Documentation for G-Econ Statistical Analysis

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This note documents the data creation for the data set used in the draft article, William D. Nordhaus, "Geography and Macroeconomics: New Data and New Findings," December 2, 2005, prepared for *Proceedings of the National Academy of Sciences*. All programs and data analysis were performed in EViews 5.0. The major program files discussed below are added as Annexes to this documentation.

I. Public Data Files

The underlying economic and geographical data are available in large Excel spreadsheets. The spreadsheet "Economic_3.xls" contains the major economic and demographic data as well as markers (country, countryid, latitude, longitude). The documentation for the economic data is contained in the background paper (William Nordhaus, Qazi Azam, Nadejda Makarova Victor, Mukhtar Mohammed, and Alexander Miltner, "The G-Econ Database on Gridded Output: Methods and Data," Yale University, June 6, 2005 and the more recent version). The public version (with noise added) is "Economic_3_R.xls".

The spreadsheet "Geography_L_1.xls" contains the major geographical data (temperature, precipitation, soils, vegetation, etc.) The documentation for the geographical data are contained in Kyle Hood, "Documentation for data," Summer, 2004.

The underlying data and methodology for individual countries is on the project is available on the web page at http://www.econ.yale.edu/~nordhaus/homepage/economics_and_geography.htm .

II. Data Preparation

The underlying data can be easily inspected in the two spreadsheets described in part I above and section 1 below.

1. The underlying geography data are in "climate_L_1.xls" (see above). "Economic_L_3.xls" contains the economic data (in file "C:\Major\Research\Geography\Documentation\ProgAndFiles"). The economic data were merged by Qazi Azam and David Corderi. The latest complete update

for the project was October 27, 2005, so were "date" is used, files are "date" = "102705". These include the project files augmented by Antarctica and Angola. The latter are preliminary and incomplete, and Antarctica is not used in the analysis.

2. The file creation program is in the EViews file, total_file_create_v7_long.prg. Currently in the folder "C:\Major\Research\Geography\Documentation\ProgAndFiles". This takes the Excel sheets described in 1 and merges them by country, latitude, and longitude. It then creates a unitary file with all the economic and climate data called "e_{date}", where {date} is the creation date.

3. The soils and vegetation data are in "Soils_Vegetation_wdn.xls". These are merged with "e_{date}.wf1" to obtain the file "e_{date}a.wf1". This has 25,571 observations, with 19,136 outside Antarctica. We then manually check latitude and longitude to make sure that the transfer was correct.

4. The data are then processed and cleaned in the file, "clean_data_{date}.prg", with the output file, "c_{date}_clean". This removes small observations (rig<.02) as well as ones with very large discrepancies. That removes 1030 observations. This leaves 18,106 observations with high quality. A further program to test for quality is to compare old and new data in further_quality_102705.prg. Tests indicate that the difference in the estimates is very small and this is therefore omitted. For example, the temp coefficient changes from 0.216235 to 0.216489 in a simple temp, prec, and country regression. This suggests that the estimates are reasonably robust to small measurement errors.

5. We have also created a file comparing the old (2001) data with the new data. This is generated by the file "compare_old_data_v3.prg" and is contained in the file "newold_c_merged_{date}.wf1". This new file has some useful auxiliary data (distance from coast) as well as data for comparisons.

6. We next create a new file that has unlinked all series. This is in program "remove_links_102705.prg", and the saved file is n_{date}.wf1.

7. Finally, we need to correct for the measurement error at low levels of population. There are 3170 zero observations for gcpdens. For this, we have program "neighbor_est_v8.prg", which estimates data on the basis of neighbor's GCP. The resulting file is "interp_{date}.wf1". This calculates the neighbor GCP as .03 of the average of the two neighboring cells, and .01 for longitude (which comes from regressions of low-intensity cells). These add 618 high-quality cells, primarily in

Canada (353), Russia (108), the US (52), and Australia (78). The new interpolated series is gcpdensi and the log series is lydi and lydi1.

8. These data can be tested using the program "test_distance_v3.prg". This shows samples of the cross sections of different variables for latitude and longitude slices.

9. The interpolation estimation adds 618 non-trivial non-zero observations. Note that the interpolation changes the regression of log(gcpdens) on temp very little (when zeros are included as 1) . The mean gcpdens for the non-trivial observations is 246 $/km2, whereas for the non-zero gcpdens the mean is 315,000 246 $/km2. The regression of log output density (with zeros as 1) on temp with interpolated values is as follows. Note the big difference when zeros are omitted (these are the results with the prior data, but they are essentially the same with the new data).

With zero observations as lyd = 1:		b	se(b)	t(b)
lydi1	TEMPAV	0.145	0.002	83.123
ldy1	TEMPAV	0.151	0.002	82.931
Omitting zero observation (but including interpolated)				
lydi	TEMPAV	0.044	0.002	26.342
lyd	TEMPAV	0.018	0.002	12.007

10. The next file is the f_{day}.wf1. This differs only from the earlier ones in that extraneous files have been removed. Additionally, Antarctica is removed. Removal is with remove_est_102805.prg. New file is "f_102705s.wf1". We have also removed extraneous and old series to shorten the file.

11. We have created regional and country dummy variables. These are in "C:\Major\Research\Geography\FigsandTabs\CountryDums\count_dum_102705 .prg". The regions are North America, Latin America, Western Europe, Eastern Europe, continental Asia, Middle East, Sub-saharan Africa, and Oceanic. This creates data file "C:\Major\Research\Geography\ Documentation\ProgAndFiles\ f_{date}b.wf1". The country symbols are in "country_symbols_all.rtf" (not updated in October).

12. We also create five country groups depending upon the number of grid cells, in file group_dums_110705.prg. The groups are as follows: large > 600; medium > 150; small > 75; very small > 40; tiny rest.

13. The distance from coast variable has been created by Christopher Small (Lamont-Doherty Earth Observatory in May 2000) and David Corderi (Yale) using ArcView. The original data are then modified so that cells which are iced in December in the northern hemisphere are treated as land, and distance is to the nearest ice-free cell. David's new estimates are in worksheet "distance_projected" in Distance_calc_David_271005.xls. The final distance to coast series being dist_rev. The new file is f_102705g.wf1. A description of the methodology will be available on the project web site.

14. We then create dummies for the soil groups (0 through 27). This program is "create_dum_soils_v2.prg" and creates "f_{date}e.wf1". [Note that it might be preferable to use more detailed classifications for some soils, such as anthros.]

15. Final file with all changes is f_102705_fin.wf1

Figures and Tables for Paper

16. Table 1 with the data summary statistics are from table_gecon_data_103105.xls.

Figures 1 and 2

17. Figure 1 created by David Corderi from basic G-Econ data using ArvView with modifications.

18. Figure 2 created by taking quantiles for each variable. Program for sorting and new program is C:\Major\Research\Geography\FigsandTabs\ScatAllVar\scat_110105_v3.prg. Figure 2 is Figure 4a in C:\Major\Research\Geography\FigsandTabs\ScatAllVar\rank_f_102705a.wf1

Climate Output Reversal and Box Diagrams

19. Notes on section B (The Climate-Output Reversal). The program for this section is C:\Major\Research\Geography\FigsandTabs\PerCapitaComp\box_program_temp_all_{date}.prg. Source program is C:\Major\Research\Geography\FigsandTabs\PerCapitaComp\f{date}e.wf1. Results saved in C:\Major\Research\Geography\FigsandTabs\PerCapitaComp\box_102705.wf1. The main problems here are to make sure that the data program is correctly loaded. Also, the boxes will need to be fine tuned for axes and labels, and the whiskers and staples are removed. (China lat 34 long 78 is a problem and is removed.)

20. The program for with and without country effects in the reversal is in C:\Major\Research\Geography\ FigsandTabs\ PerCapitaComp\ withandwithout_count_111105.prg. Source file is wfopen C:\Major\Research\Geography\Documentation\ProgAndFiles\f_102705_fin_af.wf 1. We have included all but "tiny" countries.

Multivariate estimates

21. Multivariate approaches. Program for multivariate analysis: (How much of differences in output is explained by pure geography?) The program is C:\Major\Research\Geography\FigsandTabs\Multivar\ regr_multivar_v7b.prg. The estimate shown in Table A1 below limits the regression to high-quality observations, but the difference between that and all observations is very small. There are some bad outliers but they do not affect the outcome.

22. Regression is shown in Table A1 below. The equation is shown in f_102705_fin_multi.wf1.

Africa

23. The procedure with Africa is to estimate the regression and then estimate the results of geography as the conditional predictions of geography from the regression. Country effects are then differences in the (logarithms) of the different regions. Results differ slightly upon specifications.

24. The work file is drawn from C:\Major\Research\Geography\Documentation\ProgAndFiles\ 'wfopen f_102705_fin.wf1. The program is C:\Major\Research\Geography\FigsandTabs\Africa\ new_decomoposition_110505_v4.prg. The region averages (wtmean) are created in new_calc_means_110605_v4.prg. The new results are in new_af_results_110605.xls.

25. Table A2 shows the results for the regression for population density.

26. Some sensitivities in the results:
    a. The geographical specifications differ slightly but affect the results little.

    b. Note also that the estimates assume a log-normal distribution of the variable (omitting zero observations). This means that the means of the variables will

differ from the means of the exp(ln) variables. Hence, the difference in ln variables are not equal to the ratio of the ln of the variables. For example, the exp of the mean ln of pcy for India is 1489, while the actual is 1536. The differences are small for pcy but large for output density.

[Needs adjustment for corrected distance and unpopulated regions.]

Global Warming

27. The methodology is to estimate an equation and forecast output from that (providing base). Then change climate variables in each grid cell according to assumptions and use the equation to forecast with climate change. Result is difference between the two. Average then takes the difference and uses weights of pop, gcp, or area. The program for doing this is "C:\Major\Research\ Geography\FigsandTabs\GlobalWarming \ gw_110705_sim_v6.prg". The workfile is f_102705_fin_gw.wf1. The methodology is simple, but the program is extremely intricate. The structure as follows:

    a. The two scenarios are divided into two parts. They are virtually identical except for the precipitation assumptions.

    b. Within each section, the first part is the definition and the estimation of the equation. Then the variable is forecast. Next temperature and precipitation are changed according to the scenario. Then the difference is calculated for each grid cell. Then the total is summed over all grid cells.

    c. The bootstrap is straightforward. For the first bootstrap, the rows are permuted. This tests to make sure that there are no errors in the program. Then the rows are sampled with replacement for the bootstrap. (Note that this leads to slight underestimate of error because first estimate is double-counted.

28. Note on mid-continental drying: IPCC TAR has multi-model plots of precipitation changes (pp. 550-552), along with ranges and model t plots. The scenario most closely associated with the CC2 scenario is the IS92a G (greenhouse gases only). The warming is slightly less than the assumptions because the equilibrium has not been reached.

    The following provides the rough estimates:

Region	Warming	Drying

U.S.	2-3 oC	0 – 5 % drying
Eurasia through 60 W	2-3 oC (except in far W)	0 – 15 % 20 N to 45 N
Eurasia W of 60 W	2-3 oC	Wetter
Africa and Australia	1-3 oC	0 – 10 % 15 to 45 S lat
S America	1-3 oC	Mixed; up to -10 % on low lat E

From this, it would appear that the best simplification would be 10 percent drying from 15 to 45 latitudes. This is scaled up to 15 percent because equilibrium has not been reached.

29. The results are well-determined but sensitive to the specification. It will be useful to have further tests and specifications to determine whether this approach is fruitful.

30. The global-warming estimation/simulation program is complicated. We have run two tests to ensure its (programming) accuracy. Files are C:\Major\Research\Geography\Documentation\MonteCarlo\gw_091505_sim_cc12._v4_montecarlo.prg and C:\Major\Research\Geography\Documentation\MonteCarlo\monte_v1.wf1. Operating the first calls the second and performs the Monte Carlo simulation. Results used to check program against hand calculations are in C:\Major\Research\Geography\ Documentation\ MonteCarlo\ test_monte.xls. First, we did a Monte Carlo to see if it generated the correct answers, which it clearly did for the linear case and seemed correct for the higher order case. Second, we examined alternative solution techniques, and these gave the same results. Note that the program calculates the linearized impact at the original equilibrium rather than a discrete step. This is done because of serious non-linearities that arise when using the logarithm for large (3 oC) steps.

31. The calculations for the table are provided in the basic simulation with a sample size of 100. These are collated in table3_110705.xls. The baseline global warming equation is shown in Table A3.

Annex Tables and Programs

This Annex contains the regression results used in the paper. Additionally, the major programs used in creating the data, regressions, and tables are in Annexes A through P.

Annex Tables

Table A1. Regression for Multivariate Case
Table A2. Equation for Africa for population density
Table A3. Baseline Global Warming Equation

Files in Annexes

Annex A. total_file_create_v7_long.prg
Annex B. clean_data__102705.prg
Annex C. compare_old_data_v3.prg
Annex D. remove_links_102705.prg
Annex E. neighbor_est_v9.prg
Annex F. test_distance_v3.prg
Annex G. remove_est_102805.prg
Annex H. count_dum_102705.prg
Annex I. create_dum_soils_v2.prg
Annex J. scat_110105_v3.prg
Annex K. box_program_temp_all_110105.prg
Annex L. withandwithout_count_110105.prg
Annex M. regr_multivar_v7b.prg
Annex N. new_decomposition_110505_v4.prg
Annex O. new_calc_means_110605_v4.prg
Annex P. gw_110705_sim_v6.prg

Table A1. Regression for Multivariate Case

Dependent Variable: LYDI1
Method: Least Squares
Date: 11/10/05 Time: 17:52
Sample: 1 19136 IF QUALITY=1
Included observations: 17409
Weighting series: AREANEW

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.54794	0.448567	32.43203	0.0000
T	0.511515	0.031529	16.22353	0.0000
T^2	-0.009161	0.000307	-29.87665	0.0000
T^3	-9.25E-05	1.03E-05	-8.936777	0.0000
P	0.010669	0.001134	9.407875	0.0000
P^2	-0.000237	1.12E-05	-21.14637	0.0000
P^3	4.91E-07	1.94E-08	25.36917	0.0000
T*P	0.001570	8.56E-05	18.33441	0.0000
T^2*P	-6.36E-05	4.65E-06	-13.68589	0.0000
P^2*T	-1.17E-06	6.44E-07	-1.819206	0.0689
CVAV	-0.006686	0.000561	-11.92555	0.0000
TEMPMAX	-0.048580	0.040842	-1.189474	0.2343
TEMPMIN	-0.225336	0.035560	-6.336753	0.0000
TEMPSD	-0.129051	0.083032	-1.554224	0.1201
TEMPMAX^2	-0.000986	0.000512	-1.926044	0.0541
EMEAN	0.267036	0.037535	7.114287	0.0000
ESD	0.090808	0.111785	0.812346	0.4166
PRECMIN	0.002219	0.000818	2.713022	0.0067
DIST_MED_N	0.545384	0.067147	8.122203	0.0000
DIST_SHORT_N	0.462837	0.075421	6.136724	0.0000
DIST_LONG_N	0.941525	0.050107	18.79012	0.0000
DUMSOIL1	-0.659713	0.097745	-6.749300	0.0000
DUMSOIL0	-0.399259	0.169073	-2.361454	0.0182
DUMSOIL2	-0.372135	0.098128	-3.792356	0.0001
DUMSOIL3	1.183328	0.144300	8.200481	0.0000
DUMSOIL4	0.216022	0.146609	1.473452	0.1406
DUMSOIL5	0.230540	0.267681	0.861248	0.3891
DUMSOIL6	-0.665310	0.099184	-6.707865	0.0000
DUMSOIL7	-0.429256	0.111373	-3.854215	0.0001
DUMSOIL8	0.591412	0.151064	3.914976	0.0001
DUMSOIL9	-0.459370	0.087788	-5.232696	0.0000
DUMSOIL10	0.412704	0.129198	3.194362	0.0014
DUMSOIL11	0.021099	0.109247	0.193135	0.8469
DUMSOIL12	0.561669	0.093407	6.013153	0.0000
DUMSOIL14	-0.309361	0.136733	-2.262516	0.0237
DUMSOIL16	0.161781	0.122684	1.318679	0.1873

DUMSOIL17	-0.702859	0.096900	-7.253414	0.0000
DUMSOIL18	-0.913702	0.102474	-8.916384	0.0000
DUMSOIL19	-0.055833	0.165932	-0.336484	0.7365
DUMSOIL20	-0.088184	0.182336	-0.483633	0.6287
DUMSOIL22	0.083584	0.114602	0.729344	0.4658
DUMSOIL23	0.382813	0.153470	2.494391	0.0126
DUMSOIL24	-0.046680	0.108302	-0.431016	0.6665
DUMSOIL25	-0.442340	0.095162	-4.648287	0.0000
DUMSOIL26	-0.153034	0.164104	-0.932542	0.3511
DUMSOIL27	0.030232	0.406203	0.074427	0.9407
DUM_RU	-0.421381	0.186244	-2.262516	0.0237
DUM_CA	-3.996564	0.188619	-21.18852	0.0000
DUM_US	-1.227984	0.175784	-6.985756	0.0000
DUM_CN	-0.820290	0.178159	-4.604252	0.0000
DUM_AU	-6.339055	0.183697	-34.50825	0.0000
DUM_BR	-2.098236	0.193266	-10.85675	0.0000
DUM_GL	-2.953843	0.452941	-6.521478	0.0000
DUM_KZ	-2.051178	0.204117	-10.04903	0.0000
DUM_ID	-1.194699	0.229444	-5.206940	0.0000
DUM_IN	0.286772	0.197515	1.451896	0.1465
DUM_AR	-3.360296	0.193313	-17.38271	0.0000
DUM_DZ	-1.348438	0.209839	-6.426073	0.0000
DUM_MX	-1.708219	0.203173	-8.407705	0.0000
DUM_SD	-1.427659	0.213677	-6.681394	0.0000
DUM_CD	-2.962550	0.212274	-13.95624	0.0000
DUM_MN	-3.087331	0.219583	-14.05996	0.0000
DUM_SA	1.130992	0.213445	5.298763	0.0000
DUM_IR	-0.022022	0.213868	-0.102969	0.9180
DUM_LY	-0.857042	0.219915	-3.897160	0.0001
DUM_SO	-2.179677	0.236609	-9.212127	0.0000
DUM_ZA	-1.932279	0.218365	-8.848852	0.0000
DUM_CL	-2.329615	0.264741	-8.799599	0.0000
DUM_PE	-2.223210	0.221431	-10.04019	0.0000
DUM_ML	-2.923821	0.233863	-12.50231	0.0000
DUM_AO	-4.400874	0.226949	-19.39148	0.0000
DUM_TD	-2.635429	0.231517	-11.38329	0.0000
DUM_CO	-1.493572	0.230661	-6.475185	0.0000
DUM_NE	-2.126501	0.233812	-9.094917	0.0000
DUM_NO	-0.470153	0.412881	-1.138713	0.2548
DUM_BO	-4.176063	0.224765	-18.57972	0.0000
DUM_ET	-2.710188	0.227423	-11.91697	0.0000
DUM_MR	-2.817443	0.241968	-11.64386	0.0000
DUM_JP	0.935919	0.328765	2.846772	0.0044
DUM_SE	-0.651020	0.344187	-1.891472	0.0586
DUM_TR	-1.155718	0.239277	-4.830034	0.0000
DUM_VE	-2.568548	0.234492	-10.95365	0.0000
DUM_EG	-0.529242	0.249783	-2.118809	0.0341
DUM_PK	0.313062	0.241538	1.296118	0.1950
DUM_MZ	-4.753213	0.239645	-19.83441	0.0000

DUM_NG	-0.628012	0.235651	-2.665009	0.0077
DUM_TZ	-3.716232	0.231587	-16.04680	0.0000
DUM_FI	-0.387561	0.395143	-0.980814	0.3267
DUM_NA	-2.977794	0.240695	-12.37164	0.0000
DUM_FR	0.267627	0.273642	0.978021	0.3281
DUM_ES	-0.095078	0.277529	-0.342586	0.7319
DUM_AF	-1.588764	0.256897	-6.184430	0.0000
DUM_MM	-1.357234	0.250346	-5.421439	0.0000
DUM_ZM	-4.096657	0.246463	-16.62177	0.0000
DUM_MA	-1.909809	0.251005	-7.608663	0.0000
DUM_PG	-3.095024	0.294158	-10.52165	0.0000
DUM_PH	0.339103	0.367068	0.923815	0.3556
DUM_IT	0.661476	0.353167	1.872983	0.0611
DUM_MG	-4.558041	0.252010	-18.08677	0.0000
DUM_TH	0.057397	0.271796	0.211179	0.8328
DUM_UZ	-1.817895	0.308875	-5.885544	0.0000
DUM_UK	0.394306	0.411392	0.958468	0.3378
DUM_CF	-4.294682	0.257194	-16.69819	0.0000
DUM_DE	1.946622	0.330666	5.886981	0.0000
DUM_KE	-2.858256	0.259024	-11.03472	0.0000
DUM_BW	-3.797137	0.260386	-14.58270	0.0000
DUM_CM	-1.963310	0.277627	-7.071744	0.0000
DUM_IQ	1.198518	0.291551	4.110827	0.0000
DUM_VN	-1.755649	0.315371	-5.566928	0.0000
DUM_YE	-2.428436	0.286872	-8.465235	0.0000
DUM_MY	-0.240583	0.332734	-0.723050	0.4697
DUM_ZW	-2.242220	0.284563	-7.879533	0.0000
DUM_GR	-1.570971	0.560285	-2.803879	0.0051
DUM_RO	-0.232239	0.365388	-0.635594	0.5250
DUM_LA	-3.008442	0.364691	-8.249300	0.0000
DUM_KG	-0.855190	0.431325	-1.982704	0.0474
DUM_GH	-1.499264	0.344564	-4.351191	0.0000
DUM_SY	-0.355487	0.396046	-0.897590	0.3694

Weighted Statistics

R-squared	0.908350	Mean dependent var	9.135930
Adjusted R-squared	0.907730	S.D. dependent var	6.488201
S.E. of regression	1.970851	Akaike info criterion	4.201563
Sum squared resid	67162.64	Schwarz criterion	4.254193
Log likelihood	-36454.51	F-statistic	326.0882
Durbin-Watson stat	0.607693	Prob(F-statistic)	0.000000

Unweighted Statistics

R-squared	0.743322	Mean dependent var	8.537330
Adjusted R-squared	0.741585	S.D. dependent var	4.161993
S.E. of regression	2.115730	Sum squared resid	77399.90
Durbin-Watson stat	0.531403		

Table A2. Equation for Africa for population density

Dependent Variable: LPD1
Method: Least Squares
Date: 11/07/05 Time: 10:12
Sample (adjusted): 7 19136
Included observations: 18816 after adjustments
Weighting series: AREANEW

Variable	Coefficient	Std. Error	t-Statistic	Prob.
T	0.177056	0.019562	9.050785	0.0000
T^2	-0.005303	0.000125	-42.34795	0.0000
T^3	-0.000213	5.51E-06	-38.61500	0.0000
P	0.019416	0.000576	33.68228	0.0000
P^2	-0.000261	4.78E-06	-54.54620	0.0000
P^3	5.13E-07	1.15E-08	44.51910	0.0000
T*P	9.34E-05	3.67E-05	2.546991	0.0109
TEMPMAX	-0.034145	0.012559	-2.718735	0.0066
TEMPMIN	-0.014175	0.008918	-1.589440	0.1120
EMEAN	-0.232166	0.022749	-10.20566	0.0000
PRECMIN	-0.001879	0.000523	-3.596993	0.0003
DIST_MED_N	0.309960	0.044799	6.918864	0.0000
DIST_SHORT_N	0.246545	0.050338	4.897835	0.0000
DIST_LONG_N	0.464351	0.033070	14.04161	0.0000
DUMSOIL0	-0.071125	0.090509	-0.785830	0.4320
DUMSOIL2	0.269890	0.041271	6.539496	0.0000
DUMSOIL3	1.600721	0.082887	19.31218	0.0000
DUMSOIL4	0.584786	0.085957	6.803199	0.0000
DUMSOIL6	-0.300322	0.042561	-7.056270	0.0000
DUMSOIL10	0.600222	0.070561	8.506418	0.0000
DUMSOIL12	0.498139	0.037295	13.35686	0.0000
DUMSOIL25	-0.343498	0.034496	-9.957465	0.0000
IFAF	-1.994380	0.091675	-21.75486	0.0000
IFINDEUROPE	0.877944	0.166707	5.266398	0.0000
IFTEMPUS	1.428636	0.127092	11.24092	0.0000
IFOTHERLOLAT	-0.267035	0.043021	-6.207134	0.0000

C	4.818170	0.237890	20.25380	0.0000
DUM_RU	-1.654725	0.087177	-18.98125	0.0000
DUM_CA	-3.529556	0.087417	-40.37618	0.0000
DUM_US	-3.514134	0.136388	-25.76578	0.0000
DUM_CN	0.261132	0.069052	3.781689	0.0002
DUM_AU	-5.517509	0.066027	-83.56415	0.0000
DUM_BR	-2.271197	0.073469	-30.91365	0.0000
DUM_GL	-3.501465	0.172234	-20.32972	0.0000
DUM_KZ	-1.595100	0.095773	-16.65495	0.0000
DUM_ID	0.280997	0.104978	2.676715	0.0074
DUM_IN	1.378205	0.079211	17.39921	0.0000
DUM_AR	-3.076103	0.083436	-36.86768	0.0000
DUM_DZ	-1.942837	0.089917	-21.60712	0.0000
DUM_MX	-1.487618	0.087190	-17.06178	0.0000
DUM_SD	1.339369	0.087087	15.37975	0.0000
DUM_CD	0.106438	0.087317	1.218992	0.2229
DUM_MN	-1.052435	0.110900	-9.489952	0.0000
DUM_SA	-0.099611	0.093319	-1.067423	0.2858
DUM_IR	0.112079	0.098651	1.136121	0.2559
DUM_LY	-2.774769	0.096659	-28.70668	0.0000
DUM_SO	1.320980	0.106926	12.35414	0.0000
DUM_ZA	-2.136322	0.104977	-20.35043	0.0000
DUM_CL	-2.410174	0.143341	-16.81424	0.0000
DUM_PE	-1.210762	0.102927	-11.76334	0.0000
DUM_ML	0.541422	0.110358	4.906045	0.0000
DUM_AO	-1.589461	0.101037	-15.73151	0.0000
DUM_TD	0.194581	0.104546	1.861198	0.0627
DUM_CO	-1.099989	0.109354	-10.05900	0.0000
DUM_NE	0.557402	0.110518	5.043556	0.0000
DUM_NO	-2.074736	0.258350	-8.030714	0.0000
DUM_BO	-2.861143	0.107638	-26.58115	0.0000
DUM_ET	1.200312	0.103649	11.58051	0.0000
DUM_MR	0.044210	0.118858	0.371957	0.7099
DUM_JP	0.111717	0.198868	0.561766	0.5743
DUM_SE	-1.796683	0.209865	-8.561150	0.0000
DUM_TR	-0.444106	0.127816	-3.474573	0.0005
DUM_VE	-2.185614	0.113989	-19.17384	0.0000
DUM_EG	-1.249082	0.111901	-11.16236	0.0000
DUM_PK	1.335662	0.125228	10.66587	0.0000

DUM_MZ	-0.588865	0.121829	-4.833528	0.0000
DUM_NG	2.342603	0.113594	20.62258	0.0000
DUM_TZ	0.135989	0.109871	1.237708	0.2158
DUM_FI	-1.396812	0.248278	-5.626008	0.0000
DUM_NA	-1.583391	0.120360	-13.15550	0.0000
DUM_FR	-1.570310	0.186687	-8.411478	0.0000
DUM_ES	-1.335643	0.160256	-8.334417	0.0000
DUM_AF	0.164145	0.138602	1.184287	0.2363
DUM_MM	-0.375118	0.133143	-2.817405	0.0048
DUM_ZM	-0.703733	0.121936	-5.771336	0.0000
DUM_MA	-1.603918	0.131604	-12.18749	0.0000
DUM_PG	-0.971985	0.163493	-5.945101	0.0000
DUM_PH	1.650994	0.221294	7.460652	0.0000
DUM_IT	-0.539350	0.214680	-2.512347	0.0120
DUM_MG	-0.578991	0.136841	-4.231136	0.0000
DUM_TH	0.569282	0.146773	3.878663	0.0001
DUM_UZ	-0.666902	0.178287	-3.740607	0.0002
DUM_UK	-0.980461	0.266797	-3.674937	0.0002
DUM_CF	-1.430505	0.131060	-10.91490	0.0000

Weighted Statistics

R-squared	0.790445	Mean dependent var	1.081109
Adjusted R-squared	0.789517	S.D. dependent var	3.026287
S.E. of regression	1.388413	Akaike info criterion	3.498654
Sum squared resid	36109.51	Schwarz criterion	3.533665
Log likelihood	-32831.34	F-statistic	724.5078
Durbin-Watson stat	0.826353	Prob(F-statistic)	0.000000

Unweighted Statistics

R-squared	0.760065	Mean dependent var	0.739947
Adjusted R-squared	0.759002	S.D. dependent var	2.738679
S.E. of regression	1.344460	Sum squared resid	33859.43
Durbin-Watson stat	0.821156		

Table A3. Baseline Global Warming Equation

Dependent Variable: LYD
Method: Least Squares
Date: 11/07/05 Time: 13:44
Sample (adjusted): 7 19136
Included observations: 15545 after adjustments
Weighting series: LYD

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TT^2	-0.000307	0.000286	-1.073032	0.2833
PP	0.008470	0.000689	12.28440	0.0000
PP^2	-3.40E-05	2.12E-06	-16.06918	0.0000
EMEAN	-0.528043	0.027864	-18.95064	0.0000
ROUGH	0.621636	0.170006	3.656559	0.0003
ROUGH^2	-0.325540	0.160543	-2.027743	0.0426
DIST_MED_N	0.355660	0.057482	6.187356	0.0000
DIST_SHORT_N	0.208317	0.050988	4.085622	0.0000
DIST_LONG_N	0.095310	0.043453	2.193379	0.0283
C	14.14448	0.138258	102.3047	0.0000
DUM_RU	-2.153673	0.148155	-14.53662	0.0000
TDUM_RU	0.188341	0.008174	23.04288	0.0000
DUM_CA	-2.232182	0.169587	-13.16245	0.0000
TDUM_CA	0.255958	0.013294	19.25323	0.0000
DUM_US	-2.401844	0.138343	-17.36152	0.0000
TDUM_US	0.142353	0.005394	26.39341	0.0000
DUM_CN	-2.434549	0.140754	-17.29649	0.0000
TDUM_CN	0.017360	0.005908	2.938599	0.0033
DUM_AU	-2.090067	0.220968	-9.458692	0.0000
TDUM_AU	-0.257000	0.015587	-16.48835	0.0000
DUM_BR	1.215278	0.332267	3.657535	0.0003
TDUM_BR	-0.323877	0.020255	-15.98965	0.0000
DUM_GL	-4.340987	1.521839	-2.852462	0.0043
TDUM_GL	0.001648	0.117000	0.014087	0.9888
DUM_KZ	-4.461794	0.162966	-27.37867	0.0000
TDUM_KZ	-0.100093	0.019881	-5.034707	0.0000
DUM_ID	-6.313550	1.018490	-6.198932	0.0000
TDUM_ID	0.168423	0.057367	2.935882	0.0033
DUM_IN	-1.893646	0.221552	-8.547197	0.0000
TDUM_IN	0.013958	0.010926	1.277542	0.2014
DUM_AR	-4.806362	0.182920	-26.27577	0.0000
TDUM_AR	0.061211	0.015658	3.909155	0.0001
DUM_MX	-1.011454	0.327276	-3.090525	0.0020
TDUM_MX	-0.126303	0.022881	-5.520064	0.0000
DUM_DZ	1.345626	0.376444	3.574566	0.0004
TDUM_DZ	-0.442739	0.026777	-16.53415	0.0000

DUM_SD	-13.52044	1.387062	-9.747533	0.0000
TDUM_SD	0.425173	0.073920	5.751789	0.0000
DUM_MN	-7.054383	0.342683	-20.58572	0.0000
TDUM_MN	-0.104905	0.032432	-3.234623	0.0012
DUM_CD	3.220968	0.856151	3.762151	0.0002
TDUM_CD	-0.500184	0.055039	-9.087885	0.0000
DUM_SA	-3.639481	0.593065	-6.136738	0.0000
TDUM_SA	0.045104	0.034731	1.298660	0.1941
DUM_IR	-1.044085	0.235779	-4.428235	0.0000
TDUM_IR	-0.146729	0.019326	-7.592470	0.0000
DUM_LY	5.445357	1.135844	4.794106	0.0000
TDUM_LY	-0.757817	0.085011	-8.914339	0.0000
DUM_SO	-1.547314	1.544950	-1.001530	0.3166
TDUM_SO	-0.229574	0.083371	-2.753654	0.0059
DUM_ZA	-1.434637	0.468696	-3.060912	0.0022
TDUM_ZA	-0.124413	0.045714	-2.721569	0.0065
DUM_CL	-4.350734	0.185245	-23.48635	0.0000
TDUM_CL	0.182518	0.033873	5.388378	0.0000
DUM_PE	-1.869475	0.265441	-7.042912	0.0000
TDUM_PE	-0.171419	0.018502	-9.264818	0.0000
DUM_ML	2.560013	3.560883	0.718926	0.4722
TDUM_ML	-0.426337	0.175944	-2.423138	0.0154
DUM_AO	-5.475898	1.061992	-5.156250	0.0000
TDUM_AO	0.040118	0.078416	0.511611	0.6089
DUM_TD	-12.70555	1.919675	-6.618598	0.0000
TDUM_TD	0.335698	0.101307	3.313661	0.0009
DUM_CO	1.664279	0.597736	2.784304	0.0054
TDUM_CO	-0.308556	0.036145	-8.536640	0.0000
DUM_NE	-20.01554	2.379629	-8.411203	0.0000
TDUM_NE	0.720225	0.120312	5.986306	0.0000
DUM_NO	-0.953604	0.340398	-2.801438	0.0051
TDUM_NO	0.367210	0.043737	8.395876	0.0000
DUM_BO	-3.208591	0.329411	-9.740374	0.0000
TDUM_BO	-0.175653	0.022270	-7.887290	0.0000
DUM_ET	0.122812	0.565310	0.217248	0.8280
TDUM_ET	-0.322326	0.037070	-8.695099	0.0000
DUM_MR	-5.569013	1.975315	-2.819304	0.0048
TDUM_MR	-0.042762	0.099407	-0.430176	0.6671
DUM_JP	-0.431973	0.190719	-2.264969	0.0235
TDUM_JP	0.108029	0.021459	5.034265	0.0000
DUM_SE	-0.647449	0.254000	-2.549012	0.0108
TDUM_SE	0.381117	0.034279	11.11814	0.0000
DUM_TR	-1.659178	0.202435	-8.196121	0.0000
TDUM_TR	-0.055582	0.030608	-1.815928	0.0694
DUM_VE	-3.555596	1.112116	-3.197145	0.0014
TDUM_VE	-0.016442	0.063496	-0.258949	0.7957
DUM_PK	-2.185620	0.310355	-7.042321	0.0000
TDUM_PK	-0.014161	0.019548	-0.724425	0.4688
DUM_EG	2.278383	1.162257	1.960308	0.0500

TDUM_EG	-0.462424	0.086303	-5.358124	0.0000
DUM_MZ	-4.461757	1.781857	-2.503992	0.0123
TDUM_MZ	-0.085116	0.115848	-0.734721	0.4625
DUM_NG	-1.889985	1.832018	-1.031641	0.3023
TDUM_NG	-0.080992	0.098912	-0.818829	0.4129
DUM_TZ	-4.165942	1.157698	-3.598471	0.0003
TDUM_TZ	-0.044408	0.080137	-0.554153	0.5795
DUM_FI	0.589631	0.403296	1.462028	0.1438
TDUM_FI	0.533769	0.054185	9.850907	0.0000
DUM_NA	-8.646603	1.017516	-8.497756	0.0000
TDUM_NA	0.293840	0.084716	3.468527	0.0005
DUM_ES	-1.790549	0.296511	-6.038718	0.0000
TDUM_ES	0.140226	0.040393	3.471582	0.0005
DUM_FR	-0.427824	0.212429	-2.013961	0.0440
TDUM_FR	-0.081237	0.055053	-1.475595	0.1401
DUM_MM	-6.742047	0.626889	-10.75478	0.0000
TDUM_MM	0.225435	0.039343	5.729931	0.0000
DUM_AF	-3.574605	0.228378	-15.65216	0.0000
TDUM_AF	-0.071402	0.023317	-3.062181	0.0022
DUM_ZM	-3.238318	2.226811	-1.454240	0.1459
TDUM_ZM	-0.158833	0.167114	-0.950445	0.3419
DUM_MA	1.975915	0.552272	3.577797	0.0003
TDUM_MA	-0.530709	0.050480	-10.51332	0.0000
DUM_PG	0.418837	1.637571	0.255767	0.7981
TDUM_PG	-0.311356	0.096140	-3.238572	0.0012
DUM_PH	-7.123558	2.838500	-2.509620	0.0121
TDUM_PH	0.285323	0.158062	1.805138	0.0711
DUM_IT	0.420587	0.210743	1.995738	0.0460
TDUM_IT	-0.109225	0.027222	-4.012321	0.0001
DUM_MG	-0.749270	1.163831	-0.643796	0.5197
TDUM_MG	-0.318786	0.080353	-3.967330	0.0001
DUM_TH	-9.181231	1.722247	-5.330962	0.0000
TDUM_TH	0.381986	0.095349	4.006172	0.0001
DUM_UZ	-3.073403	0.294878	-10.42264	0.0000
TDUM_UZ	-0.077594	0.050997	-1.521542	0.1281
DUM_UK	-1.244406	0.189450	-6.568511	0.0000
TDUM_UK	0.839880	0.114007	7.366890	0.0000
DUM_CF	2.109998	3.820213	0.552325	0.5807
TDUM_CF	-0.473626	0.228255	-2.074982	0.0380
DUM_DE	0.379642	0.174606	2.174284	0.0297
TDUM_DE	0.075067	0.115569	0.649545	0.5160
DUM_KE	1.443832	0.841691	1.715394	0.0863
TDUM_KE	-0.385445	0.053206	-7.244422	0.0000
DUM_BW	4.513024	3.056904	1.476338	0.1399
TDUM_BW	-0.738704	0.234960	-3.143956	0.0017
DUM_CM	-6.822045	1.634651	-4.173395	0.0000
TDUM_CM	0.168519	0.096527	1.745819	0.0809
DUM_VN	-6.774712	1.215998	-5.571318	0.0000
TDUM_VN	0.228804	0.073571	3.109956	0.0019

DUM_IQ	-1.799318	0.533257	-3.374207	0.0007
TDUM_IQ	-0.030516	0.039010	-0.782261	0.4341
DUM_YE	-3.240816	1.307615	-2.478418	0.0132
TDUM_YE	-0.090233	0.073781	-1.222987	0.2214
DUM_ZW	0.759805	1.580604	0.480705	0.6307
TDUM_ZW	-0.311671	0.118694	-2.625828	0.0087
DUM_MY	-16.35449	3.249037	-5.033643	0.0000
TDUM_MY	0.774671	0.181206	4.275093	0.0000
DUM_GR	-1.968285	0.476171	-4.133564	0.0000
TDUM_GR	0.054834	0.065788	0.833499	0.4046
DUM_RO	-1.304113	0.234788	-5.554430	0.0000
TDUM_RO	-0.065660	0.091299	-0.719174	0.4720
DUM_LA	-9.162561	1.941045	-4.720426	0.0000
TDUM_LA	0.284673	0.121185	2.349078	0.0188
DUM_KG	-2.932115	0.345691	-8.481894	0.0000
TDUM_KG	0.003387	0.047201	0.071755	0.9428
DUM_GH	-1.334519	4.852577	-0.275012	0.7833
TDUM_GH	-0.103883	0.256478	-0.405039	0.6855
DUM_SY	-2.572583	1.297480	-1.982754	0.0474
TDUM_SY	0.020497	0.134482	0.152412	0.8789
DUM_PT	-2.589312	1.022858	-2.531449	0.0114
TDUM_PT	0.167390	0.140816	1.188715	0.2346
DUM_BD	5.396976	2.385097	2.262791	0.0237
TDUM_BD	-0.381262	0.142489	-2.675735	0.0075
DUM_AT	-0.166831	0.274691	-0.607340	0.5436
TDUM_AT	0.075922	0.096360	0.787904	0.4308
DUM_BG	-1.055174	0.501883	-2.102431	0.0355
TDUM_BG	-0.280446	0.164882	-1.700896	0.0890
DUM_IE	-2.604490	0.453967	-5.737179	0.0000
TDUM_IE	0.330354	0.415393	0.795281	0.4265
DUM_DK	-0.937119	0.317591	-2.950709	0.0032
TDUM_DK	-0.090557	0.557183	-0.162526	0.8709
DUM_HU	-0.787031	0.435549	-1.806985	0.0708
TDUM_HU	-0.003538	0.217096	-0.016299	0.9870
DUM_KP	-2.419121	0.315929	-7.657156	0.0000
TDUM_KP	0.032616	0.077947	0.418432	0.6756
DUM_CZ	-0.212006	0.295607	-0.717188	0.4733
TDUM_CZ	0.159851	0.307223	0.520309	0.6029
DUM_EE	-5.700601	1.300792	-4.382408	0.0000
TDUM_EE	-0.955914	0.416558	-2.294792	0.0218
DUM_LT	-1.651569	1.807931	-0.913513	0.3610
TDUM_LT	0.025386	0.821007	0.030921	0.9753
DUM_KR	-0.977369	0.505677	-1.932792	0.0533
TDUM_KR	0.183815	0.138104	1.330990	0.1832

Weighted Statistics

R-squared	0.917603	Mean dependent var	10.58992
Adjusted R-squared	0.916654	S.D. dependent var	4.870723

S.E. of regression	1.406162	Akaike info criterion	3.530990
Sum squared resid	30385.06	Schwarz criterion	3.618605
Log likelihood	-27266.62	Durbin-Watson stat	0.888259

Unweighted Statistics			
R-squared	0.606667	Mean dependent var	10.02644
Adjusted R-squared	0.602136	S.D. dependent var	2.376975
S.E. of regression	1.499312	Sum squared resid	34544.02
Durbin-Watson stat	0.705850		

Annex A. total_file_create_v7_long.prg

```
' total_file_create_v7_long.prg; folder C:\Major\Research\Geography\Documentation\ProgAndFiles
' This is the program to create the data file for G-Econ analysis. October 27, 2005.
' There are 3 sub-programs, numbered 1 to 3
' It creates a single-page Eview workfile with all data for which climate data are linked to economic data,
'   but links have been removed for simplicity.
' filename is "c_<current date>", where current date is provided by user at beginning of program.

' File name is "c_<date>", where date is provided in next line
%day = "102705"

'Program 1
' This routine loads the raw data from the relevant Excel files, saves them, and closes them

wfopen(wf=new1, page="climate")
"C:\Major\Research\Geography\Documentation\ProgAndFiles\climate_L_1.xls"

smpl @all
series totalid=countryid*1000000+1000*lat+long

wfsave C:\Major\Research\Geography\Documentation\ProgAndFiles\new1.wf1
close new1

wfopen(page="economic", wf=new)
"C:\Major\Research\Geography\Documentation\ProgAndFiles\economic_L_3.xls"
smpl @all
series totalid=countryid*1000000+1000*lat+long

'SUBSTITUTE LINGFENG'S OUTPUT FOR US
smpl if country="US"
genr gcpppp=gcp_lingfeng

wfsave C:\Major\Research\Geography\Documentation\ProgAndFiles\new.wf1

pageload(wf=new, page = "climate")
C:\Major\Research\Geography\Documentation\ProgAndFiles\new1.wf1
wfsave C:\Major\Research\Geography\Documentation\ProgAndFiles\new.wf1
close new

' Renames some series for clarity
wfopen C:\Major\Research\Geography\Documentation\ProgAndFiles\new.wf1
pageselect economic

rename gcpppp gcpppp_e
rename lat lat_e
rename long long_e
rename popgpw popgpw_e
```

```
rename rig rig_e
rename gcpppp_cn gcppppalt_e
rename area area_e
rename gcpnoppp gcpnoppp_e

wfsave C:\Major\Research\Geography\Documentation\ProgAndFiles\new.wf1
close new

'Program 2
' This routine opens the new file and link the data
' The link is from the Economic page to the Climate page

wfopen C:\Major\Research\Geography\Documentation\ProgAndFiles\new.wf1

' Creates links for the names series
pageselect economic
smpl @all
series cellid=lat_e*1000+long_e
for %name cvav cvmax cvsd emean esd popgpw precav precmax precmin precsd rig rough tempav
tempmax tempmin tempsd
link {%name}.linkto climate::{%name} @src cellid @dest cellid
next

'Program 3
' This program changes the linked files into unlinked; removes the linked; and removes the source page.
It is tricky and needs to be checked carefully.

pageselect economic
' Now we are creating unlinked variables to reduce the size of the sheet.

for %name cvav cvmax cvsd emean esd popgpw precav precmax precmin precsd rig rough tempav
tempmax tempmin tempsd
series {%name}_u={%name}
d {%name}
series {%name}={%name}_u
d {%name}_u
next

series popgpw_c=popgpw
series rig_c=rig
d popgpw
d rig

for %name AREA  GCPNOPPP  GCPPPP GCPPPPALT  LAT  LONG  POPGPW  RIG
series {%name}={%name}_e
d {%name}_e
next

' Now remove the source page to reduce the file size and simplify
```

```
pagedelete climate

wfsave  C:\Major\Research\Geography\Documentation\ProgAndFiles\e_{%day}
```

Annex B. clean_data_102705.prg

```
' This program cleans the raw data file for statistical analysis
' The name of this program is clean_data_102705.prg

' 1. The first step is to load the raw data created in the data creation program

%day = "102705"
load  C:\Major\Research\Geography\Documentation\ProgAndFiles\e_{%day}a
save  C:\Major\Research\Geography\Documentation\ProgAndFiles\c_{%day}_clean

' 2.   Data integrity checks include determining that lat, long, and country are identical in link and original data. This is done manually. The stats should be uniformly 1.

' 3. Set default quality = 1; then remove observations not meeting quality standard as quality = -1

smpl @all
series quality = 1


' 4. Fix area data. The area data in the economic file have various problems, chiefly because they are from different sources and vintages. We have therefore defined "totarea_grid" as the area of a latitude-longitude cell (km sq). We then defined "areanew" as rig*totarea_grid (with and without _e suffixes for the two data bases). Area of grid from a program and parameterized as areaf=12364.17+2.553748*alat-1.978062*alat^2+.001966*alat^3-5.727706*alat^.5+3.13e-05*alat^4.

series alat=lat^2^.5
series totarea_grid=12364.17+2.553748*alat-1.978062*alat^2+.001966*alat^3-5.727706*alat^.5+3.13e-05*alat^4
series areanew=rig*totarea_grid

' Areanew is the default area calculation.

' 5. There are still remaining problems with the rig files. We generally prefer the G-Econ rig's ("RIG") to the climate rig's (RIG_C"), because the former have been extensively checked. We set as low quality all observations with both RIG's less than .02. We have removed observations with G-Econ RIGs less than .02 and observations with large rig discrepancies.This removes approximately 190 observations. (This was written as program "RIGFIX_v1.PRG")

' Put Antarctica as low quality
smpl if countryid=181
series quality=-2

smpl if rig < .02
series quality = -1

smpl if (rig-rig_c )^2^.5 >.5
series quality = -1
```

```
smpl if  (rig/rig_c-1)^2>1
series quality = -1


' 6. Next we generate the densities for both the Economics RIGs and the G-Econ RIGs.  We then remove any observations where the data between the two calcuations of GCP density are too discrepant (ratio > 5), which is 13 observations.

'This program defines the intensity variables. The main potential problem here is that differences in areas may lead to major problems.

' Definition of GCP density using G-Econ RIGs

smpl if areanew>0 and rig>0
series gcpdens=gcpppp/areanew

' Definition of GCP density using "Economic" RIGs

smpl if area>0
series gcpdens_u=gcpppp/area

' Remove discrepant observations -- those whose squared ratios of the densities are greater than 0.2 (33 observations)

series ratdens= (gcpdens_u+.00001)/(gcpdens+.00001)
smpl if (ratdens-1)^2 > .2
genr quality = -1

' 7. Density calculations. Define log density with zeros as na as LYD.

smpl if gcpdens>0 and quality = 1
genr lyd=log(gcpdens)

' Define log density setting zeros as 1 $ per square km as LYD1.

smpl if quality = 1
genr lyd1=log(gcpdens+1)

' 8. Clean up the file and save it as "clean" version.

' Clean up (but these are needed for data integrity checks).
d ratdens

' Save file
save c_{%day}_clean
```

Annex C. compare_old_data_v3.prg

```
' This program compares old and new data

' 1. Load new data
'load old_data.wf1

%day = "102705"
'load c_{%day}_clean

'2. MANUAL: create new page "olddata" in c file; then load in olddata

'3. Save in "newold_c_{%day}" (or as temp file as newold)
open c_{%day}_clean_newold.wf1
wfsave  c_{%day}_clean_newold.wf1
 stop
'3a. load and create totalid

pageselect olddata
smpl @all
series totalid=countryid*1000000+1000*lat+long
series cellidn=1000*lat+long

pageselect economic
series cellidn=1000*lat+long

pageselect olddata

'4 Rename olddata
for  %varnam alt area cellid country countryid distcoast gspdens obs lat long mepcy pop90 prec ric rig
temp nnn
rename {%varnam} {%varnam}_old
next



'4a.Link old economic data to new page by totalid
' Creates links for the names series
pageselect economic
for  %name area_old cellid_old country_old countryid_old gspdens_old obs_old mepcy_old pop90_old
ric_old rig_old
link {%name}.linkto olddata::{%name} @src totalid @dest totalid
next

' 4b Link geographic data by cellidn = 1000*lat+long

for  %name  alt_old distcoast_old lat_old long_old  prec_old temp_old
link {%name}.linkto olddata::{%name} @src  cellidn @dest cellidn
next
```

```
'5. Create final data
smpl @all
series popdens=popgpw/areanew
smpl if popdens>0
series lpd=log(popdens)
smpl if (popdens+.05)>0
series lpd1=log(popdens+.05)

'6. Save as merged file
wfsave newold_c_merged_{%day}
```

Annex D. remove_links_102705.prg

```
'This file removes links and "old data" worksheet for each of calculations.


%day = "102705"
open newold_c_merged_{%day}.wf1

delete obs_old

for %name alt_old area_old cellid_old countryid_old distcoast_old gspdens_old lat_old long_old
mepcy_old pop90_old prec_old ric_old rig_old temp_old

series {%name}_c={%name}
delete {%name}
series {%name}={%name}_c
delete {%name}_c
next

for %name country_old
alpha {%name}_c={%name}
delete {%name}
alpha {%name}={%name}_c
delete {%name}_c
next

pagedelete olddata
smpl @all
wfsave n_{%day}.wf1
```

Annex E. neighbor_est_v9.prg

```
' This is the interpolation file for estimating the censored observations for neighbors.
' file is neighbor_est_v9.prg

%day = "102705"
wfopen C:\Major\Research\Geography\Documentation\ProgAndFiles\n_{%day}.wf1


'REGRESSION TO TEST FOR SPATIAL CORRELATION for longitudes
sort lat long
series distance=(lat-lat(-1))^2+(lat-lat(1))^2+(long-long(-1))^2+(long-long(1))^2
smpl if distance<10 and quality=1 and gcpdens=0 and country=country(-1) and country=country(1)
and  (gcpdens(-1)>0 or gcpdens(1)>0)
genr gcpdensi1=.015*(gcpdens(1)+gcpdens(-1))

'REGRESSION TO TEST FOR SPATIAL CORRELATION for latitudes
sort long lat
series distance=(lat-lat(-1))^2+(lat-lat(1))^2+(long-long(-1))^2+(long-long(1))^2
smpl if distance<10 and quality=1 and gcpdens=0 and country=country(-1) and country=country(1)
and  (gcpdens(-1)>0 or gcpdens(1)>0)
genr gcpdensi2=.005*(gcpdens(1)+gcpdens(-1))

smpl if gcpdensi1>01
series gcpdensi11=gcpdensi1
smpl if gcpdensi2>01
series gcpdensi22=gcpdensi2
smpl if gcpdensi1=na  and gcpdens=0
series gcpdensi11=0
smpl if gcpdensi2=na  and gcpdens=0
series gcpdensi22=0
smpl if gcpdens=0
series gcpdensi=(gcpdensi11+gcpdensi22)/2

smpl if gcpdens>0
series gcpdensi=gcpdens


'CREATE LOG SERIES FOR INTERPOLATE
smpl if gcpdens>0
genr gcpdensi=gcpdens
smpl if gcpdensi>0
series lydi=log(gcpdensi)
smpl @all
series lydi1=log(gcpdensi+1)

smpl if lyd=na and lydi<>na
series quality=.5
smpl @all
```

wfsave C:\Major\Research\Geography\Documentation\ProgAndFiles\interp_{%day}.wf1

Annex F. test_distance_v3.prg

```
'TEST PROGRAM
' test_distance_v3.prg

%day="102705"
load interp_{%day}.wf1

sort lat long

!dist = 500
!sss=19000
!far = 25
!change=50

for !k = 1 to 30
!del=!k*!change
smpl !sss-!far+!del  !sss+!far+!del
scat(t=fig) long log(gcpdensi) log(gcpdens)+.1 log(gcpdens)+.2
'show log(gcpnext) log(gcpdens)
'scat tempav log(gcpnext) log(gcpdens)+.1 log(gcpinter)
next
```

Annex G. remove_est_102805.prg

```
' Remove extraneous series and antartica

%day = "102705"
wfopen C:\Major\Research\Geography\Documentation\ProgAndFiles\interp_{%day}.wf1

smpl @all

' Remove antarctica
smpl @all
series include=0
series idid=@trend
smpl if countryid<>181
 include=1
smpl @all
sort -include

' Now limit sample to first 19136
pagestruct(end=@last-6435) *
sort idid
d idid

' remove extraenous
for %r   cellid_old countryid_old gcpdensi1 gcpdensi11 gcpdensi2 gcpdensi22 gcpmer_cn lat_old
long_old
d {%r}
next

wfsave C:\Major\Research\Geography\Documentation\ProgAndFiles\f_{%day}s.wf1
```

Annex H. count_dum_102705.prg

```
' Country dummy program
'
%d = "102705"
load C:\Major\Research\Geography\Documentation\ProgAndFiles\f_{%d}s.wf1

'INITIALIZE
smpl @all
series dum_af =     0
series dum_ar =     0
series dum_au=      0
series dum_bd=      0
series dum_bo=      0
series dum_br =     0
series dum_bw       =       0
series dum_ca =     0
series dum_cd=      0
series dum_cf  =    0
series dum_cl  =    0
series dum_cm       =       0
series dum_cn=      0
series dum_co =     0
series dum_dz=      0
series dum_eg=      0
series dum_es =     0
series dum_et  =    0
series dum_gh=      0
series dum_gl  =    0
series dum_id  =    0
series dum_in  =    0
series dum_iq  =    0
series dum_ir  =    0
series dum_jp  =    0
series dum_ke=      0
series dum_kg=      0
series dum_kp=      0
series dum_kw       =       0
series dum_kz=      0
series dum_la  =    0
series dum_ly  =    0
series dum_mg       =       0
series dum_ml=      0
series dum_mm       =       0
series dum_mn       =       0
series dum_mr       =       0
series dum_mx       =       0
series dum_my       =       0
series dum_mz       =       0
```

```
series dum_na =     0
series dum_ne =     0
series dum_ng=      0
series dum_no=      0
series dum_pe=      0
series dum_pg=      0
series dum_ph=      0
series dum_pk=      0
series dum_ru =     0
series dum_sa =     0
series dum_td =     0
series dum_th =     0
series dum_tr  =    0
series dum_so =     0
series dum_za =     0
series dum_kr =     0
series dum_sd =     0
series dum_sy =     0
series dum_tz  =    0
series dum_us =     0
series dum_uz=      0
series dum_ve =     0
series dum_vn=      0
series dum_ye =     0
series dum_zm       =       0
series dum_zw       =       0
series dum_ao = 0
series dum_at= 0
 series dum_be= 0
 series dum_bg = 0
 series dum_ca= 0
 series dum_dk= 0
series dum_ee= 0
series dum_fi= 0
series dum_fr= 0
series dum_de= 0
series dum_gr= 0
series dum_hu = 0
series dum_ie = 0
series dum_it = 0
series dum_lt = 0
series dum_nl= 0
series dum_pt = 0
series dum_pt = 0
series dum_ro= 0
series dum_sk= 0
series dum_si= 0
series dum_se= 0
series dum_uk= 0
```

```
series dum_ma=0

'REGIONAL
for %r amer  wes ease  mideas ssaf asi oci
series dum_{%r}=0
series dum
next

smpl if country="Morocco"
series dum_ma=1
smpl if country = "Afghanistan"
series dum_af           = 1
series dum_asi=1
smpl if country = "Algeria"
series dum_dz           = 1
series dum_mideas=1
smpl if country = "Argentina"
series dum_ar           = 1
series dum_amer=1
smpl if country = "Australia"
series dum_au           = 1
series dum_oci=1
smpl if country = "Bangladesh"
series dum_bd           = 1
series dum_asi=1
smpl if country = "Bolivia"
series dum_bo           = 1
series dum_amer=1
smpl if country = "Botswana"
series dum_bw                   = 1
series dum_ssaf=1
smpl if country = "Brazil"
series dum_br           = 1
series dum_amer=1
smpl if country = "Cameroon"
series dum_cm                   = 1
series dum_ssaf=1
smpl if country = "Canada"
series dum_ca           = 1
series dum_amer=1
smpl if country = "Central African Republic"
series dum_cf           = 1
series dum_ssaf=1
smpl if country = "Chad"
series dum_td           = 1
series dum_ssaf=1
smpl if country = "Chile"
series dum_cl           = 1
series dum_amer=1
```

```
smpl if country = "China"
series dum_cn           = 1
series dum_asi=1
smpl if country = "Colombia"
series dum_co           = 1
series dum_amer=1
smpl if country = "Democratic Republic of Congo"
series dum_cd           = 1
series dum_ssaf=1
smpl if country = "Egypt"
series dum_eg           = 1
series dum_mideas=1
smpl if country = "Ethiopia"
series dum_et           = 1
series dum_ssaf=1
smpl if country = "Ghana"
series dum_gh           = 1
series dum_ssaf=1
smpl if country = "Greenland"
series dum_gl           = 1
series dum_asi=1
smpl if country = "India"
series dum_in           = 1
series dum_asi=1
smpl if country = "Indonesia"
series dum_id           = 1
series dum_oci=1
smpl if country = "Iran"
series dum_ir           = 1
series dum_mideas=1
smpl if country = "Iraq"
series dum_iq           = 1
series dum_mideas=1
smpl if country = "Kazakhstan"
series dum_kz           = 1
series dum_asi=1
smpl if country = "Kenya"
series dum_ke           = 1
series dum_ssaf=1
smpl if country = "Kuwait"
series dum_kw                   = 1
series dum_mideas=1
smpl if country = "Kyrgyzstan"
series dum_kg           = 1
series dum_asi=1
smpl if country = "Laos"
series dum_la           = 1
series dum_asi=1
smpl if country = "Libya"
```

```
series dum_ly           = 1
series dum_mideas=1
smpl if country = "Madagascar"
series dum_mg                   = 1
series dum_ssaf=1
smpl if country = "Malaysia"
series dum_my                   = 1
series dum_asi=1
smpl if country = "Mali"
series dum_ml           = 1
series dum_ssaf=1
smpl if country = "Mauritania"
series dum_mr                   = 1
series dum_ssaf=1
smpl if country = "Mexico"
series dum_mx                   = 1
series dum_amer=1
smpl if country = "Mongolia"
series dum_mn                   = 1
series dum_asi=1
smpl if country = "Mozambique"
series dum_mz                   = 1
series dum_ssaf=1
smpl if country = "Myanmar (Burma)"
series dum_mm                   = 1
series dum_asi=1
smpl if country = "Namibia"
series dum_na           = 1
series dum_ssaf=1
smpl if country = "Niger"
series dum_ne           = 1
series dum_ssaf=1
smpl if country = "Nigeria"
series dum_ng           = 1
series dum_ssaf=1
smpl if country = "Korea Democratic Peoples Republic of"
series dum_kp           = 1
series dum_asi=1
smpl if country = "Norway"
series dum_no           = 1
series dum_wes=1
smpl if country = "Pakistan"
series dum_pk           = 1
series dum_asi=1
smpl if country = "Papua New Guinea"
series dum_pg           = 1
series dum_oci=1
smpl if country = "Peru"
series dum_pe           = 1
```

```
series dum_amer=1
smpl if country = "Philippines"
series dum_ph           = 1
series dum_oci=1
smpl if country = "Russia"
series dum_ru           = 1
series dum_asi=1
smpl if country = "Saudi Arabia"
series dum_sa           = 1
series dum_mideas=1
smpl if country = "Somalia"
series dum_so           = 1
series dum_ssaf=1
smpl if country = "South Africa"
series dum_za           = 1
series dum_ssaf=1
smpl if country = "Korea, Republic of"
series dum_kr           = 1
series dum_asi=1
smpl if country = "Sudan"
series dum_sd           = 1
series dum_ssaf=1
smpl if country = "Syria"
series dum_sy           = 1
series dum_mideas=1
smpl if country = "Tanzania"
series dum_tz           = 1
series dum_ssaf=1
smpl if country = "US"
series dum_us           = 1
series dum_amer=1
smpl if country = "Uzbekistan"
series dum_uz           = 1
series dum_asi=1
smpl if country = "Venezuela"
series dum_ve           = 1
series dum_amer=1
smpl if country = "Yemen"
series dum_ye           = 1
series dum_mideas=1
smpl if country = "Zambia"
series dum_zm                   = 1
series dum_ssaf=1
smpl if country = "Zimbabwe"
series dum_zw                   = 1
series dum_ssaf=1
smpl if country = "Japan"
series dum_jp           = 1
series dum_asi=1
```

```
smpl if country = "Spain"
series dum_es           = 1
series dum_wes=1
smpl if country = "Thailand"
series dum_th           = 1
series dum_asi=1
smpl if country = "Turkey"
series dum_tr           = 1
series dum_ssaf=1
smpl if country = "Vietnam"
series dum_vn           = 1
series dum_asi=1
smpl if country = "Angola"
series dum_ao = 1
series dum_ssaf=1

smpl if country = "Austria"
series dum_at= 1
series dum_wes=1
smpl if country = "Belgium"
series dum_be= 1
series dum_wes=1
smpl if country = "Bulgaria"
series dum_bg = 1
series dum_ease=1
smpl if country = "Czech Republic"
series dum_ca= 1
series dum_ease=1
smpl if country = "Denmark"
series dum_dk= 1
series dum_wes=1
smpl if country = "Estonia"
series dum_ee= 1
series dum_ease=1
smpl if country = "Finland"
series dum_fi= 1
series dum_wes=1
smpl if country = "France"
series dum_fr= 1
series dum_wes=1
smpl if country = "Germany"
series dum_de= 1
series dum_wes=1
smpl if country = "Greece"
series dum_gr= 1
series dum_wes=1
smpl if country = "Hungary"
series dum_hu = 1
series dum_ease=1
```

```
smpl if country = "Ireland"
series dum_ie = 1
series dum_wes=1
smpl if country = "Italy"
series dum_it = 1
series dum_wes=1
smpl if country = "Lithuania"
series dum_lt = 1
series dum_ease=1
smpl if country = "Netherlands"
series dum_nl= 1
series dum_wes=1
smpl if country = "Portugal"
series dum_pt = 1
series dum_wes=1
smpl if country = "Portugal Islands"
series dum_pt = 1
series dum_wes=1
smpl if country = "Romania"
series dum_ro= 1
series dum_ease=1
smpl if country = "Slovakia"
series dum_sk= 1
series dum_ease=1
smpl if country = "Slovenia"
series dum_si= 1
series dum_ease=1
smpl if country = "Sweden"
series dum_se= 1
series dum_wes=1
smpl if country = "United Kingdom"
series dum_uk= 1
series dum_wes=1



smpl @all
series adumtot=0
for %name  af ar au bd bo br  bw  ca  cd  cf  cl  cm  cn  co dz  eg  es et  gh gl id in  iq  ir jp  ke  kg  kp kw
kz la  ly ma mg ml  mm  mn  mr  mx  my mz na  ne ng  no pe pg  ph pk ru sa td th tr  so za kr sd sy tz us
uz ve vn ye  zm zw  ao  at  be  bg  dk  ee fi  fr  de  gr  hu  ie  it  lt  nl  pt  ro  sk si se uk

adumtot=adumtot+dum_{%name}
next

smpl @all
series ardumtot=0
for %name amer wes ease mideas ssaf asi oci
```

```
ardumtot=ardumtot+dum_{%name}
next

Group gmed DUM_GL DUM_KZ DUM_IN DUM_ID DUM_AR DUM_DZ DUM_MX DUM_SD
DUM_CD DUM_MN DUM_SA DUM_IR DUM_LY DUM_ZA DUM_CL DUM_PE DUM_ML
DUM_CO DUM_AO DUM_TD DUM_NE DUM_BO DUM_MR DUM_ET DUM_EG DUM_NO
DUM_PK DUM_SE DUM_VE DUM_MZ DUM_NG DUM_TZ DUM_NA DUM_FR DUM_AF DUM_ES
DUM_FI DUM_MM DUM_ZM DUM_PH DUM_PG DUM_SO DUM_UZ DUM_MG DUM_CF
DUM_IT DUM_DE DUM_UK DUM_KE DUM_BW DUM_CM DUM_IQ DUM_YE DUM_MY dum_ma

Group glarge DUM_BR DUM_AU DUM_RU DUM_US  DUM_CN DUM_CA

Group greg dum_amer dum_wes dum_ease dum_mideas dum_ssaf dum_asi dum_oci

save C:\Major\Research\Geography\Documentation\ProgAndFiles\\f_{%d}b.wf1
```

Annex I. create_dum_soils_v2.prg

```
' Create dummies for soils
' October 31, 2005
' create_dum_soils_v2.prg

wfopen C:\Major\Research\Geography\Documentation\ProgAndFiles\f_102705d.wf1

smpl @all

for !i= 1 to 27
smpl @all
series dumsoil{!i}=0
smpl if great_soil={!i}
series dumsoil{!i}=1
 next

smpl @all
series dumsoil0=0
smpl if great_soil=0
series dumsoil0=1

 smpl @all
group gsoil dumsoil1
gsoil.add dumsoil0 dumsoil1 dumsoil2 dumsoil3 dumsoil4 dumsoil5 dumsoil6 dumsoil7 dumsoil8
dumsoil9   dumsoil10 dumsoil11 dumsoil12   dumsoil14  dumsoil16 dumsoil17 dumsoil18 dumsoil19
dumsoil20   dumsoil22 dumsoil23 dumsoil24 dumsoil25 dumsoil26 dumsoil27

genr totsoil=dumsoil0 +dumsoil1+ dumsoil2+ dumsoil3+ dumsoil4 +dumsoil5 +dumsoil6+ dumsoil7+
dumsoil8+ dumsoil9 +  dumsoil10 +dumsoil11+ dumsoil12   +dumsoil14  +dumsoil16+ dumsoil17+
dumsoil18+ dumsoil19 +dumsoil20 +  dumsoil22 +dumsoil23+ dumsoil24 +dumsoil25+ dumsoil26+
dumsoil27


wfsave C:\Major\Research\Geography\Documentation\ProgAndFiles\f_102705e.wf1
```

Annex J. scat_110105_v3.prg

```
' To calculate the scatter plots
%date = "102705"
wfopen C:\Major\Research\Geography\Documentation\ProgAndFiles\f_{%date}e.wf1
wfsave C:\Major\Research\Geography\FigsandTabs\ScatAllVar\rank_f_{%date}.wf1

'REMOVE QUALITY<1 AND NONZERO LYDI1

'CREATE RANK ORDER FOR DIFFERENT VARIABLES
smpl @all
series abslat=lat^2^.5

!b_tempav=3
sort tempav
'smpl if tempav>0 and lydi1>-1
series num_tempav=@trend
group gtempav tempav lydi1
gtempav.kerfit(s=lydi1f_tempav,b={!b_tempav})
show num_tempav lydi1f_tempav


!b_precav=30
sort precav
series num_precav=@trend
group gprecav precav lydi1
gprecav.kerfit(s=lydi1f_precav,b={!b_precav})
show num_precav lydi1f_precav


!b_emean=.4
sort emean
series num_emean=@trend
group gemean emean lydi1
gemean.kerfit(s=lydi1f_emean,b={!b_emean})
show num_emean lydi1f_emean


!b_distcoastice=500
sort distcoastice
series num_distcoastice=@trend
group gdistcoastice distcoastice lydi1
gdistcoastice.kerfit(s=lydi1f_distcoastice,b={!b_distcoastice})
show num_distcoastice lydi1f_distcoastice


!b_tempmax=3
sort tempmax
series num_tempmax=@trend
```

```
group gtempmax tempmax lydi1
gtempmax.kerfit(s=lydi1f_tempmax,b={!b_tempmax})
show num_tempmax lydi1f_tempmax


!b_abslat=3
sort abslat
series num_abslat=@trend
group gabslat abslat lydi1
gabslat.kerfit(s=lydi1f_abslat,b={!b_abslat})
show num_abslat lydi1f_abslat


!b_precmin=30
sort precmin
series num_precmin=@trend
group gprecmin precmin lydi1
gprecmin.kerfit(s=lydi1f_precmin,b={!b_precmin})
show num_precmin lydi1f_precmin
stop

'NEXT NEED TO CREATE EXCEL OF THE RA NK ORDER FILES
' For each of above, take sorted forecast into a spreadsheet
' called rank_vars_092105

''Next create new file with ranked data
'open C:\Major\Research\Geography\FigsandTabs\ScatAllVar\fract_092105.wf1

' Add data from excel sheet through data command

' Then scat
smpl @all
series tttt=@trend
series frac=tttt/17796
scat frac LYDI1F_TEMPAV/log(10) LYDI1F_PRECAV/log(10)LYDI1F_EMEAN/log(10)
LYDI1F_distcoastice/log(10) LYDI1F_ABSLAT/log(10)

'wfsave C:\Major\Research\Geography\FigsandTabs\ScatAllVar\fract_092105.wf1
```

Annex K. box_program_temp_all_110105.prg

```
'Box diagram for various magnitudes
' box_program_temp_all_110105.prg
%date = "102705"
'load C:\Major\Research\Geography\Documentation\progandfiles\f_{%date}e.wf1

'wfsave C:\Major\Research\Geography\FigsandTabs\PerCapitaComp\box_{%date}.wf1
'wfopen C:\Major\Research\Geography\FigsandTabs\PerCapitaComp\box_{%date}.wf1

smpl if lat=34 and long=78
show popgpw popgpw  gcpppp country lat long areanew quality

smpl if gcpppp/popgpw>0
genr lpcy=log(gcpppp/popgpw)

for %n lpd lpd1 lyd lyd1 lydi lydi1 lpcy
series {%n}10={%n}/log(10)
next


%varind = "tempav"
'%vardep = "lpcy10"
%vardep = "lydi110"

d box1
smpl @all
freeze(box1) {%vardep}.boxplotby(b, b=20, nofarout, nonearout, width=rootn,  b=80,  nov, nostaple,
nowhisk)  {%varind}
show box1

'Range will differ according to dependent variable
'For lyd10 or ldyi10
box1.scale(left) range(-1,6) grid
'For lpcy10 or lpcy110
'box1.scale(left) range(-2,2) grid
'For lpcy10
'box1.scale(left) range(2.5,4.5) grid

box1.setelem(mean) symbol(circle) lwidth(.25) lcolor(red)
box1.setelem(median) linewidth(1) lcolor(red)
box1.setelem(box) lcolor(blue)
box1.setelem(staples) lwidth(2)
show box1
```

Annex L. withandwithout_count_111105.prg

```
 ' Program to estimate third reason for reversal

'wfopen C:\Major\Research\Geography\Documentation\ProgAndFiles\f_102705_fin_af.wf1
smpl if DUM_PT=0 and       DUM_BD=0 and       DUM_AT=0 and       DUM_BG=0 and
        DUM_IE=0 and       DUM_DK=0 and       DUM_HU=0 and       DUM_CZ=0 and
        DUM_EE=0 and       DUM_KP=0 and       DUM_LT=0 and       DUM_KR=0 and
        DUM_SK=0 and       DUM_NL=0 and       DUM_BE=0 and       DUM_SI=0 and
        DUM_KW=0

vector(10) ccc
vector(10) ccc
vector(10) ccc
vector(10) ccc

ls lydi1   tempav c
smpl 1 1
ccc(1)=@coefs(1)

smpl if DUM_PT=0 and       DUM_BD=0 and       DUM_AT=0 and       DUM_BG=0 and
        DUM_IE=0 and       DUM_DK=0 and       DUM_HU=0 and       DUM_CZ=0 and
        DUM_EE=0 and       DUM_KP=0 and       DUM_LT=0 and       DUM_KR=0 and
        DUM_SK=0 and       DUM_NL=0 and       DUM_BE=0 and       DUM_SI=0 and
        DUM_KW=0
ls lydi1   tempav glarge gmed gsmall gvsmall
smpl 2 2
ccc(2)=@coefs(1)

smpl if DUM_PT=0 and       DUM_BD=0 and       DUM_AT=0 and       DUM_BG=0 and
        DUM_IE=0 and       DUM_DK=0 and       DUM_HU=0 and       DUM_CZ=0 and
        DUM_EE=0 and       DUM_KP=0 and       DUM_LT=0 and       DUM_KR=0 and
        DUM_SK=0 and       DUM_NL=0 and       DUM_BE=0 and       DUM_SI=0 and
        DUM_KW=0
ls lpcy  tempav c

smpl 3 3
ccc(3)=@coefs(1)

smpl if DUM_PT=0 and       DUM_BD=0 and       DUM_AT=0 and       DUM_BG=0 and
        DUM_IE=0 and       DUM_DK=0 and       DUM_HU=0 and       DUM_CZ=0 and
        DUM_EE=0 and       DUM_KP=0 and       DUM_LT=0 and       DUM_KR=0 and
        DUM_SK=0 and       DUM_NL=0 and       DUM_BE=0 and       DUM_SI=0 and
        DUM_KW=0
ls lpcy  tempav glarge gmed gsmall gvsmall
smpl 4 4
     ccc(4)=@coefs(1)
```

Annex M. regr_multivar_v7b.prg

```
 ' Multivariate regression
' File name regr_multivar_v7b.prg

'wfopen C:\Major\Research\Geography\Documentation\ProgAndFiles\f_102705_fin.wf1
'wfsave
C:\Major\Research\Geography\Documentation\ProgAndFiles\f_102705_fin_multi.wf1

smpl if quality=1 and gcpdens<>na and lydi1=na
series lydi1=log(gcpdens+1)
smpl if quality=1
smpl @all


smpl @all
%vardep = "lydi1"
%varind = "alat"
genr t=tempav-@mean(tempav)
genr p=precav-@mean(precav)

smpl if quality=1

ls(w=areanew) {%vardep}  c  t t^2 t^3 p p^2 p^3 t*p t^2*p p^2*t cvav tempmax tempmin
tempsd tempmax^2 emean   esd precmin dist_med_n dist_short_n dist_long_n   gsoil
glarge gmed gsmall gvsmall

 stop

'LATITUDE TEST
'ls(w=areanew) {%vardep}  alat abslat^2 c t t^2 t^3 p p^2 p^3 t*p t^2*p p^2*t cvav
tempmax tempmin tempsd tempmax^2 emean esd precmin dist_med dist_short dist_long
glarge gmed dum_wes dum_ease
'genr {%vardep}_flat=  @coefs(1)*abslat+ @coefs(2)*abslat^2
'scat lat {%vardep}_flat


forecast  {%vardep}_{%varind}_fmulti
group gg {%varind}  {%vardep}_{%varind}_fmulti
gg.kerfit(s={%vardep}_{%varind}_fmulti_ker)


sort {%varind}
scat {%varind} {%vardep}    {%vardep}_{%varind}_fmulti_ker
 stop
group gg {%varind}  {%vardep}_{%varind}_fmulti
gg.kerfit(s={%vardep}_{%varind}_fmulti_ker)

group gg  {%varind} {%vardep}
gg.kerfit(s={%vardep}_{%varind}_f_ker)

 scat   {%varind} {%vardep}_{%varind}_fmulti_ker {%vardep}_{%varind}_f_ker
```

Annex N. new_decomposition_110505_v4.prg

```
'calculate effects of geography
'new_decomoposition_110505_v4.prg

wfopen f_102705_fin.wf1
smpl if quality =1
%wt= "areanew"
matrix(10,3)  cof
coef(35) geocoef

!num=1

for %var lyd1 lpcy lpd1
  smpl @all



ls(w={%wt}) {%var}    t t^2 t^3  p  p^2 p^3 t*p  tempmax tempmin emean precmin  dist_med_n
dist_short_n  dist_long_n dumsoil0 dumsoil2 dumsoil3  dumsoil4 dumsoil6 dumsoil10 dumsoil12
dumsoil25 ifaf ifindeurope iftempus ifotherlolat   c glarge  gmed gsmall

      !reg=1
      for %vvv ifaf dum_amer iftempus ifindeurope ifotherlolat dum_ru dum_cn dum_gl dum_au

      smpl if {%vvv}=1
      series geo=@coefs(1)*t+@coefs(2)*t^2+@coefs(3)* t^3+@coefs(4)* p+@coefs(5)* p^2+@coefs(6)*
p^3+@coefs(7)* t*p+@coefs(8)* tempmax+@coefs(9)* tempmin+@coefs(10)* emean+@coefs(11)*
precmin+@coefs(12)* dist_med+@coefs(13)* dist_short+@coefs(14)*
dist_long+@coefs(15)*dumsoil0+@coefs(16)*dumsoil2+@coefs(17)*dumsoil3+@coefs(18)*dumsoil4+@coe
fs(19)*dumsoil6+@coefs(20)*dumsoil10+@coefs(21)*dumsoil12+@coefs(22)*dumsoil25

      cof(!reg,!num)= @mean(geo)
      !reg=!reg+1
      next

!num=!num+1
next
```

Annex O. new_calc_means_110605_v4.prg

```
'calculate effects of geography
'new_decomoposition_110505.prg

wfopen f_102705_fin.wf1
smpl if quality =1
%wt= "areanew"
matrix(10,3)  means
 matrix(10,3)  wtmeans
!num=1
for %var lyd1 lpcy lpd1
  smpl @all
      !reg=1
      for %vvv ifaf dum_amer iftempus ifindeurope ifotherlolat dum_ru dum_cn dum_gl dum_au
      smpl if {%vvv}=1
ls(w=areanew) {%var}   c

      means(!reg,!num)= @mean({%var})
     wtmeans(!reg,!num)= @coefs(1)
      !reg=!reg+1

      next

!num=!num+1
next
```

Annex P. gw_110705_sim_v6.prg

```
' gw_110705_sim_v6.prg
' PROGRAM FOR ESTIMATING THE IMPACTS OF CLIMATE CHANGE
' Program as of 11/7/2005

' LOAD PROGRAM AND REDEFINE VARIABLES
load C:\MAJOR\Research\Geography\FigsandTabs\GlobalWarming\f_102705_fin_gw.wf1


' Number of bootstraps
!sample=100
!tempch=.001

smpl @all
series tdiff=2.759+0.001415*lat+0.000305*lat^2-6.55e-06*lat^3-6.15e-09*lat^4+6.45e-10*lat^5
series abslat=lat^2^.5
series pp=precav
series pop=popgpw
series tempdm=tempav-@mean(tempav)
series tt=tempdm
series t = tt
series p = pp
series wtone=1
vector(13478) respop
vector(13478) resarea
vector(13478) resgcp

'*****************************************************************
' ********** SUBROUTINES ****************************
'*****************************************************************
' This subroutine defines variables for base

subroutine reglist
group testgreg tt^2   pp pp^2   emean   rough rough^2    dist_med_n dist_short_n dist_long_n   c

endsub

'This subroutine defines variables for bootstrap

subroutine reglistb
group testgregb tt_b^2   pp_b pp_b^2   emean_b    rough_b rough_b^2    dist_med_n_b dist_short_n_b
dist_long_n_b   c
endsub

' ****************************************************************
''********* SCENARIO CC1 ******************************
'*****************************************************************
!num = 1
```

```
!drought =-0.0
!precch  = 0.0

'DEPDENDENT VARIABLE
%depvar ="lyd"

'MODELING MIDCONTINENTAL DRYING
smpl @all
genr delprec=!precch
smpl if dist_rev> 300 and alat >15 and alat <45
delprec=!drought
smpl @all

'GENERATE DUMMY VARIABLES AND GROUPS FOR COUNTRIES
series dumbig=0
genr tdum_ru=tt*dum_ru
group gc dum_ru   tdum_ru
genr dumbig=dumbig+dum_ru

' All countries
'RU CA US CN AU BR GL KZ ID IN AR MX DZ SD MN CD SA IR LY SO ZA CL PE ML AO TD CO NE
NO BO ET MR JP SE TR VE PK  EG MZ NG TZ FI NA  ES FR Mm AF ZM  MA PG PH IT  MG TH UZ
UK CF DE KE  BW CM VN IQ YE ZW MY GR RO LA KG GH SY PT BD AT BG IE DK HU KP CZ EE
LT KR SK NL BE SI KW

'Limit for not small
for %m  RU CA US CN AU BR GL KZ ID IN AR MX DZ SD MN CD SA IR LY SO ZA CL PE ML AO
TD CO NE NO BO ET MR JP SE TR VE PK  EG MZ NG TZ FI NA  ES FR Mm AF ZM  MA PG PH IT
MG TH UZ UK CF DE KE  BW CM VN IQ YE ZW MY GR RO LA KG GH SY PT BD AT BG IE DK HU
KP CZ EE LT KR

  genr tdum_{%m}=tt*dum_{%m}
  gc.add dum_{%m} tdum_{%m}
  genr dumbig=dumbig+dum_{%m}
next

' WEIGHTING FOR REGRESSION
%wt =  "lyd"

' INCLUDED VARIABLES IN GROUP GREG
group greg  tt^2 pp pp^2 rough rough^2 emean  dist_long_n dist_short_n dist_med_n c

'Call subroutine for variable definitions
call reglist

'FIT BASIC EQUATION WITHOUT COUNTRY DUMS

ls(w={%wt}) {%depvar} testgreg  gc
```

```
'FORECAST DIFFERENT VERSIONS
'BASELINE
forecast {%depvar}f_tempdm
'WITH CHANGE
genr tt=tempdm+!tempch*tdiff
pp=precav*(1+delprec*!tempch)
forecast {%depvar}f_tempplus3
genr diff{%depvar}3= {%depvar}f_tempplus3-{%depvar}f_tempdm

'CONSTRUCT RESULTS
scalar srespop= @inner(pop,diff{%depvar}3)/@sum(pop)/!tempch
scalar sresarea= @inner(areanew,diff{%depvar}3)/@sum(areanew)/!tempch
scalar sresgcp= @inner(gcpppp,diff{%depvar}3)/@sum(gcpppp)/!tempch
smpl !num !num
respop(!num) = srespop
resarea(!num) = sresarea
resgcp(!num) = sresgcp

for !k = 1 to !sample
!num= !num +1

smpl @all

'BOOTSTRAP (FIRST IS PERMUTATION TO CHECK THAT GET SAME RESULTS)
group gboot *
if !num<3 then gboot.resample(permute)
endif
if !num>2 then gboot.resample
endif
smpl @all
series tt_b=tempdm_b
series pp_b=precav_b
series dumbig_b=0

'DEFINE COUNTRY GROUP
smpl @all
group gc_b dum_ru_b   tdum_ru_b
genr dumbig_b=dumbig_b+dum_ru_b
for %m  RU CA US CN AU BR GL KZ ID IN AR MX DZ SD MN CD SA IR LY SO ZA CL PE ML AO
TD CO NE NO BO ET MR JP SE TR VE PK  EG MZ NG TZ FI NA  ES FR Mm AF ZM  MA PG PH IT
MG TH UZ UK CF DE KE  BW CM VN IQ YE ZW MY GR RO LA KG GH SY PT BD AT BG IE DK HU
KP CZ EE LT KR
gc_b.add dum_{%m}_b tdum_{%m}_b
genr dumbig_b=dumbig_b+dum_{%m}_b
next

'Define regression group
smpl @all
```

```
group greg_b   tt_b^2  pp_b pp_b^2 rough_b rough_b^2 emean_b   dist_long_n_b    dist_short_n_b
dist_med_n_b c

'Call subroutine for variable definitions
call reglistb

'FIT BASIC EQUATION WITHOUT COUNTRY DUMS
smpl @all
ls(w={%wt}_b) {%depvar}_b  testgregb  gc_b

'FORECAST DIFFERENT VERSIONS
'BASELINE
forecast {%depvar}f_tempdm

'WITH CHANGE
genr tt_b=tempdm_b+!tempch*tdiff_b
pp_b=precav_b*(1+delprec_b*!tempch)
forecast {%depvar}f_tempplus3
genr diff{%depvar}3= {%depvar}f_tempplus3-{%depvar}f_tempdm

'CONSTRUCT RESULTS
scalar srespop= @inner(pop_b,diff{%depvar}3)/@sum(pop_b)/!tempch
scalar sresarea= @inner(areanew_b,diff{%depvar}3)/@sum(areanew_b)/!tempch
scalar sresgcp= @inner(gcpppp_b,diff{%depvar}3)/@sum(gcpppp_b)/!tempch
smpl !num !num
respop(!num) = srespop
resarea(!num) = sresarea
resgcp(!num) = sresgcp

d *_b
next

smpl @all
mtos(respop,Population1)
mtos(resarea,Area1)
mtos(resgcp,Output1)

' PRODUCE BOX PLOT OF RESULTS
'smpl 1 !sample+1
'group gbox1 Output1 Population1 Area1
'freeze(agbox1) gbox1.boxplot
'agbox1.scale(left)   grid
'show agbox1

' ************************************************************
''SCENARIO CC2  ***************************************
'************************************************************

smpl @all
```

```
series tdiff=2.759+0.001415*lat+0.000305*lat^2-6.55e-06*lat^3-6.15e-09*lat^4+6.45e-10*lat^5
series abslat=lat^2^.5
series pp=precav
series pop=popgpw
genr tempdm=tempav-@mean(tempav)
series tt=tempdm
series wtone=1
series tdiff=2.759+0.001415*lat+0.000305*lat^2-6.55e-06*lat^3-6.15e-09*lat^4+6.45e-10*lat^5

!drought =-.15
!precch=0.07

smpl @all
vector(13478) respop
vector(13478) resarea
vector(13478) resgcp
respop=0
resarea=0
resgcp=0

'MODELING MIDCONTINENTAL DRYING
smpl @all
genr delprec=!precch
smpl if dist_rev> 300 and alat >15 and alat <45
delprec=!drought
!num=1

smpl @all
group greg    tt^2   pp pp^2 rough rough^2 emean  dist_long_n dist_short_n dist_med_n c

'FIT BASIC EQUATION WITHOUT COUNTRY DUMS
ls(w={%wt}) {%depvar} greg  gc

'FORECAST DIFFERENT VERSIONS
'   BASELINE
forecast {%depvar}f_tempdm
'   WITH CHANGE
genr tt=tempdm+!tempch*tdiff
pp=precav*(1+delprec*!tempch)
forecast {%depvar}f_tempplus3
genr diff{%depvar}3= {%depvar}f_tempplus3-{%depvar}f_tempdm

'CONSTRUCT RESULTS
scalar srespop= @inner(pop,diff{%depvar}3)/@sum(pop)/!tempch
scalar sresarea= @inner(areanew,diff{%depvar}3)/@sum(areanew)/!tempch
scalar sresgcp= @inner(gcpppp,diff{%depvar}3)/@sum(gcpppp)/!tempch
smpl !num !num
respop(!num) = srespop
resarea(!num) = sresarea
```

```
resgcp(!num) = sresgcp

for !k = 1 to !sample
!num= !num +1

'BOOTSTRAP (FIRST IS PERMUTATION TO CHECK THAT GET SAME RESULTS)
smpl @all
group gboot *
if !num<3 then gboot.resample(permute)
endif
if !num>2 then gboot.resample
endif
smpl @all
series tt_b=tempdm_b
series pp_b=precav_b
series dumbig_b=0

'DEFINE COUNTRY GROUP
smpl @all
group gc_b dum_ru_b   tdum_ru_b
genr dumbig_b=dumbig_b+dum_ru_b
for %m  RU CA US CN AU BR GL KZ ID IN AR MX DZ SD MN CD SA IR LY SO ZA CL PE ML AO
TD CO NE NO BO ET MR JP SE TR VE PK  EG MZ NG TZ FI NA  ES FR Mm AF ZM  MA PG PH IT
MG TH UZ UK CF DE KE  BW CM VN IQ YE ZW MY GR RO LA KG GH SY PT BD AT BG IE DK HU
KP CZ EE LT KR
gc_b.add dum_{%m}_b tdum_{%m}_b
genr dumbig_b=dumbig_b+dum_{%m}_b
next

'Define regression group
smpl @all
group greg_b   tt_b^2  pp_b pp_b^2 rough_b rough_b^2 emean_b   dist_long_n_b    dist_short_n_b
dist_med_n_b c

'FIT BASIC EQUATION WITHOUT COUNTRY DUMS
smpl @all
ls(w={%wt}_b) {%depvar}_b greg_b  gc_b

'FORECAST DIFFERENT VERSIONS
'BASELINE
forecast {%depvar}f_tempdm

'WITH CHANGE
genr tt_b=tempdm_b+!tempch*tdiff_b
pp_b=precav_b*(1+delprec_b*!tempch)
forecast {%depvar}f_tempplus3
genr diff{%depvar}3= {%depvar}f_tempplus3-{%depvar}f_tempdm

'CONSTRUCT RESULTS
```

```
scalar srespop= @inner(pop_b,diff{%depvar}3)/@sum(pop_b)/!tempch
scalar sresarea= @inner(areanew_b,diff{%depvar}3)/@sum(areanew_b)/!tempch
scalar sresgcp= @inner(gcpppp_b,diff{%depvar}3)/@sum(gcpppp_b)/!tempch

smpl !num !num
respop(!num) = srespop
resarea(!num) = sresarea
resgcp(!num) = sresgcp

d *_b
next

smpl @all
mtos(respop,Population2)
mtos(resarea,Area2)
mtos(resgcp,Output2)

' PRODUCE BOX PLOT OF RESULTS
'smpl 1 !sample+1
'group gbox2 Output2 Population2 Area2
'freeze(agbox2) gbox2.boxplot
'agbox2.scale(left)   grid
'show agbox2

' combined results
smpl 1 !sample+1
group gboxall output1 Output2 population1 Population2 area1 Area2
freeze(agboxall) gboxall.boxplot
agboxall.scale(left)   grid
show agboxall

show output1 output2 population1 population2 area1 area2
```

Annex M. Program for Calculating Output Potential by Grid Cell (for non-zero cells)

```
' calculation of potential
' potential_v7_cont.prg

tic
%d = "091205"
'wfload C:\Major\Research\Geography\Documentation\ProgAndFiles\\f_{%d}c.wf1
'wfsave C:\Major\Research\Geography\Documentation\ProgAndFiles\\pot_{%d}.wf1

wfopen C:\Major\Research\Geography\potentialprogram\pot_{%d}_home.wf1


smpl @all
genr latrad=(lat)*3.14159/180
genr longrad=long*3.14159/180

sort -gcpppp_u
'This is the continuation program.


'total sample is smpl 1 18182
'Sample to complete from 1 to 15012 (non zeros)
!start= 1
!end = 15012

!n =15012

smpl 1 15012

vector(!n) pot1
vector(!n) pot2
vector(!n) pot15
vector(!n) xlatr = latrad
vector(!n) xlongr=longrad
vector(!n) xx=gcpppp_u/1000000000
scalar xsum1
scalar xsum2
scalar xsum15

for !i = !start to !end
vector(!n) d1
vector(!n) d2
vector(!n) d3
vector(!n) invd1
vector(!n) invd2
vector(!n) invd15
xsum1=0
```

```
xsum2=0
xsum15=0

  for !j = 1 to !n

  '  DISTANCE CALCULATION
  if !i=!j then d1(!j)=1000
  else d1(!j) =
@acos(@sin(xlatr(!i))*@sin(xlatr(!j)+.00000001)+@cos(xlatr(!i))*@cos(xlatr(!j)+.00000001)*cos(xlongr(!i)-
xlongr(!j)))
  endif

 d2(!j)=(xx(!j)/((6366.71*d1(!j))+.001)^2)
 d3(!j)=(xx(!j)/((6366.71*d1(!j))+.001))

  xsum1=xsum1+ (xx(!j)/((6366.71*d1(!j))+.001)^2)
  xsum2=xsum2+ xx(!j)/((6366.71*d1(!j))+.001)
  xsum15=xsum15+ xx(!j)/((6366.71*d1(!j))+.001)^1.5

  next

pot1(!i) = xsum1
pot2(!i) = xsum2
pot15(!i) = xsum15
next

'create series on potential
series pot1ser
series pot2ser
series pot15ser

smpl 1 !n
mtos(pot1,pot1ser)
mtos(pot2,pot2ser)
mtos(pot15,pot15ser)


wfsave C:\Major\Research\Geography\Documentation\ProgAndFiles\\pot_{%d}cont.wf1
toc
```

Annex. Program for fractile plot (scat_091705_v3.prg)

```
' To calculate the scatter plots
'wfopen C:\Major\Research\Geography\Documentation\ProgAndFiles\f_091205b.wf1
'wfsave C:\Major\Research\Geography\FigsandTabs\ScatAllVar\rank_f_091205b.wf1

'REMOVE QUALITY<1 AND NONZERO LYDI1

'CREATE RANK ORDER FOR DIFFERENT VARIABLES
smpl @all
series abslat=lat^2^.5

!b_tempav=3
sort tempav
'smpl if tempav>0 and lydi1>-1
series num_tempav=@trend
group gtempav tempav lydi1
gtempav.kerfit(s=lydi1f_tempav,b={!b_tempav})
show num_tempav lydi1f_tempav


!b_precav=30
sort precav
series num_precav=@trend
group gprecav precav lydi1
gprecav.kerfit(s=lydi1f_precav,b={!b_precav})
show num_precav lydi1f_precav


!b_emean=.4
sort emean
series num_emean=@trend
group gemean emean lydi1
gemean.kerfit(s=lydi1f_emean,b={!b_emean})
show num_emean lydi1f_emean


!b_dc1=500
sort dc1
series num_dc1=@trend
group gdc1 dc1 lydi1
gdc1.kerfit(s=lydi1f_dc1,b={!b_dc1})
show num_dc1 lydi1f_dc1
stop

!b_tempmax=3
sort tempmax
series num_tempmax=@trend
```

```
group gtempmax tempmax lydi1
gtempmax.kerfit(s=lydi1f_tempmax,b={!b_tempmax})
show num_tempmax lydi1f_tempmax


!b_abslat=3
sort abslat
series num_abslat=@trend
group gabslat abslat lydi1
gabslat.kerfit(s=lydi1f_abslat,b={!b_abslat})
show num_abslat lydi1f_abslat


!b_precmin=30
sort precmin
series num_precmin=@trend
group gprecmin precmin lydi1
gprecmin.kerfit(s=lydi1f_precmin,b={!b_precmin})
show num_precmin lydi1f_precmin
stop

'NEXT NEED TO CREATE EXCEL OF THE RA NK ORDER FILES
' For each of above, take sorted forecast into a spreadsheet
' called rank_vars_092105

''Next create new file with ranked data
'open C:\Major\Research\Geography\FigsandTabs\ScatAllVar\fract_092105.wf1

' Add data from excel sheet through data command

' Then scat
smpl @all
series tttt=@trend
series frac=tttt/17796
scat frac LYDI1F_TEMPAV/log(10) LYDI1F_PRECAV/log(10)LYDI1F_EMEAN/log(10)
LYDI1F_DC1/log(10) LYDI1F_ABSLAT/log(10)

'wfsave C:\Major\Research\Geography\FigsandTabs\ScatAllVar\fract_092105.wf1
```

Annex. Program for calculating statistics in Table 1 (prog_calc_av_count_tab1.prg)

```
!i = 181
smpl if countryid = 222 or countryid=169 or countryid=48 or countryid=192 or countryid=116 or
countryid=234 or countryid=18 or countryid=69 or countryid=186 or countryid=55 or countryid=120 or
countryid=172 or countryid=197 or countryid=201 or countryid=84 or countryid=225 or countryid=107
or countryid=210 or countryid=77 or countryid=250

smpl if countryid=181 or countryid=1 or countryid=198 or countryid=1 or countryid=194 or
countryid=220 or countryid=155 or countryid=203 or countryid=3 or countryid=182 or countryid=227
smpl if countryid =!i
'smpl @all
series meangcp=@mean(gcpppp)
series meanarea=@mean(area)
series meanpop=@mean(popgpw)
series sumgcp=@sum(gcpppp)
series sumarea=@sum(area)
series sumpop=@sum(popgpw)


series gcpdens=meangcp/meanarea
series pcy=meangcp/meanpop
show gcpdens pcy country meangcp meanarea meanpop sumgcp sumarea sumpop
```