Oven!ÅÅ>?@€=varnameifin+;xtline##overlaid        xtline varname [i
   > f] [in], overlay [overlaid_options] !"'$)+;<Å!!arname!!!3!YYH+panel    panel_o
   > ptions              DescriptionB
   unrecognized command:  XT
   r(199);

   end of do-file

   r(199);

 4 . use "C:\Users\Anshul Goel\AppData\Local\Temp\STi04000002.tmp", clear
   file C:\Users\Anshul Goel\AppData\Local\Temp\STi04000002.tmp not Stata format
   r(610);

 5 . clear

 6 . import excel "E:\Monthly_new\monthly_only_loc_new_sq.xlsx", sheet("com") firstrow

 7 . destring time, replace
   time has all characters numeric; replaced as int

 8 . xtset lat time
          panel variable:  lat (strongly balanced)
           time variable:  time, 1 to 180
                   delta:  1 unit

 9 .
10 . xtset location time
          panel variable:  location (strongly balanced)
           time variable:  time, 1 to 180
                   delta:  1 unit
```

```
11 .
12 . ** FE vs RE vs Pooled OLS

13 . xtreg rel_dhi lat D monthly_dew monthly_pre monthly_tem monthly_wsd monthly_rhd monthly_sza mont
> wsd_sq monthly_rhd_sq monthly_sza_sq monthly_wdn_sq, fe
note: lat omitted because of collinearity
note: D omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =      4140
Group variable: location                        Number of groups   =        23

R-sq:  within  = 0.8507                         Obs per group: min =       180
       between = 0.9738                                        avg =     180.0
       overall = 0.9018                                        max =       180

                                                F(14,4103)         =   1670.32
corr(u_i, Xb)  = 0.1382                         Prob > F           =    0.0000

------------------------------------------------------------------------------
     rel_dhi |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         lat |          0  (omitted)
           D |          0  (omitted)
 monthly_dew |   -4.01732   .1877881   -21.39   0.000    -4.385487   -3.649154
 monthly_pre |   .1075612   .3021094     0.36   0.722     -.484737    .6998593
 monthly_tem |  -1.719418   .2131645    -8.07   0.000    -2.137336     -1.3015
 monthly_wsd |  -5.800348   .7039577    -8.24   0.000    -7.180487   -4.420209
 monthly_rhd |   1.377062    .128102    10.75   0.000     1.125913    1.628211
 monthly_sza |   6.730194   .4287297    15.70   0.000     5.889652    7.570737
 monthly_wdn |  -.1410581   .0136198   -10.36   0.000    -.1677602    -.114356
monthly_dew_sq |   .0307352   .0020434    15.04   0.000      .026729    .0347414
monthly_pre_sq |  -.0000101   .0001562    -0.06   0.949    -.0003163    .0002961
monthly_tem_sq |   .0340311   .0022803    14.92   0.000     .0295605    .0385017
monthly_wsd_sq |   .5513589   .0864663     6.38   0.000     .3818381    .7208796
monthly_rhd_sq |  -.0090224   .0006427   -14.04   0.000    -.0102824   -.0077624
monthly_sza_sq |  -.0416309   .0024342   -17.10   0.000    -.0464033   -.0368585
monthly_wdn_sq |   .0004145   .0000368    11.25   0.000     .0003423    .0004868
       _cons |  -274.7337   145.1552    -1.89   0.058    -559.3167    9.849292
-------------+----------------------------------------------------------------
     sigma_u |   2.458722
     sigma_e |  6.6634166
         rho |  .11983629   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(22, 4103) =    20.50            Prob > F = 0.0000

14 . estimates store FE

15 . xtreg rel_dhi lat D monthly_dew monthly_pre monthly_tem monthly_wsd monthly_rhd monthly_sza mont
> wsd_sq monthly_rhd_sq monthly_sza_sq monthly_wdn_sq, re

Random-effects GLS regression                   Number of obs      =      4140
Group variable: location                        Number of groups   =        23

R-sq:  within  = 0.8505                         Obs per group: min =       180
       between = 0.9844                                        avg =     180.0
       overall = 0.9063                                        max =       180

                                                Wald chi2(16)      =  28964.29
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

rel_dhi	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lat	.2157345	.0414483	5.20	0.000	.1344974	.2969716
D	.1430999	.032719	4.37	0.000	.0789718	.207228
monthly_dew	-4.092942	.1814619	-22.56	0.000	-4.448601	-3.737284
monthly_pre	.0338919	.0728252	0.47	0.642	-.1088429	.1766267
monthly_tem	-1.51713	.2018985	-7.51	0.000	-1.912843	-1.121416
monthly_wsd	-4.789717	.6239488	-7.68	0.000	-6.012635	-3.5668
monthly_rhd	1.461984	.1238542	11.80	0.000	1.219235	1.704734
monthly_sza	6.883971	.4282959	16.07	0.000	6.044526	7.723415
monthly_wdn	-.1267868	.0133945	-9.47	0.000	-.1530396	-.1005341
monthly_dew_sq	.0316384	.0020256	15.62	0.000	.0276683	.0356085
monthly_pre_sq	.0000264	.0000401	0.66	0.510	-.0000522	.0001051
monthly_tem_sq	.0321788	.0022252	14.46	0.000	.0278175	.0365402
monthly_wsd_sq	.4783146	.0798909	5.99	0.000	.3217313	.634898
monthly_rhd_sq	-.0095091	.0006281	-15.14	0.000	-.0107402	-.0082781
monthly_sza_sq	-.0421338	.0024339	-17.31	0.000	-.0469041	-.0373635
monthly_wdn_sq	.0003768	.0000362	10.41	0.000	.0003058	.0004478
_cons	-272.7382	40.67294	-6.71	0.000	-352.4557	-193.0207
sigma_u	.72361074					
sigma_e	6.6634166					
rho	.01165533	(fraction of variance due to u_i)				

16 . estimates store RE

17 . hausman FE RE

Note: the rank of the differenced variance matrix (**10**) does not equal the number of coefficients b
may be problems computing the test. Examine the output of your estimators for anything un
the coefficients are on a similar scale.

	Coefficients (b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
monthly_dew	-4.01732	-4.092942	.075622	.0483316
monthly_pre	.1075612	.0338919	.0736693	.2932005
monthly_tem	-1.719418	-1.51713	-.2022887	.0683822
monthly_wsd	-5.800348	-4.789717	-1.01063	.3259514
monthly_rhd	1.377062	1.461984	-.0849223	.0327148
monthly_sza	6.730194	6.883971	-.1537763	.0192801
monthly_wdn	-.1410581	-.1267868	-.0142713	.0024667
monthly_de~q	.0307352	.0316384	-.0009032	.0002692
monthly_pr~q	-.0000101	.0000264	-.0000365	.0001509
monthly_te~q	.0340311	.0321788	.0018523	.0004982
monthly_ws~q	.5513589	.4783146	.0730442	.0330735
monthly_rh~q	-.0090224	-.0095091	.0004868	.0001362
monthly_sz~q	-.0416309	-.0421338	.0005029	.0000418
monthly_wd~q	.0004145	.0003768	.0000377	6.76e-06

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(**10**) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= **109.72**
Prob>chi2 = **0.0000**
(V_b-V_B is not positive definite)

```
18 . do "C:\Users\ANSHUL~1\AppData\Local\Temp\STD05000000.tmp"

19 . . import excel "E:\Monthly_new\monthly_only_loc_new_sq.xlsx", sheet("com") firstrow
   no; data in memory would be lost
   r(4);

   end of do-file

   r(4);

20 . * use FE

21 . * checking between FE and pooled OLS

22 . * generating dummies

23 . tabulate location, generate(l)
```

location	Freq.	Percent	Cum.
1	180	4.35	4.35
2	180	4.35	8.70
3	180	4.35	13.04
4	180	4.35	17.39
5	180	4.35	21.74
6	180	4.35	26.09
7	180	4.35	30.43
8	180	4.35	34.78
9	180	4.35	39.13
10	180	4.35	43.48
11	180	4.35	47.83
12	180	4.35	52.17
13	180	4.35	56.52
14	180	4.35	60.87
15	180	4.35	65.22
16	180	4.35	69.57
17	180	4.35	73.91
18	180	4.35	78.26
19	180	4.35	82.61
20	180	4.35	86.96
21	180	4.35	91.30
22	180	4.35	95.65
23	180	4.35	100.00
Total	4,140	100.00	

```
24 . regress rel_dhi lat D monthly_dew monthly_pre monthly_tem monthly_wsd monthly_rhd monthly_sza mo
   > y_wsd_sq monthly_rhd_sq monthly_sza_sq monthly_wdn_sq l1 l2 l3 l4 l5 l6 l7 l8 l9 l10 l11 l12 l13
   note: l2 omitted because of collinearity
   note: l19 omitted because of collinearity
   note: l20 omitted because of collinearity
```

Source	SS	df	MS
Model	1912964.94	36	53137.915
Residual	182177.8	4103	44.4011211
Total	2095142.74	4139	506.195395

```
Number of obs =    4140
F( 36,  4103) = 1196.77
Prob > F      =  0.0000
R-squared     =  0.9130
Adj R-squared =  0.9123
Root MSE      =  6.6634
```

rel_dhi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lat	.2035271	.2757958	0.74	0.461	-.3371823	.7442365
D	.1732331	.244154	0.71	0.478	-.3054412	.6519074
monthly_dew	-4.01732	.1877881	-21.39	0.000	-4.385487	-3.649154
monthly_pre	.1075612	.3021094	0.36	0.722	-.484737	.6998593
monthly_tem	-1.719418	.2131645	-8.07	0.000	-2.137336	-1.3015
monthly_wsd	-5.800348	.7039577	-8.24	0.000	-7.180487	-4.420209
monthly_rhd	1.377062	.128102	10.75	0.000	1.125913	1.628211
monthly_sza	6.730194	.4287297	15.70	0.000	5.889652	7.570737
monthly_wdn	-.1410581	.0136198	-10.36	0.000	-.1677602	-.114356
monthly_dew_sq	.0307352	.0020434	15.04	0.000	.026729	.0347414
monthly_pre_sq	-.0000101	.0001562	-0.06	0.949	-.0003163	.0002961
monthly_tem_sq	.0340311	.0022803	14.92	0.000	.0295605	.0385017
monthly_wsd_sq	.5513589	.0864663	6.38	0.000	.3818381	.7208796
monthly_rhd_sq	-.0090224	.0006427	-14.04	0.000	-.0102824	-.0077624
monthly_sza_sq	-.0416309	.0024342	-17.10	0.000	-.0464033	-.0368585
monthly_wdn_sq	.0004145	.0000368	11.25	0.000	.0003423	.0004868
l1	-2.966713	4.825979	-0.61	0.539	-12.42825	6.494823
l2	0	(omitted)				
l3	1.123651	4.569164	0.25	0.806	-7.834389	10.08169
l4	-2.318014	3.5429	-0.65	0.513	-9.264019	4.627992
l5	-2.706269	1.416582	-1.91	0.056	-5.483538	.0710002
l6	-1.844636	2.474488	-0.75	0.456	-6.695974	3.006702
l7	.0632535	1.700245	0.04	0.970	-3.270148	3.396655
l8	-.3532443	4.966835	-0.07	0.943	-10.09094	9.384447
l9	-.5346906	5.532209	-0.10	0.923	-11.38082	10.31144
l10	-.7138907	1.646529	-0.43	0.665	-3.941981	2.5142
l11	.5491887	1.646562	0.33	0.739	-2.678965	3.777343
l12	4.660726	3.703592	1.26	0.208	-2.600323	11.92178
l13	-4.104225	2.745719	-1.49	0.135	-9.487323	1.278873
l14	-.9121966	5.219885	-0.17	0.861	-11.146	9.321609
l15	-.0669688	2.712019	-0.02	0.980	-5.383997	5.250059
l16	-1.961149	3.793931	-0.52	0.605	-9.399311	5.477014
l17	.0626426	2.826042	0.02	0.982	-5.477933	5.603218
l18	-.7178366	1.686752	-0.43	0.670	-4.024785	2.589112
l19	0	(omitted)				
l20	0	(omitted)				
l21	.6685277	1.578468	0.42	0.672	-2.426125	3.763181
l22	-3.623106	3.073074	-1.18	0.238	-9.647998	2.401786
l23	4.189657	1.628677	2.57	0.010	.9965678	7.382747
_cons	-292.091	131.0806	-2.23	0.026	-549.0801	-35.10189

```
25 . test  l1 l2 l3 l4 l5 l6 l7 l8 l9 l10 l11 l12 l13 l14 l15 l16 l17 l18 l19 l20 l21 l22 l23

 ( 1)  l1 = 0
 ( 2)  o.l2 = 0
 ( 3)  l3 = 0
 ( 4)  l4 = 0
 ( 5)  l5 = 0
 ( 6)  l6 = 0
 ( 7)  l7 = 0
 ( 8)  l8 = 0
 ( 9)  l9 = 0
 (10)  l10 = 0
 (11)  l11 = 0
 (12)  l12 = 0
 (13)  l13 = 0
 (14)  l14 = 0
 (15)  l15 = 0
 (16)  l16 = 0
 (17)  l17 = 0
 (18)  l18 = 0
 (19)  o.l19 = 0
 (20)  o.l20 = 0
```

```
 (21)  l21 = 0
 (22)  l22 = 0
 (23)  l23 = 0
       Constraint 2 dropped
       Constraint 19 dropped
       Constraint 20 dropped

       F( 20,  4103) =   15.08
            Prob > F =    0.0000

26 . * use FE

27 . ** testing for time fixed effects

28 . ** fe with time dummies

29 . xtreg rel_dhi i.time lat D monthly_dew monthly_pre monthly_tem monthly_wsd monthly_rhd monthly_s
> onthly_wsd_sq monthly_rhd_sq monthly_sza_sq monthly_wdn_sq, fe
note: lat omitted because of collinearity
note: D omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =      4140
Group variable: location                        Number of groups   =        23

R-sq:  within  = 0.8991                         Obs per group: min =       180
       between = 0.1620                                        avg =     180.0
       overall = 0.0543                                        max =       180

                                                F(193,3924)        =    181.25
corr(u_i, Xb)  = -0.7133                        Prob > F           =    0.0000
```

rel_dhi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
time						
2	-4.821509	1.718904	-2.80	0.005	-8.191539	-1.451479
3	6.062271	1.914405	3.17	0.002	2.308948	9.815594
4	-9.290423	2.051859	-4.53	0.000	-13.31323	-5.267613
5	-19.80075	2.207031	-8.97	0.000	-24.12778	-15.47371
6	-22.37349	2.281792	-9.81	0.000	-26.8471	-17.89988
7	-24.31875	2.245314	-10.83	0.000	-28.72084	-19.91665
8	-21.85635	2.130319	-10.26	0.000	-26.03299	-17.67972
9	-16.88285	1.973813	-8.55	0.000	-20.75265	-13.01306
10	-1.992853	1.79604	-1.11	0.267	-5.514112	1.528406
11	3.88179	1.67302	2.32	0.020	.6017186	7.161861
12	6.622814	1.664316	3.98	0.000	3.359809	9.885819
13	5.752439	1.656072	3.47	0.001	2.505597	8.999281
14	2.851162	1.729884	1.65	0.099	-.5403936	6.242718
15	-7.693251	1.916814	-4.01	0.000	-11.4513	-3.935206
16	-15.39664	2.107465	-7.31	0.000	-19.52847	-11.26481
17	-18.7283	2.209182	-8.48	0.000	-23.05955	-14.39705
18	-23.37868	2.286718	-10.22	0.000	-27.86195	-18.89542
19	-23.80478	2.255391	-10.55	0.000	-28.22663	-19.38293
20	-22.20992	2.132751	-10.41	0.000	-26.39132	-18.02852
21	-16.19651	1.988654	-8.14	0.000	-20.0954	-12.29762
22	-3.879893	1.794333	-2.16	0.031	-7.397806	-.3619802
23	5.26412	1.687549	3.12	0.002	1.955565	8.572675
24	12.4213	4.154707	2.99	0.003	4.275706	20.56688
25	-1.909594	1.657434	-1.15	0.249	-5.159107	1.33992
26	-7.952944	1.758633	-4.52	0.000	-11.40087	-4.505023
27	-8.844146	1.920001	-4.61	0.000	-12.60844	-5.079852
28	-10.3971	2.082838	-4.99	0.000	-14.48065	-6.313553
29	-14.94952	2.197562	-6.80	0.000	-19.25799	-10.64104
30	-23.35955	2.278921	-10.25	0.000	-27.82753	-18.89157
31	-21.61844	2.280518	-9.48	0.000	-26.08956	-17.14733
32	-21.82914	2.133466	-10.23	0.000	-26.01195	-17.64634
33	-18.08004	1.988317	-9.09	0.000	-21.97828	-14.18181

34	-4.383893	1.791465	-2.45	0.014	-7.896184	-.8716024
35	1.67923	1.677781	1.00	0.317	-1.610174	4.968634
36	13.00969	4.308962	3.02	0.003	4.561677	21.45771
37	2.740592	1.675687	1.64	0.102	-.5447076	6.025891
38	-7.5324	1.720409	-4.38	0.000	-10.90538	-4.15942
39	-5.052673	1.920059	-2.63	0.009	-8.817081	-1.288266
40	-14.08332	2.107092	-6.68	0.000	-18.21442	-9.952223
41	-11.95176	2.201377	-5.43	0.000	-16.26771	-7.635807
42	-21.61598	2.26117	-9.56	0.000	-26.04916	-17.1828
43	-24.23223	2.247226	-10.78	0.000	-28.63807	-19.82639
44	-21.67977	2.137283	-10.14	0.000	-25.87006	-17.48948
45	-16.13359	1.978493	-8.15	0.000	-20.01256	-12.25462
46	-4.332638	1.802671	-2.40	0.016	-7.866899	-.7983765
47	5.89172	1.690574	3.49	0.000	2.577234	9.206206
48	11.21932	4.246517	2.64	0.008	2.893727	19.5449
49	-2.026485	1.65693	-1.22	0.221	-5.275011	1.222041
50	3.263338	1.72715	1.89	0.059	-.1228582	6.649535
51	-1.094991	1.910901	-0.57	0.567	-4.841444	2.651461
52	-12.68552	2.085872	-6.08	0.000	-16.77502	-8.596029
53	-16.58348	2.193495	-7.56	0.000	-20.88398	-12.28298
54	-22.6667	2.305025	-9.83	0.000	-27.18586	-18.14754
55	-23.33278	2.245272	-10.39	0.000	-27.73479	-18.93077
56	-21.83004	2.140797	-10.20	0.000	-26.02722	-17.63286
57	-17.01409	1.996147	-8.52	0.000	-20.92767	-13.10051
58	-5.553456	1.819056	-3.05	0.002	-9.11984	-1.987073
59	2.678729	1.696582	1.58	0.114	-.647537	6.004995
60	5.853403	1.669853	3.51	0.000	2.579543	9.127264
61	-3.368976	1.655752	-2.03	0.042	-6.61519	-.1227607
62	-10.57993	1.739263	-6.08	0.000	-13.98987	-7.169985
63	-12.83305	1.934333	-6.63	0.000	-16.62544	-9.040655
64	-13.19661	2.150632	-6.14	0.000	-17.41307	-8.980149
65	-18.25123	2.208492	-8.26	0.000	-22.58113	-13.92133
66	-23.67549	2.255282	-10.50	0.000	-28.09713	-19.25386
67	-23.93202	2.258911	-10.59	0.000	-28.36077	-19.50327
68	-21.5029	2.131338	-10.09	0.000	-25.68154	-17.32427
69	-16.50924	1.974187	-8.36	0.000	-20.37977	-12.63871
70	-4.362528	1.790045	-2.44	0.015	-7.872035	-.8530209
71	6.487126	1.671044	3.88	0.000	3.21093	9.763323
72	18.79358	4.424752	4.25	0.000	10.11855	27.46861
73	-.2838244	1.655698	-0.17	0.864	-3.529933	2.962285
74	1.325491	1.722076	0.77	0.442	-2.050757	4.701739
75	-10.04985	1.911683	-5.26	0.000	-13.79783	-6.301862
76	-13.03472	2.077228	-6.28	0.000	-17.10727	-8.962169
77	-18.95883	2.203828	-8.60	0.000	-23.27958	-14.63807
78	-23.86672	2.264654	-10.54	0.000	-28.30673	-19.42672
79	-22.93993	2.274065	-10.09	0.000	-27.39839	-18.48147
80	-21.72877	2.128903	-10.21	0.000	-25.90263	-17.55491
81	-15.96172	1.986107	-8.04	0.000	-19.85562	-12.06782
82	-4.569277	1.852949	-2.47	0.014	-8.20211	-.9364442
83	1.626792	1.69565	0.96	0.337	-1.697647	4.951231
84	13.95094	4.262211	3.27	0.001	5.594579	22.30729
85	.998348	1.673396	0.60	0.551	-2.28246	4.279156
86	-4.956187	1.71905	-2.88	0.004	-8.326503	-1.585871
87	-5.815132	1.922901	-3.02	0.003	-9.585111	-2.045152
88	-14.13723	2.109204	-6.70	0.000	-18.27247	-10.00199
89	-19.38593	2.210207	-8.77	0.000	-23.71919	-15.05266
90	-23.09213	2.248603	-10.27	0.000	-27.50067	-18.68359
91	-22.43267	2.241194	-10.01	0.000	-26.82669	-18.03866
92	-20.49871	2.119945	-9.67	0.000	-24.655	-16.34241
93	-14.628	1.973656	-7.41	0.000	-18.49749	-10.75852
94	-2.397309	1.78288	-1.34	0.179	-5.892767	1.098149
95	7.870974	1.679162	4.69	0.000	4.578862	11.16309
96	15.91484	4.413829	3.61	0.000	7.261226	24.56846
97	-1.214179	1.653621	-0.73	0.463	-4.456217	2.027858
98	8.059197	1.727398	4.67	0.000	4.672514	11.44588
99	-2.745606	1.886995	-1.46	0.146	-6.44519	.9539781
100	-10.3137	2.073361	-4.97	0.000	-14.37866	-6.248732

101	-16.74383	2.207604	-7.58	0.000	-21.07199	-12.41567
102	-22.15826	2.278228	-9.73	0.000	-26.62488	-17.69163
103	-22.17374	2.244342	-9.88	0.000	-26.57392	-17.77355
104	-21.03597	2.114833	-9.95	0.000	-25.18224	-16.88969
105	-15.16966	1.976076	-7.68	0.000	-19.04389	-11.29543
106	.3819261	1.807804	0.21	0.833	-3.162398	3.92625
107	14.23459	1.682183	8.46	0.000	10.93655	17.53263
108	7.519782	1.67421	4.49	0.000	4.237377	10.80219
109	2.514319	1.662456	1.51	0.131	-.7450396	5.773677
110	1.770119	1.722753	1.03	0.304	-1.607457	5.147695
111	-1.381062	1.917879	-0.72	0.472	-5.141196	2.379072
112	-6.815474	2.077342	-3.28	0.001	-10.88825	-2.742702
113	-15.40638	2.177796	-7.07	0.000	-19.6761	-11.13666
114	-22.30751	2.265404	-9.85	0.000	-26.74899	-17.86603
115	-22.53307	2.267835	-9.94	0.000	-26.97932	-18.08683
116	-20.41801	2.135779	-9.56	0.000	-24.60535	-16.23067
117	-14.92142	1.980476	-7.53	0.000	-18.80428	-11.03856
118	-5.041867	1.788003	-2.82	0.005	-8.547371	-1.536364
119	1.68776	1.686494	1.00	0.317	-1.618728	4.994249
120	13.67615	4.344516	3.15	0.002	5.158427	22.19387
121	1.580545	1.67459	0.94	0.345	-1.702604	4.863694
122	-4.435058	1.731205	-2.56	0.010	-7.829206	-1.040911
123	-3.182654	1.931709	-1.65	0.100	-6.969902	.6045932
124	-11.64418	2.115797	-5.50	0.000	-15.79234	-7.496011
125	-14.28549	2.187586	-6.53	0.000	-18.57441	-9.996582
126	-22.67487	2.270404	-9.99	0.000	-27.12615	-18.22359
127	-24.07444	2.241729	-10.74	0.000	-28.46951	-19.67938
128	-21.49015	2.1297	-10.09	0.000	-25.66558	-17.31473
129	-15.28152	1.973204	-7.74	0.000	-19.15012	-11.41291
130	-2.646553	1.797391	-1.47	0.141	-6.170462	.877357
131	1.28339	1.71815	0.75	0.455	-2.085162	4.651941
132	14.82657	4.655643	3.18	0.001	5.698862	23.95428
133	3.425387	1.658117	2.07	0.039	.174534	6.67624
134	-1.847015	1.712683	-1.08	0.281	-5.204848	1.510818
135	-4.583022	1.896764	-2.42	0.016	-8.301758	-.8642863
136	-14.00957	2.10484	-6.66	0.000	-18.13625	-9.882885
137	-17.87423	2.213585	-8.07	0.000	-22.21412	-13.53435
138	-21.02121	2.267888	-9.27	0.000	-25.46756	-16.57486
139	-22.54971	2.225332	-10.13	0.000	-26.91262	-18.18679
140	-20.48001	2.108647	-9.71	0.000	-24.61416	-16.34586
141	-15.9352	1.974813	-8.07	0.000	-19.80696	-12.06345
142	-3.60548	1.809853	-1.99	0.046	-7.153821	-.0571398
143	4.797873	1.690969	2.84	0.005	1.482612	8.113135
144	18.99039	4.482709	4.24	0.000	10.20173	27.77905
145	.0602942	1.65565	0.04	0.971	-3.185721	3.30631
146	.0584835	1.712086	0.03	0.973	-3.298178	3.415145
147	15.31304	1.913737	8.00	0.000	11.56102	19.06505
148	-15.29983	2.091727	-7.31	0.000	-19.4008	-11.19885
149	-14.73186	2.195216	-6.71	0.000	-19.03573	-10.42799
150	-21.39429	2.267441	-9.44	0.000	-25.83976	-16.94881
151	-22.24763	2.240587	-9.93	0.000	-26.64046	-17.85481
152	-21.02175	2.124554	-9.89	0.000	-25.18709	-16.85642
153	-16.12775	1.985615	-8.12	0.000	-20.02068	-12.23482
154	-3.901812	1.799875	-2.17	0.030	-7.43059	-.3730338
155	6.808075	1.674913	4.06	0.000	3.524294	10.09186
156	6.588203	1.667505	3.95	0.000	3.318945	9.857461
157	4.74327	1.660057	2.86	0.004	1.488615	7.997925
158	-5.034479	1.721865	-2.92	0.003	-8.410313	-1.658644
159	-6.88288	1.929939	-3.57	0.000	-10.66666	-3.099102
160	-14.5864	2.092608	-6.97	0.000	-18.6891	-10.4837
161	-15.02279	2.178489	-6.90	0.000	-19.29387	-10.75171
162	-23.00745	2.268763	-10.14	0.000	-27.45552	-18.55939
163	-23.1397	2.256628	-10.25	0.000	-27.56397	-18.71542
164	-21.73563	2.118374	-10.26	0.000	-25.88885	-17.58242
165	-15.13725	1.971469	-7.68	0.000	-19.00245	-11.27205
166	-4.462629	1.795683	-2.49	0.013	-7.983188	-.942069
167	8.499417	1.678793	5.06	0.000	5.208029	11.79081

168	20.51246	4.427942	4.63	0.000	11.83118	29.19375
169	3.242997	1.674816	1.94	0.053	-.0405956	6.52659
170	-2.678517	1.723506	-1.55	0.120	-6.057569	.700535
171	-8.319283	1.948871	-4.27	0.000	-12.14018	-4.498386
172	-13.93682	2.148679	-6.49	0.000	-18.14946	-9.72419
173	-19.54669	2.232373	-8.76	0.000	-23.92341	-15.16997
174	-19.79687	2.271783	-8.71	0.000	-24.25086	-15.34288
175	-23.37497	2.263426	-10.33	0.000	-27.81257	-18.93737
176	-21.20367	2.12255	-9.99	0.000	-25.36507	-17.04226
177	-16.11076	1.985435	-8.11	0.000	-20.00334	-12.21818
178	-3.580304	1.822178	-1.96	0.050	-7.152809	-.0077991
179	9.584647	1.675374	5.72	0.000	6.299962	12.86933
180	23.78767	4.34108	5.48	0.000	15.27668	32.29865
lat	0	(omitted)				
D	0	(omitted)				
monthly_dew	-2.502012	.1775337	-14.09	0.000	-2.850079	-2.153945
monthly_pre	.7797709	.4018999	1.94	0.052	-.0081815	1.567723
monthly_tem	-3.770526	.2174512	-17.34	0.000	-4.196854	-3.344198
monthly_wsd	-4.457052	.6784862	-6.57	0.000	-5.78727	-3.126833
monthly_rhd	.4934791	.1205435	4.09	0.000	.2571452	.729813
monthly_sza	7.817337	.8143129	9.60	0.000	6.220821	9.413853
monthly_wdn	-.0377866	.0132551	-2.85	0.004	-.0637742	-.011799
monthly_dew_sq	.0289625	.0020933	13.84	0.000	.0248585	.0330666
monthly_pre_sq	-.00008	.000161	-0.50	0.619	-.0003957	.0002357
monthly_tem_sq	.0479638	.0030706	15.62	0.000	.0419437	.0539838
monthly_wsd_sq	.6228818	.0862907	7.22	0.000	.4537029	.7920606
monthly_rhd_sq	-.0045908	.0006183	-7.42	0.000	-.0058031	-.0033785
monthly_sza_sq	-.0543676	.0046348	-11.73	0.000	-.0634545	-.0452807
monthly_wdn_sq	.0001966	.0000351	5.61	0.000	.0001279	.0002654
_cons	-805.5972	248.1253	-3.25	0.001	-1292.064	-319.1305
sigma_u	30.908442					
sigma_e	5.6009156					
rho	.96820696	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(22, 3924) =    25.14             Prob > F = 0.0000

30 . testparm i.time

 ( 1)  2.time = 0
 ( 2)  3.time = 0
 ( 3)  4.time = 0
 ( 4)  5.time = 0
 ( 5)  6.time = 0
 ( 6)  7.time = 0
 ( 7)  8.time = 0
 ( 8)  9.time = 0
 ( 9)  10.time = 0
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 (18)  19.time = 0
 (19)  20.time = 0
 (20)  21.time = 0
 (21)  22.time = 0
 (22)  23.time = 0
 (23)  24.time = 0
 (24)  25.time = 0
 (25)  26.time = 0
 (26)  27.time = 0
 (27)  28.time = 0
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29.time = 0
30.time = 0
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(95) **96.time = 0**
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 (162)  163.time = 0
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 (174)  175.time = 0
 (175)  176.time = 0
 (176)  177.time = 0
 (177)  178.time = 0
 (178)  179.time = 0
 (179)  180.time = 0

       F(179,  3924) =   10.52
            Prob > F =    0.0000

31 . * time effects are needed

32 . xttest3

   Modified Wald test for groupwise heteroskedasticity
   in fixed effect regression model

   H0: sigma(i)^2 = sigma^2 for all i

   chi2 (23)  =    1274.44
   Prob>chi2 =      0.0000


33 . * presence of heteroscedasticity

34 . correlate rel_dhi L.rel_dhi
   (obs=4117)
```

	rel_dhi	L. rel_dhi
rel_dhi		
--.	1.0000	
L1.	0.8293	1.0000

```
35 . . correlate rel_dhi L2.rel_dhi
   (obs=4094)
```

	rel_dhi	L2. rel_dhi
rel_dhi		
--.	1.0000	
L2.	0.6192	1.0000

```
36 . clear

37 . import excel "C:\Users\Anshul Goel\Downloads\data_prashast.xlsx", sheet("Sheet1") firstrow

38 . ** arellano bover estimate is rel_yhat

39 . regress rel_dhi rel_yhat

      Source |       SS           df       MS      Number of obs   =     4117
-------------+----------------------------------   F(1, 4115)      = 54417.65
       Model |  1937119.73         1  1937119.73   Prob > F        =   0.0000
    Residual |  146482.755     4,115  35.5972673   R-squared       =   0.9297
-------------+----------------------------------   Adj R-squared   =   0.9297
       Total |  2083602.48     4,116  506.220234   Root MSE        =   5.9663

------------------------------------------------------------------------------
     rel_dhi |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    rel_yhat |   .9665897   .0041435   233.28   0.000     .9584662    .9747133
       _cons |   1.216107   .1771825     6.86   0.000     .8687334     1.56348
------------------------------------------------------------------------------

40 . xtline rel_dhi rel_yhat
must specify panelvar; use xtset
r(459);

41 . xtset location time
       panel variable:  location (strongly balanced)
        time variable:  time, 1 to 180
                delta:  1 unit

42 .
43 . . regress rel_dhi rel_yhat

      Source |       SS           df       MS      Number of obs   =     4117
-------------+----------------------------------   F(1, 4115)      = 54417.65
       Model |  1937119.73         1  1937119.73   Prob > F        =   0.0000
    Residual |  146482.755     4,115  35.5972673   R-squared       =   0.9297
-------------+----------------------------------   Adj R-squared   =   0.9297
       Total |  2083602.48     4,116  506.220234   Root MSE        =   5.9663

------------------------------------------------------------------------------
     rel_dhi |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    rel_yhat |   .9665897   .0041435   233.28   0.000     .9584662    .9747133
       _cons |   1.216107   .1771825     6.86   0.000     .8687334     1.56348
------------------------------------------------------------------------------

44 . xtline rel_dhi rel_yhat

45 . xtline rel_dhi rel_yhat if time < 13

46 . ** for 1 year

47 .
```