Are Chinese Cities Too Small?
Supplementary Material

J. Vernon Henderson and Chun-Chung Au
September 30, 2005

In this supplement are (1) a print-out from Limdep of material in Table 2 in the paper, including first stage regressions for the IV work and specification test material; (2) a print-out of material from Stata in Table 4 including specification test material; and (3) a print-out of material upon which the information in Tables 5-7 for the generalized Leontief specification is based. All this is proceeded by a table defining the variables appearing in the print-out, as they relate to variables in the paper. Documentation on data is given in the Appendix to the paper. The data itself and actual programs used in estimation are archived with the journal separately.

Key to Variables in Dataset

lnyna	ln(output of city); output is value added in non-agricultural production
lnk	ln(capital)
lna	Employment in non-agricultural production (10,000's)
ryms	manufacturing to service ratio (value added)
pshs90	percentage of population over age 6 with senior high school education
rfdlnan	(cumulative FDI since 1990) / (employment*10000) [divided by 1000]
lmp6_976	ln($MP_{j,domestic}$)
tcint6m6	1 / ($MP_{j,domestic} * Ad_{j,coast}^{.82}$) [multiplied by 1,000]
area90	area (1990)
book90	books per capita (1990)
doctor90	doctors per capital (1990)
tel90	telephone per 100 persons (1990)
lnroad90	ln(roads per capita) (1990)
drw	dummy for in western region
drc	dummy for in central region
agn90	ratio of municipality GDP in 1st sector to output of city (1990)
lnrkl90	ln(capital/employment) (1990)
nofdi90	dummy for zero FDI in 1990
lnisiv90	ln(ratio of sales by all enterprises to that of independent accounting units) (1990)
ryms90	manufacturing to service ratio (1990)
rfdln90	(FDI in 1990) / (employment*10000)
lmp6_906	ln($MP_{j,domestic}$) (1990)
tnt6m906	1 / ($MP_{j,domestic} * Ad_{j,coast}^{.82}$) (1990)

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Table 2. This output shows estimation of models in Table 2, along with
(1) first stage regressionsof endogenous covariates on instruments
and (2) specification test regressing residuals on instruments.
Variables defined in first table.

? ************************************************************************
?
?     Sept 28, 2005
?
?     REStud
?     Au and Henderson, "Are Chinese Cities Too Small?"
?     LIMDEP program for regressions in Table 2
?
?     Prefecture level cities 1997 on 1990 instruments
?
?     1. Table 2, 1st Col. - IV Estimation, structural model
      2. First stage, OLS regressions: endogeneous covariates on instruments
      3. Regressions of residuals on instruments
?     4. Table 2, 2nd Col. - Ordinary NLLS, structural model
?
? ************************************************************************


 1. Table 2, 1st Col. - IV Estimation, structural modelTYPE; ------------------
--> NLSQ; Lhs = lnyna
    ; Fcn = constant + a0*lnk + a1*log(lna-a2*(lna^1.5))
    + a3*rysna*log(lna-a2*(lna^1.5)) + _pshs90*pshs90
    + _rfdlnaN*rfdlnaN + _lmp6976*lmp6_976 + _tint6M6*tcint6M6
    ; Labels = constant, a0, a1, a2, a3, _pshs90, _rfdlnaN, _lmp6976,
    _tint6M6
    ; Start = .2, .40, 1.1, -.15, -.05, .007, 1.0, .5, 4
    ; Inst = ONE,area90,book90,doctor90,tel90,lnroad90,drw,drc,agn90,
    lnrkl90,nofdi90,lnisiv90,ms90ar90,rfdlN90,lmp6_906,tnt6M906,
    pshs90,area9015
    ; Res = residual $


+----------------------------------------------------------------------+
| Instrumental Variables (NL2SLS)                                      |
| Nonlinear   least squares regression    Weighting variable = none    |
| Number of iterations completed =  18                                 |
| Dep. var. = LNYNA    Mean=   13.52868059    , S.D.=   1.035270599    |
| Model size: Observations =     205, Parameters =   9, Deg.Fr.=    196 |
| Residuals:  Sum of squares= 18.92173176    , Std.Dev.=         .30381 |
| Fit:        R-squared=  .913459, Adjusted R-squared =          .91388 |
|             (Note:  Not using OLS.  R-squared is not bounded in [0,1] |
| Model test: F[  8,    196] =  258.60,    Prob value =          .00000 |
| Diagnostic: Log-L =    -46.6558, Restricted(b=0) Log-L =    -297.4871 |
|             LogAmemiyaPrCrt.=   -2.340, Akaike Info. Crt.=       .543 |
+----------------------------------------------------------------------+
+---------+--------------+----------------+--------+---------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] |
+---------+--------------+----------------+--------+---------+
 CONSTANT     .1816195744       1.1270488     .161   .8720
 A0           .4284463723   .84608061E-01    5.064   .0000
 A1           .6053129003       .18166802    3.332   .0009
 A2        .3471094591E-01  .49402628E-02    7.026   .0000
 A3           .4254838160       .18656480    2.281   .0226
 _PSHS90   .4729055437E-03  .43197328E-02     .109   .9128
 _RFDLNAN  .7929230392E-01  .27219768E-01    2.913   .0036
 _LMP6976     .6500863290   .98728102E-01    6.585   .0000
 _TINT6M6     1.456393623       2.9156448     .500   .6174
 (Note: E+nn or E-nn means multiply by 10 to + or -nn power.)
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2. First stage regressions $
 First stage regressions
--> REGRESS; Lhs = lnk
    ; Rhs = ONE,area90,book90,doctor90,tel90,lnroad90,drw,drc,agn90,
    lnrkl90,nofdi90,lnisiv90,ms90ar90,rfdlN90,lmp6_906,tnt6M906,
    pshs90,area9015 $

```
+----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = LNK      Mean=   13.75037083    , S.D.=   1.055576028     |
| Model size: Observations =     205, Parameters =  18, Deg.Fr.=    187 |
| Residuals:  Sum of squares= 23.83416291    , Std.Dev.=         .35701 |
| Fit:        R-squared=  .895145, Adjusted R-squared =          .88561 |
| Model test: F[ 17,    187] =   93.91,    Prob value =          .00000 |
| Diagnostic: Log-L =    -70.3137, Restricted(b=0) Log-L =    -301.4689 |
|             LogAmemiyaPrCrt.=   -1.976, Akaike Info. Crt.=       .862 |
| Autocorrel: Durbin-Watson Statistic =   1.87335,   Rho =       .06333 |
+----------------------------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |t-ratio |P[|T|>t] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant     1.160763976       .81645513    1.422   .1568
 AREA90    .3019472963E-01  .27780236E-02   10.869   .0000     45.624390
 BOOK90    .4119889274E-03  .57896016E-03     .712   .4776     73.187477
 DOCTOR90     .5453940915       .34063223    1.601   .1110     .37585514
 TEL90     .2251033877E-01  .11104597E-01    2.027   .0441     3.5443902
 LNROAD90    -.1111759700   .46696127E-01   -2.381   .0183     .93497865
 DRW          .1948439263       .12511081    1.557   .1211     .16097561
 DRC       .5146122554E-01  .93057494E-01     .553   .5809     .39024390
 AGN90    -.6324511433E-01  .26783579E-01   -2.361   .0192     .91902871
 LNRKL90      .7807593536   .66032264E-01   11.824   .0000     9.0067920
 NOFDI90     -.1447946179   .72844281E-01   -1.988   .0483     .30731707
 LNISIV90     .4804964203       .19717362    2.437   .0157     .14841506
 MS90AR90  .1349683936E-03  .52168851E-03     .259   .7961     97.273214
 RFDLN90      .7078871593       .30380007    2.330   .0209  .30007581E-01
 LMP6_906     1.092778406       .12126510    9.011   .0000     4.1837383
 TNT6M906     1.432880572       .85699983    1.672   .0962  .92593285E-01
 PSHS90   -.1316618049E-01  .70426377E-02   -1.869   .0631     22.416878
 AREA9015 -.1187725124E-02  .13697714E-03   -8.671   .0000     416.81772
 (Note: E+nn or E-nn means multiply by 10 to + or -nn power.)
```

--> REGRESS; Lhs = lna
    ; Rhs = ONE,area90,book90,doctor90,tel90,lnroad90,drw,drc,agn90,
    lnrkl90,nofdi90,lnisiv90,ms90ar90,rfdlN90,lmp6_906,tnt6M906,
    pshs90,area9015 $

```
+----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = LNA      Mean=   52.87624385    , S.D.=   67.32792451     |
| Model size: Observations =     205, Parameters =  18, Deg.Fr.=    187 |
| Residuals:  Sum of squares= 136521.2306    , Std.Dev.=       27.01962 |
| Fit:        R-squared=  .852368, Adjusted R-squared =          .83895 |
| Model test: F[ 17,    187] =   63.51,    Prob value =          .00000 |
| Diagnostic: Log-L =   -957.2580, Restricted(b=0) Log-L =   -1153.3441 |
|             LogAmemiyaPrCrt.=    6.677, Akaike Info. Crt.=      9.515 |
| Autocorrel: Durbin-Watson Statistic =   1.67952,   Rho =       .16024 |
+----------------------------------------------------------------------+
```

table2

Variable	Coefficient	Standard Error	t-ratio	P[|T|>t]	Mean of X
Constant	-153.6811682	61.792031	-2.487	.0138	
AREA90	.9768733641	.21025004	4.646	.0000	45.624390
BOOK90	-.3715610651E-02	.43817624E-01	-.085	.9325	73.187477
DOCTOR90	-11.10875098	25.780177	-.431	.6670	.37585514
TEL90	4.141085289	.84043271	4.927	.0000	3.5443902
LNROAD90	-6.124688613	3.5341176	-1.733	.0847	.93497865
DRW	23.05305032	9.4688011	2.435	.0158	.16097561
DRC	8.706109741	7.0428996	1.236	.2180	.39024390
AGN90	-4.426342189	2.0270700	-2.184	.0302	.91902871
LNRKL90	-6.409182442	4.9975406	-1.282	.2013	9.0067920
NOFDI90	7.388238266	5.5130966	1.340	.1818	.30731707
LNISIV90	-11.18283423	14.922753	-.749	.4546	.14841506
MS90AR90	-.5557237395E-01	.39483116E-01	-1.407	.1609	97.273214
RFDLN90	-3.300238669	22.992596	-.144	.8860	.30007581E-01
LMP6_906	49.83864917	9.1777451	5.430	.0000	4.1837383
TNT6M906	93.10042219	64.860588	1.435	.1528	.92593285E-01
PSHS90	-.2350816243	.53301016	-.441	.6597	22.416878
AREA9015	.1247834131E-01	.10366884E-01	1.204	.2302	416.81772

(Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

```
--> REGRESS; Lhs = rysna
    ; Rhs = ONE,area90,book90,doctor90,tel90,lnroad90,drw,drc,agn90,
    lnrkl90,nofdi90,lnisiv90,ms90ar90,rfdlN90,lmp6_906,tnt6M906,
    pshs90,area9015 $
```

Ordinary least squares regression Weighting variable = none
Dep. var. = RYSNA Mean= .4379240056 , S.D.= .1056938843
Model size: Observations = 205, Parameters = 18, Deg.Fr.= 187
Residuals: Sum of squares= 1.146154586 , Std.Dev.= .07829
Fit: R-squared= .497063, Adjusted R-squared = .45134
Model test: F[17, 187] = 10.87, Prob value = .00000
Diagnostic: Log-L = 240.7438, Restricted(b=0) Log-L = 170.2965
LogAmemiyaPrCrt.= -5.011, Akaike Info. Crt.= -2.173
Autocorrel: Durbin-Watson Statistic = 1.84972, Rho = .07514

Variable	Coefficient	Standard Error	t-ratio	P[|T|>t]	Mean of X
Constant	1.126711616	.17904161	6.293	.0000	
AREA90	.2057035135E-02	.60919676E-03	3.377	.0009	45.624390
BOOK90	.9115285482E-04	.12696100E-03	.718	.4737	73.187477
DOCTOR90	-.7574721773E-01	.74697727E-01	-1.014	.3119	.37585514
TEL90	.3696923018E-02	.24351429E-02	1.518	.1307	3.5443902
LNROAD90	.2526234759E-02	.10240060E-01	.247	.8054	.93497865
DRW	-.1855452634E-02	.27435729E-01	-.068	.9462	.16097561
DRC	.1311592684E-01	.20406710E-01	.643	.5212	.39024390
AGN90	.1911745477E-01	.58734091E-02	3.255	.0013	.91902871
LNRKL90	-.6170854209E-01	.14480309E-01	-4.262	.0000	9.0067920
NOFDI90	.5423127232E-02	.15974126E-01	.339	.7346	.30731707
LNISIV90	.4466695917E-02	.43238483E-01	.103	.9178	.14841506
MS90AR90	-.5976760405E-03	.11440182E-03	-5.224	.0000	97.273214
RFDLN90	-.1399817032	.66620749E-01	-2.101	.0370	.30007581E-01
LMP6_906	-.6781180367E-01	.26592397E-01	-2.550	.0116	4.1837383
TNT6M906	.3414526196	.18793271	1.817	.0708	.92593285E-01
PSHS90	.3763287963E-02	.15443900E-02	2.437	.0158	22.416878
AREA9015	-.3637102879E-04	.30037912E-04	-1.211	.2275	416.81772

(Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

```
--> TYPE; Note: *** pshs90 is a regressor as well as an instrument *** $
 Note: *** pshs90 is a regressor as well as an instrument ***
--> TYPE; $

--> REGRESS; Lhs = rfdlnaN
    ; Rhs = ONE,area90,book90,doctor90,tel90,lnroad90,drw,drc,agn90,
    lnrkl90,nofdi90,lnisiv90,ms90ar90,rfdlN90,lmp6_906,tnt6M906,
    pshs90,area9015 $

+----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = RFDLNAN  Mean=   .9539423424    , S.D.=   1.582057446     |
| Model size: Observations =     205, Parameters =  18, Deg.Fr.=    187 |
| Residuals:  Sum of squares= 174.6177320    , Std.Dev.=         .96633 |
| Fit:        R-squared=  .658010, Adjusted R-squared =          .62692 |
| Model test: F[ 17,    187] =   21.16,    Prob value =          .00000 |
| Diagnostic: Log-L =   -274.4403, Restricted(b=0) Log-L =    -384.4200 |
|             LogAmemiyaPrCrt.=     .016, Akaike Info. Crt.=      2.853 |
| Autocorrel: Durbin-Watson Statistic =   1.58698,   Rho =       .20651 |
+----------------------------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |t-ratio |P[|T|>t] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant    -8.822230406       2.2099200   -3.992   .0001
 AREA90    .7550558999E-03  .75193475E-02     .100   .9201     45.624390
 BOOK90    .1501330350E-02  .15670862E-02     .958   .3393     73.187477
 DOCTOR90    -1.960289159       .92199796   -2.126   .0348     .37585514
 TEL90    -.1787074361E-01  .30057096E-01    -.595   .5529     3.5443902
 LNROAD90  .6061583185E-01      .12639360     .480   .6321     .93497865
 DRW          .4241023587       .33864064    1.252   .2120     .16097561
 DRC      -.2799875408E-01      .25188110    -.111   .9116     .39024390
 AGN90    -.4124450970E-01  .72495797E-01    -.569   .5701     .91902871
 LNRKL90       .2981170042       .17873121    1.668   .0970     9.0067920
 NOFDI90   .4444101347E-01      .19716947     .225   .8219     .30731707
 LNISIV90      .8913228804       .53369486    1.670   .0966     .14841506
 MS90AR90 -.2964377444E-02  .14120676E-02   -2.099   .0371     97.273214
 RFDLN90       7.111142730       .82230340    8.648   .0000  .30007581E-01
 LMP6_906      1.230245474       .32823135    3.748   .0002     4.1837383
 TNT6M906      13.14163276       2.3196633    5.665   .0000  .92593285E-01
 PSHS90    .5255457604E-01  .19062487E-01    2.757   .0064     22.416878
 AREA9015  .1387683801E-03  .37075952E-03     .374   .7086     416.81772
 (Note: E+nn or E-nn means multiply by 10 to + or -nn power.)


--> REGRESS; Lhs = lmp6_976
    ; Rhs = ONE,area90,book90,doctor90,tel90,lnroad90,drw,drc,agn90,
    lnrkl90,nofdi90,lnisiv90,ms90ar90,rfdlN90,lmp6_906,tnt6M906,
    pshs90,area9015 $

+----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = LMP6_976 Mean=   7.244718307    , S.D.=   .2789519996     |
| Model size: Observations =     205, Parameters =  18, Deg.Fr.=    187 |
| Residuals:  Sum of squares= 2.528804464    , Std.Dev.=         .11629 |
| Fit:        R-squared=  .840696, Adjusted R-squared =          .82621 |
| Model test: F[ 17,    187] =   58.05,    Prob value =          .00000 |
| Diagnostic: Log-L =    159.6321, Restricted(b=0) Log-L =     -28.6545 |
|             LogAmemiyaPrCrt.=   -4.219, Akaike Info. Crt.=     -1.382 |
| Autocorrel: Durbin-Watson Statistic =   1.36500,   Rho =       .31750 |
+----------------------------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |t-ratio |P[|T|>t] | Mean of X|
```

table2

Constant	4.606819004	.26594388	17.323	.0000	
AREA90	-.3709902338E-02	.90488546E-03	-4.100	.0001	45.624390
BOOK90	.3393462863E-04	.18858465E-03	.180	.8574	73.187477
DOCTOR90	.1617421170	.11095412	1.458	.1466	.37585514
TEL90	-.2185200416E-02	.36170997E-02	-.604	.5465	3.5443902
LNROAD90	.2112245125E-01	.15210326E-01	1.389	.1666	.93497865
DRW	-.3550633133E-01	.40752337E-01	-.871	.3847	.16097561
DRC	.6518729009E-01	.30311612E-01	2.151	.0328	.39024390
AGN90	-.6481296791E-01	.87242134E-02	-7.429	.0000	.91902871
LNRKL90	-.7964867253E-01	.21508685E-01	-3.703	.0003	9.0067920
NOFDI90	.6474449524E-01	.23727563E-01	2.729	.0070	.30731707
LNISIV90	-.6431820886E-01	.64225349E-01	-1.001	.3179	.14841506
MS90AR90	.2971729255E-03	.16992956E-03	1.749	.0820	97.273214
RFDLN90	.4948260836E-01	.98956776E-01	.500	.6176	.30007581E-01
LMP6_906	.8225619227	.39499675E-01	20.825	.0000	4.1837383
TNT6M906	.1774489083	.27915050	.636	.5258	.92593285E-01
PSHS90	-.2699260782E-02	.22939979E-02	-1.177	.2408	22.416878
AREA9015	.1224863950E-03	.44617555E-04	2.745	.0066	416.81772

(Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

```
--> REGRESS; Lhs = tcint6M6
    ; Rhs = ONE,area90,book90,doctor90,tel90,lnroad90,drw,drc,agn90,
    lnrkl90,nofdi90,lnisiv90,ms90ar90,rfdlN90,lmp6_906,tnt6M906,
    pshs90,area9015 $
```

Ordinary least squares regression Weighting variable = none
Dep. var. = TCINT6M6 Mean= .2326212439E-01, S.D.= .1276757592E-01
Model size: Observations = 205, Parameters = 18, Deg.Fr.= 187
Residuals: Sum of squares= .2097694869E-02, Std.Dev.= .00335
Fit: R-squared= .936919, Adjusted R-squared = .93118
Model test: F[17, 187] = 163.38, Prob value = .00000
Diagnostic: Log-L = 886.8350, Restricted(b=0) Log-L = 603.5923
LogAmemiyaPrCrt.= -11.314, Akaike Info. Crt.= -8.476
Autocorrel: Durbin-Watson Statistic = 1.31224, Rho = .34388

Variable	Coefficient	Standard Error	t-ratio	P[|T|>t]	Mean of X
Constant	-.3334976314E-01	.76595548E-02	-4.354	.0000	
AREA90	.8143103777E-04	.26061964E-04	3.125	.0021	45.624390
BOOK90	.2439031620E-05	.54315012E-05	.449	.6539	73.187477
DOCTOR90	-.5673641165E-02	.31956334E-02	-1.775	.0775	.37585514
TEL90	.1316267543E-03	.10417752E-03	1.263	.2080	3.5443902
LNROAD90	-.2220217949E-03	.43807862E-03	-.507	.6129	.93497865
DRW	-.1484931271E-02	.11737242E-02	-1.265	.2074	.16097561
DRC	-.2497733700E-02	.87301672E-03	-2.861	.0047	.39024390
AGN90	.1236884638E-02	.25126952E-03	4.923	.0000	.91902871
LNRKL90	.2104434191E-02	.61948015E-03	3.397	.0008	9.0067920
NOFDI90	-.9899413088E-03	.68338692E-03	-1.449	.1491	.30731707
LNISIV90	.1673294481E-02	.18497797E-02	.905	.3668	.14841506
MS90AR90	-.7551373379E-05	.48942086E-05	-1.543	.1245	97.273214
RFDLN90	-.2680713941E-02	.28500933E-02	-.941	.3481	.30007581E-01
LMP6_906	.4067944548E-02	.11376458E-02	3.576	.0004	4.1837383
TNT6M906	.2202490060	.80399240E-02	27.394	.0000	.92593285E-01
PSHS90	.1728667402E-04	.66070342E-04	.262	.7939	22.416878
AREA9015	-.2914824409E-05	.12850479E-05	-2.268	.0245	416.81772

(Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

****

```
3. Residual regression on instruments $
 Residual regression on instruments
--> REGRESS; Lhs = residual
    ; Rhs = ONE,area90,book90,doctor90,tel90,lnroad90,drw,drc,agn90,
    lnrkl90,nofdi90,lnisiv90,ms90ar90,rfdlN90,lmp6_906,tnt6M906,
    pshs90,area9015 $

+----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = RESIDUAL Mean=  -.4915832034E-09, S.D.=   .3045547357     |
| Model size: Observations =     205, Parameters =  18, Deg.Fr.=    187 |
| Residuals:  Sum of squares= 17.56041152    , Std.Dev.=         .30644 |
| Fit:        R-squared=  .071945, Adjusted R-squared =         -.01242 |
| Model test: F[ 17,    187] =     .85,    Prob value =          .63043 |
| Diagnostic: Log-L =    -39.0027, Restricted(b=0) Log-L =     -46.6558 |
|             LogAmemiyaPrCrt.=   -2.281, Akaike Info. Crt.=       .556 |
| Autocorrel: Durbin-Watson Statistic =   1.74747,   Rho =       .12626 |
+----------------------------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |t-ratio |P[|T|>t] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant     .4680924787       .70080907      .668   .5050
 AREA90   -.2947555770E-02  .23845330E-02   -1.236   .2180     45.624390
 BOOK90    .6872015897E-03  .49695386E-03    1.383   .1684     73.187477
 DOCTOR90 -.1307418071E-01      .29238369    -.045   .9644     .37585514
 TEL90     .3698022396E-02  .95316963E-02     .388   .6985     3.5443902
 LNROAD90  .5737154910E-01  .40081895E-01    1.431   .1540     .93497865
 DRW       .2823829172E-01      .10738960     .263   .7929     .16097561
 DRC      -.9201329064E-01  .79876449E-01   -1.152   .2508     .39024390
 AGN90    -.1201427907E-01  .22989843E-01    -.523   .6019     .91902871
 LNRKL90  -.2056873349E-01  .56679183E-01    -.363   .7171     9.0067920
 NOFDI90  -.4446843703E-01  .62526317E-01    -.711   .4778     .30731707
 LNISIV90 -.3486676229E-01      .16924514    -.206   .8370     .14841506
 MS90AR90  .1218059627E-03  .44779440E-03     .272   .7859     97.273214
 RFDLN90     -.2102086693       .26076858    -.806   .4212  .30007581E-01
 LMP6_906 -.3414589281E-01      .10408862    -.328   .7432     4.1837383
 TNT6M906    -.4125023027       .73561085    -.561   .5756  .92593285E-01
 PSHS90   -.3413185121E-02  .60450895E-02    -.565   .5730     22.416878
 AREA9015  .1266408548E-03  .11757514E-03    1.077   .2828     416.81772
 (Note: E+nn or E-nn means multiply by 10 to + or -nn power.)
**************************************************************************


4. Table 2, 2nd Col. - Ordinary NLLS, structural modelTYPE


--> NLSQ; Lhs = lnyna
    ; Fcn = constant + a0*lnk + a1*log(lna-a2*(lna^1.5))
    + a3*rysna*log(lna-a2*(lna^1.5)) + _pshs90*pshs90
    + _rfdlnaN*rfdlnaN + _lmp6976*lmp6_976 + _tint6M6*tcint6M6
    ; Labels = constant, a0, a1, a2, a3, _pshs90, _rfdlnaN, _lmp6976,
    _tint6M6
    ; Start = .2, .40, 1.1, -.15, -.05, .007, 1.0, .5, 4 $

Normal exit from iterations. Exit status=0.

+----------------------------------------------------------------------+
| User Defined Optimization                                            |
| Nonlinear   least squares regression    Weighting variable = none    |
| Number of iterations completed =  23                                 |
| Dep. var. = LNYNA    Mean=   13.52868059    , S.D.=   1.035270599    |
```

table2

Model size: Observations = 205, Parameters = 9, Deg.Fr.= 196
Residuals: Sum of squares= 16.84827996 , Std.Dev.= .28668
Fit: R-squared= .922942, Adjusted R-squared = .92332
(Note: Not using OLS. R-squared is not bounded in [0,1]
Model test: F[8, 196] = 293.44, Prob value = .00000
Diagnostic: Log-L = -34.7594, Restricted(b=0) Log-L = -297.4871
LogAmemiyaPrCrt.= -2.456, Akaike Info. Crt.= .427

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
CONSTANT	1.379264526	.74146070	1.860	.0629
A0	.4172500257	.44190187E-01	9.442	.0000
A1	.5761679763	.87372157E-01	6.594	.0000
A2	.8334721173E-02	.22754469E-01	.366	.7141
A3	.1432449834	.77923415E-01	1.838	.0660
_PSHS90	.4320778530E-02	.31286166E-02	1.381	.1673
_RFDLNAN	.7266529312E-01	.16558730E-01	4.388	.0000
_LMP6976	.5363506859	.78976810E-01	6.791	.0000
_TINT6M6	4.445532372	2.0054019	2.217	.0266

(Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

This contains the results for table 4, including specification tests.

```
. *************************************************************************
. *
. *     Sept 28, 2005
. *
. *     REStud
. *     Au and Henderson, "Are Chinese Cities Too Small?"
. *     STATA program for regressions in Table 4
. *
. *     Prefecture level cities 1997 on 1990 instruments
. *
. *     1. Table 4, 1st col. - IV Estimation Generalized Leontief
. *     2. Table 4, 2nd col. - IV Estimation Regular Taylor Series
. *
. *************************************************************************
.
. insheet using restud.csv, comma
(27 vars, 205 obs)

.
. gen lnlna = ln(lna)

. gen lnrylna = lnyna - lnlna

. gen lnrklna = lnk - lnlna

. gen lna2 = lna^2

. gen mslna = ryms*lna

. gen ms90ar90 = ryms90*area90

. gen area902 = area90^2

. gen ryms902 = ryms90^2

. gen ryms2 = ryms^2

. gen lna5 = lna^.5

. gen ryms5 = ryms^.5

. gen ms5lna5 = ryms5*lna5

. gen ryms905 = ryms90^5

. gen area905 = area90^5

. gen ms5area905 = ryms905*area905

.
. ************************************************************
. * 1. Table 4, 1st col. - IV Estimation Generalized Leontief *
. ************************************************************
.
.  leontief
. global iv "area90 book90 doctor90 tel90 lnroad90 drw drc agn90 lnrkl90 nofdi90 ln
> isiv90 ms5area905 rfdln90 lmp6_906 tnt6m906 pshs90 area905 ryms90 ryms905"

. ivreg lnrylna (lnrklna lna5 lna ms5lna5 ryms5 ryms rfdlnan lmp6_976 tcint6m6 pshs
> 90 = $iv)
```

```
Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =     205
-------------+------------------------------           F( 10,   194) =   24.28
       Model |  26.3241901    10  2.63241901            Prob > F      =  0.0000
    Residual |  19.7318612   194  .101710625           R-squared     =  0.5716
-------------+------------------------------           Adj R-squared =  0.5495
       Total |  46.0560513   204  .225764957           Root MSE      =  .31892

------------------------------------------------------------------------------
     lnrylna |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnrklna |   .3621793   .0915536     3.96   0.000     .1816112    .5427475
        lna5 |   .3658263   .1158684     3.16   0.002     .1373028    .5943499
         lna |    -.00805    .002542    -3.17   0.002    -.0130636   -.0030364
     ms5lna5 |  -.1843579   .0871792    -2.11   0.036    -.3562986   -.0124172
       ryms5 |   .2178876   1.932978     0.11   0.910    -3.594461    4.030236
        ryms |    .205556   .6148734     0.33   0.739    -1.007139    1.418251
     rfdlnan |   .0682999   .0285892     2.39   0.018     .0119143    .1246854
    lmp6_976 |   .6803618   .1167026     5.83   0.000      .450193    .9105306
    tcint6m6 |   3.943825   3.161232     1.25   0.214    -2.290969    10.17862
      pshs90 |   .0014206   .0049121     0.29   0.773    -.0082674    .0111087
       _cons |   .0057561   1.354982     0.00   0.997    -2.666631    2.678143
------------------------------------------------------------------------------
Instrumented:  lnrklna lna5 lna ms5lna5 ryms5 ryms rfdlnan lmp6_976 tcint6m6
               pshs90
Instruments:   area90 book90 doctor90 tel90 lnroad90 drw drc agn90 lnrkl90
               nofdi90 lnisiv90 ms5area905 rfdln90 lmp6_906 tnt6m906 pshs90
               area905 ryms90 ryms905
------------------------------------------------------------------------------

. chi2test
      n_iv =         20
     n_reg =         11
  thres_df =          9
   thres_p =        .95
 chi2_stat =  10.844446
chi2_thres =  16.918978


. predict res1, residual

. reg res1 $iv

      Source |       SS       df       MS              Number of obs =     205
-------------+------------------------------           F( 19,   185) =    0.54
       Model |  1.04381638    19  .054937704            Prob > F      =  0.9392
    Residual |  18.6880631   185  .101016557           R-squared     =  0.0529
-------------+------------------------------           Adj R-squared = -0.0444
       Total |  19.7318795   204  .096724899           Root MSE      =  .31783

------------------------------------------------------------------------------
        res1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      area90 |  -.0008233    .000844    -0.98   0.331    -.0024883    .0008418
      book90 |   .0004774     .00052     0.92   0.360    -.0005485    .0015032
    doctor90 |  -.0006742   .3044456    -0.00   0.998    -.6013057    .5999573
       tel90 |   .0053467   .0099061     0.54   0.590    -.0141968    .0248901
    lnroad90 |   .0429288   .0415563     1.03   0.303    -.0390563    .1249139
         drw |  -.0092926   .1109458    -0.08   0.933    -.2281741     .209589
         drc |  -.0874995   .0830413    -1.05   0.293    -.2513291    .0763301
       agn90 |   .0089704   .0238716     0.38   0.708    -.0381252     .056066
```

lnrkl90	-.0178831	.0661988	-0.27	0.787	-.1484848	.1127186
nofdi90	-.0137306	.0638644	-0.21	0.830	-.1397267	.1122656
lnisiv90	-.0473761	.1755981	-0.27	0.788	-.3938083	.299056
ms5area905	5.84e-15	3.78e-15	1.54	0.124	-1.62e-15	1.33e-14
rfdln90	-.1828663	.2745091	-0.67	0.506	-.7244369	.3587044
lmp6_906	-.0358415	.1087276	-0.33	0.742	-.2503468	.1786638
tnt6m906	-.4749147	.7594065	-0.63	0.532	-1.973125	1.023296
pshs90	-.0029045	.006292	-0.46	0.645	-.0153177	.0095087
area905	-2.28e-14	4.44e-14	-0.51	0.609	-1.10e-13	6.49e-14
ryms90	-.0076408	.0290331	-0.26	0.793	-.0649194	.0496378
ryms905	2.85e-06	5.75e-06	0.50	0.620	-8.48e-06	.0000142
_cons	.4156079	.7787698	0.53	0.594	-1.120804	1.952019

****
****

```
.
. ************************************************************
. * 2. Table 4, 2nd col. - IV Estimation Regular Taylor Series *
. ************************************************************
.
. global iv "area90 book90 doctor90 tel90 lnroad90 drw drc agn90 lnrkl90 nofdi90
lnisiv90 ms90ar
> 90 rfdln90 lmp6_906 tnt6m906 pshs90 area902 ryms90 ryms902"

. ivreg lnrylna (lnrklna lna lna2 mslna rfdlnan lmp6_976 tcint6m6 pshs90 ryms ryms2
= $iv)

ivreg lnrylna (lnrklna lna lna2 mslna rfdlnan lmp6_976 tcint6m6 pshs90 ryms ryms2
>  = $iv)

Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =     205
-------------+------------------------------           F( 10,   194) =   23.48
       Model |  25.4714406    10  2.54714406           Prob > F      =  0.0000
    Residual |  20.5846107   194  .106106241           R-squared     =  0.5531
-------------+------------------------------           Adj R-squared =  0.5300
       Total |  46.0560513   204  .225764957           Root MSE      =  .32574

------------------------------------------------------------------------------
     lnrylna |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnrklna |   .3625108    .089726     4.04   0.000     .1855472    .5394744
         lna |    .010187   .0029983     3.40   0.001     .0042735    .0161004
        lna2 |   -.000014   3.94e-06    -3.55   0.000    -.0000218   -6.22e-06
       mslna |  -.0047407   .0019906    -2.38   0.018    -.0086668   -.0008147
     rfdlnan |   .0651998   .0291052     2.24   0.026     .0077966    .122603
    lmp6_976 |   .7456303   .1086081     6.87   0.000     .5314261    .9598345
    tcint6m6 |    3.94318   3.279665     1.20   0.231    -2.525196    10.41156
        ryms |  -.1282522   .2784365    -0.46   0.646    -.6774035     .420899
       ryms2 |   .0507652   .0521117     0.97   0.331    -.0520131    .1535434
      pshs90 |   .0020891   .0045214     0.46   0.645    -.0068284    .0110065
       _cons |   .5932097   1.012462     0.59   0.559    -1.403636    2.590055
------------------------------------------------------------------------------
Instrumented:  lnrklna lna lna2 mslna rfdlnan lmp6_976 tcint6m6 pshs90 ryms
               ryms2
Instruments:   area90 book90 doctor90 tel90 lnroad90 drw drc agn90 lnrkl90
               nofdi90 lnisiv90 ms90ar90 rfdln90 lmp6_906 tnt6m906 pshs90
               area902 ryms90 ryms902
```

```
. chi2test
      n_iv =         20
     n_reg =         11
  thres_df =          9
   thres_p =        .95
 chi2_stat =  10.298291
chi2_thres =  16.918978


. predict res2, residual

. reg res2 $iv

      Source |       SS       df       MS              Number of obs =     205
-------------+------------------------------           F( 19,   185) =    0.52
       Model |   1.0340908    19  .054425832           Prob > F      =  0.9537
    Residual |    19.55052   185  .105678486           R-squared     =  0.0502
-------------+------------------------------           Adj R-squared = -0.0473
       Total |  20.5846108   204  .100904955           Root MSE      =  .32508

------------------------------------------------------------------------------
        res2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      area90 |  -.0025433   .0021526    -1.18   0.239    -.0067902    .0017036
      book90 |    .000484   .0005292     0.91   0.362    -.0005601    .0015281
    doctor90 |   .0741951   .3111338     0.24   0.812    -.5396315    .6880217
       tel90 |  -.0006758   .0101381    -0.07   0.947    -.0206769    .0193253
    lnroad90 |   .0482503   .0426193     1.13   0.259     -.035832    .1323325
         drw |    .048313   .1145272     0.42   0.674    -.1776344    .2742603
         drc |   -.068779   .0858659    -0.80   0.424    -.2381814    .1006233
       agn90 |  -.0008606   .0245585    -0.04   0.972    -.0493112    .0475901
     lnrkl90 |   .0038425   .0680563     0.06   0.955    -.1304237    .1381086
     nofdi90 |  -.0454967   .0662233    -0.69   0.493    -.1761466    .0851531
    lnisiv90 |  -.0522515   .1803933    -0.29   0.772    -.4081439     .303641
    ms90ar90 |   .0005751   .0007141     0.81   0.422    -.0008337    .0019839
     rfdln90 |  -.1586565   .2837592    -0.56   0.577    -.7184765    .4011635
    lmp6_906 |  -.0036298    .116049    -0.03   0.975    -.2325795    .2253198
    tnt6m906 |  -.2715671   .7812446    -0.35   0.729    -1.812861    1.269727
      pshs90 |   -.003736   .0064266    -0.58   0.562    -.0164148    .0089429
     area902 |   4.03e-06   4.15e-06     0.97   0.332    -4.15e-06    .0000122
      ryms90 |  -.0387388   .0743094    -0.52   0.603    -.1853415    .1078639
     ryms902 |   .0017156   .0080697     0.21   0.832    -.0142049    .0176361
       _cons |   .1441888   .7986366     0.18   0.857    -1.431417    1.719795
------------------------------------------------------------------------------

.
. log close
      log:  C:\Henderson\china\Restud_final\table4.log
  log type:  text
 closed on:  28 Sep 2005, 14:27:02
-------------------------------------------------------------------------------
------------
```

This section shows the details of programming used to generate material for the generalized Leontief model appearing in Tables 5-7

```
.
. ******************************************************************
. * China Too Small Cities

. *          Optimal Non-Agricultural Labor Force Calculations
. *          - actual level
. *          - optimal level
. *          - 95% confidence interval of optimal level
. *          - % gain in GDP per capita in moving to optimal level
. *          - optimal non-agricultural labor force at various ryms levels
. *
. *          Prefecture level cities 1997 on 1990 instruments
. *
.
.
. ***************************
. * 1. Regular expansion (table 4, column 2)
. ***************************
. insheet using 134dat97.csv, comma
(148 vars, 205 obs)

.
. gen area902 = area90^2

. gen ryms902 = ryms90^2

. gen ryms2 = ryms^2

. gen lnryms = ln(ryms)

. gen lnryms2 = lnryms^2

. gen lmslnlna = lnryms*lnlna

. gen lnrklna2 = lnrklna^2

. gen lmslnrklna = lnryms*lnrklna

. gen lnrkllnlna = lnrklna*lnlna

. gen lna5 = lna^.5

. gen rysna = 1/(1+ryms)

. gen rysna2 = rysna^2

. gen snlna5 = rysna*lna^.5

. gen snlnlna = rysna*lnlna

.
. global iv "area90 book90 doctor90 tel90 lnroad90 drw drc agn90 lnrkl90 nofdi90 ln
> isiv90 ms90ar90 rfdln90 lmp6_906 tnt6m906 pshs90 area902 ryms90 ryms902"

. ivreg lnrylna (lnrklna lna lna2 mslna rfdlnan lmp6_976 tcint6m6 pshs90 ryms ryms2
>  = $iv)

Instrumental variables (2SLS) regression
```

```
      Source |       SS       df       MS              Number of obs =     205
-------------+------------------------------           F( 10,   194) =   23.48
       Model |  25.4714406    10  2.54714406           Prob > F      =  0.0000
    Residual |  20.5846107   194  .106106241           R-squared     =  0.5531
-------------+------------------------------           Adj R-squared =  0.5300
       Total |  46.0560513   204  .225764957           Root MSE      =  .32574

------------------------------------------------------------------------------
     lnrylna |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnrklna |   .3625108    .089726     4.04   0.000     .1855472    .5394744
         lna |    .010187   .0029983     3.40   0.001     .0042735    .0161004
        lna2 |   -.000014   3.94e-06    -3.55   0.000    -.0000218   -6.22e-06
       mslna |  -.0047407   .0019906    -2.38   0.018    -.0086668   -.0008147
     rfdlnan |   .0651998   .0291052     2.24   0.026     .0077966     .122603
    lmp6_976 |   .7456303   .1086081     6.87   0.000     .5314261    .9598345
    tcint6m6 |    3.94318   3.279665     1.20   0.231    -2.525196    10.41156
        ryms |  -.1282522   .2784365    -0.46   0.646    -.6774035     .420899
       ryms2 |   .0507652   .0521117     0.97   0.331    -.0520131    .1535434
      pshs90 |   .0020891   .0045214     0.46   0.645    -.0068284    .0110065
       _cons |   .5932097   1.012462     0.59   0.559    -1.403636    2.590055
------------------------------------------------------------------------------
Instrumented:  lnrklna lna lna2 mslna rfdlnan lmp6_976 tcint6m6 pshs90 ryms
               ryms2
Instruments:   area90 book90 doctor90 tel90 lnroad90 drw drc agn90 lnrkl90
               nofdi90 lnisiv90 ms90ar90 rfdln90 lmp6_906 tnt6m906 pshs90
               area902 ryms90 ryms902
------------------------------------------------------------------------------

. matrix coeff = e(b)

. matrix cov = e(V)

.
. * alpha is coeff. of lnrklna (needed for calc. pgain_gdp)
. scalar alpha = coeff[1,1]

. * B0 is coeff. of lna
. scalar B0 =  coeff[1,2]

. * B1 is coeff. of lna2
. scalar B1 = coeff[1,3]

. * B2 is coeff. of mslna
. scalar B2 = coeff[1,4]

. matrix list coeff

coeff[1,11]
       lnrklna         lna        lna2       mslna     rfdlnan    lmp6_976
y1   .36251079   .01018696  -.00001399  -.00474073    .0651998   .74563026

      tcint6m6        ryms       ryms2      pshs90       _cons
y1   3.9431805  -.12825225   .05076516   .00208908   .59320968

. scalar list alpha B0 B1 B2
     alpha =  .36251079
        B0 =  .01018696
        B1 = -.00001399
        B2 = -.00474073

.
```

```
. * covariance matrix of (B0, B1, B2)
. matrix Sigma = cov[2..4,2..4]

. matrix list cov

symmetric cov[11,11]
             lnrklna         lna         lna2       mslna     rfdlnan
 lnrklna   .00805075
     lna  -.00002952   8.990e-06
    lna2   2.724e-08  -9.708e-09   1.552e-11
   mslna   4.946e-06  -5.277e-06   3.889e-09   3.963e-06
 rfdlnan   .00003567  -9.934e-06   6.678e-09   7.870e-06   .00084711
lmp6_976  -.00023709   .00004559  -8.211e-08  -.00002672  -.00095421
tcint6m6  -.10075682   .00197565  -1.024e-06  -.00148429  -.06712043
    ryms  -.01139877   .00034475  -1.117e-07  -.00028534  -.00057786
   ryms2   .00115809  -.00003338  -1.099e-08   .00003577   .00005518
  pshs90  -.00024616  -1.027e-06   2.823e-09  -1.549e-07  -.00002945
   _cons  -.05781517  -.00050209   5.981e-07   .00047554   .00859871

             lmp6_976    tcint6m6        ryms       ryms2      pshs90
lmp6_976   .01179572
tcint6m6   .04208614   10.756201
    ryms  -.00727078   .39718523   .07752688
   ryms2   .00190243  -.05830525  -.01351719   .00271563
  pshs90  -7.174e-06   .00683524   .00062274  -.00009607   .00002044
   _cons  -.07736745  -.03915437   .07080157  -.01016938   .00135873

               _cons
   _cons   1.0250786

. matrix list Sigma

symmetric Sigma[3,3]
              lna         lna2       mslna
  lna   8.990e-06
 lna2  -9.708e-09   1.552e-11
mslna  -5.277e-06   3.889e-09   3.963e-06

.
. scalar numobs = _N

. display numobs
205

.
. * optimal level of lna
. gen lna_s = - (B0 + B2*ryms)/(2*B1)

.
. * derivative of lna_s wrt [B0 B1 B2] is C=[C0 C1 C2]
. gen C0 = - 1/(2*B1)

. gen C1 = (B0 + B2*ryms)/(2*B1^2)

. gen C2 = - ryms/(2*B1)

. mkmat C0 C1 C2, matrix(bigC)

. list C0 C1 C2 if _n<=10

            C0          C1          C2
  1.  35739.52   1.82e+07   23072.27
  2.  35739.52   1.20e+07   41262.02
```

```
                                        reg143[1]
  3.  35739.52   1.37e+07   36309.81
  4.  35739.52   -1070358   79956.34
  5.  35739.52   1.74e+07   25572.51
  6.  35739.52  -1.04e+07   107363.9
  7.  35739.52  -1.88e+07   132215.5
  8.  35739.52   1.34e+07    37122.1
  9.  35739.52   1.08e+07   44935.55
 10.  35739.52  -1.72e+07   127433.4

. *matrix list bigC
.
. * var(lna_s) = C * Sigma * C'
. * where C is a 1x3 row vector
. gen var = .
(205 missing values generated)

.
. scalar index=1

. while index<=numobs {
  2.   matrix C = bigC[index,1..3]
  3.   matrix var_mat = C * Sigma * C'
  4.   quietly replace var = var_mat[1,1] if _n==index
  5.   scalar index=index+1
  6. }

.
. * 95% confidence interval is lna_s +/- 1.96* s.d.
. gen sd    = sqrt(var)

. gen upper = lna_s + 1.96*sd

. gen lower = lna_s - 1.96*sd

.
. * % gain in GDP per capita in moving to optimal level
. * (difference of log per capita GDP)
. count if lna>lna_s
   44

. count if lna<lna_s
  161

. gen A_s = B0*lna_s + B1*lna_s^2 + B2*ryms*lna_s

. gen A   = B0*lna   + B1*lna2    + B2*mslna

. gen pgain_gdp = (A_s-A)/(1-alpha)

.
. list id ryms lna lna_s lower upper pgain_gdp, nodisplay noobs

      id       ryms        lna      lna_s      lower      upper  pgain_gdp
       1   .6455675      452.9   254.6976   204.0004   305.3947   .8621175
       2   1.154521     343.49   168.4649   127.9845   208.9453   .6722792
       3   1.015957     101.99   191.9419   158.6358    225.248   .1775704
       4   2.237197      88.01  -14.97443  -176.0537   146.1048    .232751
       5   .7155248      35.97   242.8446   198.4191   287.2701   .9392102
       6   3.004068      72.65  -144.9064  -399.4701   109.6572   1.038705
       7   3.699422      34.55  -262.7212  -602.6431   77.20067   1.939341
       8   1.038685      38.36   188.0911   154.0917   222.0905   .4920086
       9   1.257307      66.67   151.0497   101.9599   200.1395   .1562515
      10   3.565617      21.74  -240.0505  -563.5255   83.42447   1.504029
```

11	1.449046	17.76	118.5631	49.93472	187.1914	.2229955
12	.7674419	20.07	234.0482	193.7068	274.3896	1.004818
14	.8956301	133.3	212.3291	178.7903	245.8679	.1370637
15	2.091549	68.01	9.702915	-133.8046	153.2104	.0746086
16	2.109641	32.83	6.637536	-139.0471	152.3222	.0150557
17	2.069291	27.24	13.47409	-127.3574	154.3056	.0041587
18	1.496338	12.15	110.5503	36.72886	184.3718	.2124915
19	1.819009	13.45	55.87974	-55.10745	166.8669	.0395084
20	.9108612	60.01	209.7485	176.6054	242.8915	.4920569
21	2.26633	73.17	-19.91049	-184.5154	144.6944	.1901368
22	2.285325	16.6	-23.12884	-190.0341	143.7764	.0346386
23	1.102664	36.64	177.2511	140.2112	214.2909	.4338979
24	.8792011	292.4	215.1127	181.0356	249.1898	.1310886
25	.8293212	120.32	223.5639	187.2015	259.9263	.2339254
26	1.552673	82	101.0054	20.88124	181.1296	.007927
27	2.402792	83.93	-43.03143	-224.1887	138.1258	.3537463
28	1.652531	51.74	84.08633	-7.443552	175.6162	.0229614
29	.8207565	33.51	225.015	188.1708	261.8593	.8048388
30	.9820372	49.49	197.689	164.994	230.3841	.4819912
31	1.719338	32.2	72.76712	-26.5174	172.0516	.0361158
32	1.086814	43.21	179.9365	143.7868	216.0863	.4102553
33	1.515811	43.06	107.251	31.26385	183.2381	.0904267
34	5.18398	32.52	-514.252	-1036.991	8.48689	6.560863
35	1.107845	15.45	176.3732	139.0247	213.7217	.5683109
36	1.457461	18.49	117.1373	47.59244	186.6822	.2135595
37	1.578604	34.96	96.61189	13.5514	179.6724	.0834144
38	1.13667	133.25	171.4894	132.2773	210.7015	.0320902
39	.995168	74.95	195.4643	162.5946	228.3339	.3187318
40	.6491528	19.95	254.0901	203.7314	304.4487	1.203095
41	.8645754	23.14	217.5907	182.9413	252.2402	.829789
42	1.051702	19.2	185.8856	151.3924	220.3789	.6097401
43	1.466629	14.91	115.584	45.03666	186.1313	.2224246
44	.6894092	13.72	247.2694	200.5911	293.9477	1.197033
47	.595723	187.01	263.1428	207.5878	318.6978	.1272017
48	1.011987	68.1	192.6146	159.4067	225.8224	.3402429
49	1.19671	33.46	161.3167	117.5425	205.0909	.3587531
50	1.572133	31.01	97.70828	15.3824	180.0342	.0976287
51	1.499602	21.86	109.9973	35.81387	184.1807	.1704779
53	1.227184	39.72	156.1535	109.7809	202.5261	.2975116
54	.6115161	29.02	260.4669	206.4798	314.454	1.175578
55	1.909147	17.67	40.60752	-81.06645	162.2815	.0115463
56	1.090969	35.87	179.2326	142.8575	215.6076	.4510452
57	.5109321	6.39	277.509	213.1774	341.8406	1.613127
58	1.045652	563.06	186.9107	152.6554	221.1659	3.105053
59	1.051889	149.62	185.8539	151.3531	220.3548	.0288123
60	1.26604	57.9	149.57	99.66832	199.4718	.184418
61	1.281852	71.89	146.891	95.49416	198.2878	.1234476
62	1.663026	48.82	82.30815	-10.43426	175.0506	.0246111
63	1.482257	54.58	112.9361	40.67119	185.201	.0747345
64	1.651962	37.9	84.18273	-7.281485	175.6469	.0470096
65	1.512632	29.63	107.7896	32.157	183.4222	.1340644
66	1.508524	21.85	108.4856	33.31063	183.6607	.1647183
67	1.221491	22.81	157.118	111.2431	202.9929	.3958699
68	1.322968	27.9	139.9247	84.5066	195.3427	.2754074
69	1.330891	28.69	138.5822	82.36964	194.7948	.2650224
72	.987365	104.21	196.7863	164.03	229.5427	.1880824
73	.9900807	114.7	196.3262	163.5336	229.1188	.1462206
74	1.674712	70.43	80.32819	-13.76698	174.4234	.0021504
75	2.084025	29.14	10.97772	-131.6249	153.5803	.0072392
76	2.029391	33.63	20.23441	-115.8073	156.2761	.003938
77	1.160225	19.41	167.4984	126.596	208.4008	.4812721
78	1.108194	15.82	176.3141	138.9445	213.6837	.565284
81	.9550442	33.95	202.2625	169.6748	234.8502	.6217003

reg143[1]

84	1.333813	84	138.0872	81.58009	194.5943	.0642004
85	1.39656	37.65	127.4559	64.45794	190.4538	.1769937
86	1.489632	30.82	111.6865	38.6074	184.7657	.1435113
87	2.031658	58.78	19.85033	-116.4632	156.1639	.0332594
88	2.772536	33.27	-105.6777	-331.9084	120.5531	.4236928
89	2.424039	38.51	-46.63132	-230.3707	137.108	.159085
90	1.418173	20.75	123.7939	58.49663	189.0912	.2330201
91	1.493821	23.56	110.9768	37.43416	184.5194	.1677019
92	.583499	13.29	265.2139	208.4291	321.9987	1.392795
93	1.270642	45.49	148.7903	98.45668	199.1239	.234181
94	1.561062	17.14	99.58405	18.51215	180.656	.1491651
95	.750762	87.09	236.8743	195.2848	278.4638	.4923582
96	1.211579	70.1	158.7974	113.776	203.8189	.1726517
97	1.332469	14.23	138.3149	81.94334	194.6864	.3378984
98	1.727648	13.5	71.35915	-28.89552	171.6138	.0734671
99	1.07289	27.17	182.2957	146.857	217.7344	.5280998
100	1.124943	16.64	173.4763	135.0512	211.9013	.5398108
101	1.88487	15.08	44.7208	-74.06681	163.5084	.0192809
102	1.427444	16.9	122.2231	55.931	188.5153	.2434423
103	1.21933	86.57	157.4842	111.7968	203.1716	.1103608
104	1.464803	19.21	115.8933	45.54603	186.2407	.2051407
105	1.805204	42.88	58.21873	-51.13961	167.5771	.0051633
106	1.260088	26.44	150.5785	101.2313	199.9257	.3381906
107	1.078544	21.61	181.3377	145.6186	217.0569	.5598984
108	.3995931	4	296.3733	219.8662	372.8805	1.875962
109	1.031032	146.64	189.3878	155.6463	223.1292	.0401027
110	1.184054	119.07	163.461	120.715	206.2071	.0432454
111	2.062149	98.81	14.68418	-125.2892	154.6576	.1553124
112	1.877411	44.57	45.9846	-71.91733	163.8865	.0000439
114	1.478097	72.11	113.6409	41.83431	185.4476	.0378525
115	1.732688	54.13	70.50523	-30.33834	171.3488	.0058847
117	1.287003	41.55	146.0182	94.12779	197.9087	.2395064
118	1.521262	13.91	106.3274	29.73146	182.9234	.1874374
119	1.472759	28.76	114.5453	43.32564	185.7651	.1615008
120	1.773565	55.18	63.57936	-42.05497	169.2137	.0015483
122	1.07573	45.57	181.8145	146.2364	217.3926	.4073678
123	.7469301	99.1	237.5235	195.6382	279.4089	.4205022
124	1.133424	48.33	172.0393	133.0489	211.0298	.3358563
125	1.326535	73.17	139.3203	83.54525	195.0953	.0960311
126	2.324223	45.49	-29.71939	-201.3393	141.9005	.1241344
127	1.979567	36.21	28.67616	-101.399	158.7513	.0012456
128	2.067302	19.3	13.81111	-126.7814	154.4036	.0006612
129	1.180652	34.33	164.0374	121.5622	206.5127	.3692141
130	2.994181	36.12	-143.2313	-396.5838	110.1213	.7059231
131	3.17195	26.48	-173.351	-448.4929	101.791	.8763428
132	2.070503	18.81	13.26875	-127.7084	154.2459	.0006738
133	1.643647	12.6	85.59157	-4.913711	176.0968	.1169213
134	.7137318	12.12	243.1484	198.572	287.7248	1.17133
135	.7030995	31.18	244.9498	199.4671	290.4326	1.002862
136	1.922816	33.51	38.29156	-85.00992	161.593	.0005018
137	.9804827	285.3	197.9524	165.2728	230.632	.1674367
138	1.226828	42.5	156.2138	109.8725	202.5551	.2837754
139	2.081439	25.28	11.41585	-130.8758	153.7075	.0042183
140	1.077105	59	181.5815	145.9349	217.2282	.3297606
141	2.176101	30.13	-4.622857	-158.3194	149.0737	.0265051
142	1.58526	35.16	95.48415	11.6668	179.3015	.0798603
143	1.662058	32.46	82.47216	-10.15832	175.1026	.0548908
144	2.080137	37.43	11.63645	-130.4987	153.7716	.0146006
145	.9578429	22.42	201.7883	169.2053	234.3713	.7060572
146	1.127337	16.54	173.0707	134.4881	211.6533	.5377091
147	.8161069	89.12	225.8028	188.6869	262.9187	.4099929
148	1.597581	36.87	93.39658	8.175044	178.6181	.0701219
149	1.343305	40.57	136.4789	79.00996	193.9479	.2018675

reg143[1]

150	.9106349	41.33	209.7868	176.6387	242.935	.6227672
151	.8083855	25.91	227.1111	189.5291	264.6931	.8884011
152	1.193459	39.78	161.8675	118.3605	205.3746	.327108
153	1.165287	36.94	166.6408	125.3574	207.9242	.369176
154	1.291313	33.72	145.288	92.98215	197.5938	.2731666
155	1.204608	17.41	159.9785	115.5469	204.4101	.4460628
156	1.509146	27.38	108.3803	33.13599	183.6245	.1439863
158	.3797943	19.7	299.7279	221.0012	378.4545	1.720882
159	.3658155	9.27	302.0963	221.7947	382.3979	1.88178
160	.7730818	225.88	233.0926	193.158	273.0272	.0011416
161	2.106765	20.97	7.124828	-138.2137	152.4633	.0042067
162	1.000203	267.5	194.6112	161.6536	227.5687	.1165924
163	1.221163	22.24	157.1736	111.3272	203.02	.3995662
164	.8800309	54.73	214.9721	180.9249	249.0193	.5635101
165	2.135118	32.7	2.320944	-146.4325	151.0744	.0202534
166	.9038462	23.97	210.937	177.6243	244.2497	.7671469
167	1.177712	42.16	164.5356	122.2924	206.7788	.3286534
168	1.603547	22.59	92.38577	6.48285	178.2887	.1069071
169	3.150784	30.73	-169.7648	-442.3109	102.7814	.8821746
170	1.324797	19.04	139.6147	84.0138	195.2157	.3190518
171	1.34851	15.36	135.597	77.59734	193.5967	.317267
173	1.324682	81.64	139.6342	84.04481	195.2237	.0738102
174	1.432169	66.74	121.4226	54.62156	188.2236	.0656215
176	.9655964	10.22	200.4746	167.8855	233.0637	.7943628
177	1.091683	16.54	179.1116	142.6973	215.5259	.580013
178	2.424908	14.71	-46.77856	-230.6236	137.0664	.082973
181	.535271	50.14	273.3853	211.627	335.1435	1.093737
182	1.395274	46.19	127.6737	64.81169	190.5358	.1457103
183	1.179323	25.67	164.2626	121.8925	206.6328	.4215302
184	.7302152	15.79	240.3556	197.143	283.5681	1.106713
185	.6214	17.88	258.7923	205.7735	311.8111	1.273698
186	1.360544	21.87	133.5581	74.32285	192.7934	.2737552
187	.7514948	30.23	236.7501	195.2168	278.2835	.9359946
188	.631972	39.61	257.0011	205.0062	308.9959	1.037127
190	.3522633	36.63	304.3925	222.5581	386.2268	1.573432
191	.8155594	11.51	225.8956	188.7473	263.0439	1.008648
196	.856108	132.83	219.0254	184.0063	254.0445	.1630482
197	1.322664	38.24	139.9762	84.58846	195.3638	.2271428
198	2.954527	33.39	-136.5126	-385.0088	111.9835	.6335031
199	1.452201	38.95	118.0285	49.05694	187.0001	.1372352
200	1.330754	25.19	138.6055	82.40663	194.8043	.2822883
201	1.813084	28.61	56.88361	-53.4042	167.1714	.0175433
202	1.078593	17.64	181.3294	145.6078	217.0511	.5880169
203	.826183	37.76	224.0956	187.5594	260.6318	.7619742
204	.8756146	34.86	215.7204	181.5108	249.9299	.7178526
205	1.48043	30.95	113.2456	41.1821	185.3092	.1486285
206	1.917048	25.5	39.26885	-83.34564	161.8833	.0041605
207	.6373903	37.06	256.083	204.608	307.5581	1.052757
208	1.2406	123.58	153.8804	106.3144	201.4464	.020149
209	1.814006	64.53	56.7274	-53.66922	167.124	.001336
210	.8880995	27.51	213.605	179.8335	247.3765	.7600077
211	1.125493	92.02	173.3831	134.922	211.8442	.1452795
212	1.451929	5.52	118.0746	49.13265	187.0166	.2780194
214	1.497073	21.04	110.4258	36.52284	184.3287	.1753418
215	.8105643	177.57	226.7419	189.2933	264.1906	.0530618
216	1.603594	20.49	92.3778	6.469516	178.2861	.113412
217	1.744491	33.21	68.50542	-33.7189	170.7298	.0273391
218	2.358367	40.12	-35.50444	-211.2668	140.2579	.1255084
219	2.541365	8.71	-66.51003	-264.528	131.5079	.1241697
220	1.450664	16.95	118.2889	49.48463	187.0932	.2253726
221	1.060197	14.79	184.4463	149.5945	219.2981	.6316674
222	1.724467	118.31	71.89811	-27.98507	171.7813	.0472725
223	4.03905	6.72	-320.2649	-701.9642	61.43431	2.34641

```
                                    reg143[1]
     225   4.138813      21.31  -337.1679  -731.1458   56.81007   2.820157
     226   1.521476       26.6   106.2912   29.67128    182.911   .1393698
     227   .6521813      36.99    253.577   203.5029    303.651   1.029469
     228   1.063422      31.63   183.8999   148.9047   218.8951   .5088345
     229   2.372536      15.95  -37.90511  -215.3875   139.5773   .0636506
     230   .6377602   69.89999   256.0204   204.5807     307.46   .7602147

. summ ryms lna lna_s lower upper pgain_gdp

    Variable |     Obs        Mean   Std. Dev.       Min        Max
-------------+--------------------------------------------------------
        ryms |     205    1.438255   .7004647   .3522633    5.18398
         lna |     205    52.87624   67.32792          4     563.06
       lna_s |     205    120.3915   118.6807   -514.252   304.3925
       lower |     205    36.73329   186.8493  -1036.991   222.5581
       upper |     205    204.0497   57.51661    8.48689   386.2268
   pgain_gdp |     205    .4435875   .6608576   .0000439   6.560863

.
. * note that some lna_s are less than zero
. count
  205

. count if lna_s>0
  183

. summ lna_s if lna_s>0

    Variable |     Obs        Mean   Std. Dev.       Min        Max
-------------+--------------------------------------------------------
       lna_s |     183    150.8026   71.48501   2.320944   304.3925

. summ pgain_gdp if lna_s>0 , detail

                          pgain_gdp
-------------------------------------------------------------
      Percentiles      Smallest
 1%     .0005018       .0000439
 5%      .003938       .0005018
10%     .0115463       .0006612       Obs                 183
25%     .0746086       .0006738       Sum of Wgt.         183

50%     .2229955                      Mean           .3808033
                        Largest       Std. Dev.       .446985
75%     .5377091       1.720882
90%     1.004818       1.875962       Variance       .1997956
95%     1.197033        1.88178       Skewness       2.320829
99%      1.88178       3.105053       Kurtosis       10.94829

.
. * Distribution of actual nonagricultural labor force around
. * 95% confidence interval of optimal level
. count
  205

. count if lna<lower
  127

. count if lna>=lower & lna<=upper
   71

. count if lna>upper
    7
```

```
.
. * Optimal non-agricultural labor force at various ryms levels
. drop _all

.
. set obs 40
obs was 0, now 40

. gen ryms = _n*.1

. gen lna_s = - (B0 + B2*ryms)/(2*B1)

. gen C0 = - 1/(2*B1)

. gen C1 = (B0 + B2*ryms)/(2*B1^2)

. gen C2 = - ryms/(2*B1)

. mkmat C0 C1 C2, matrix(bigC)

. gen var = .
(40 missing values generated)

. scalar index=1

. while index<=_N {
  2.   matrix C = bigC[index,1..3]
  3.   matrix var_mat = C * Sigma * C'
  4.   quietly replace var = var_mat[1,1] if _n==index
  5.   scalar index=index+1
  6. }

. gen sd = sqrt(var)

. gen upper = lna_s + 1.96*sd

. gen lower = lna_s - 1.96*sd

. list ryms lna_s lower upper

          ryms      lna_s      lower      upper
  1.        .1   347.1338   236.0225   458.2452
  2.        .2   330.1907   230.8218   429.5595
  3.        .3   313.2475   225.4539   401.0411
  4.        .4   296.3044   219.8427   372.7661
  5.        .5   279.3613   213.8618   344.8607
  6.        .6   262.4181   207.2902   317.5461
  7.        .7    245.475   199.7243   291.2257
  8.        .8   228.5318    190.423   266.6406
  9.        .9   211.5887   178.1738   245.0036
 10.         1   194.6456   161.6918   227.5993
 11.       1.1   177.7024   140.8179   214.5869
 12.       1.2   160.7593   116.7127   204.8059
 13.       1.3   143.8162   90.66675   196.9656
 14.       1.4    126.873   63.51105    190.235
 15.       1.5   109.9299   35.70226   184.1575
 16.       1.6   92.98672   7.489015   178.4844
 17.       1.7   76.04359  -20.98784    173.075
 18.       1.8   59.10046  -49.64446   167.8454
 19.       1.9   42.15732   -78.4285   162.7431
 20.         2   25.21418  -107.3058   157.7341
 21.       2.1   8.271052  -136.2532   152.7953
```

```
                                          reg143[1]
 22.       2.2  -8.672111  -165.2547   147.9105
 23.       2.3  -25.61523  -194.2986   143.0681
 24.       2.4   -42.5584  -223.3764   138.2596
 25.       2.5  -59.50152  -252.4817   133.4787
 26.       2.6  -76.44464  -281.6097   128.7204
 27.       2.7   -93.3878  -310.7565   123.9809
 28.       2.8  -110.3309   -339.919   119.2572
 29.       2.9  -127.2741  -369.0951   114.5469
 30.         3  -144.2172  -398.2826   109.8482
 31.       3.1  -161.1603  -427.4799   105.1592
 32.       3.2  -178.1035   -456.686    100.479
 33.       3.3  -195.0466  -485.8994   95.80619
 34.       3.4  -211.9898  -515.1196   91.13995
 35.       3.5  -228.9329  -544.3454   86.47959
 36.       3.6   -245.876  -573.5765   81.82441
 37.       3.7  -262.8192  -602.8122   77.17383
 38.       3.8  -279.7623   -632.052   72.52737
 39.       3.9  -296.7055  -661.2955   67.88458
 40.         4  -313.6486  -690.5424   63.24518

.
.
.

.
.
.
. ********************************
. * 2. leontief  expansion (Table 4, column 1)
. ********************************
. clear

. insheet using 134dat97.csv, comma
(148 vars, 205 obs)

.
. gen area902 = area90^2

. gen ryms902 = ryms90^2

. gen ryms5 = ryms^.5

. gen ryms2 = ryms^2

. gen lnryms = ln(ryms)

. gen lnryms2 = lnryms^2

. gen lmslnlna = lnryms*lnlna

. gen lnrklna2 = lnrklna^2

. gen lmslnrklna = lnryms*lnrklna

. gen lnrkllnlna = lnrklna*lnlna

. gen lna5 = lna^.5

. gen ms5lna5 = ryms5*lna5

. gen lnarea90 = ln(area90)

. gen lnarea902 = lnarea90^2
```

```
. gen lnryms90 = ln(ryms90)

. gen lnryms902 = lnryms90^2

. gen lmslarea90 = lnryms90*lnarea90

. gen ryms905 = ryms90^5

. gen area905 = area90^5

. gen ms5area905 = ryms905*area905

.
. global iv "area90 book90 doctor90 tel90 lnroad90 drw drc agn90 lnrkl90 nofdi90 ln
> isiv90 ms5area905 rfdln90 lmp6_906 tnt6m906 pshs90 area905 ryms90 ryms905"

. ivreg lnrylna (lnrklna lna5 lna ms5lna5 ryms5 ryms rfdlnan lmp6_976 tcint6m6 pshs
> 90 = $iv)

Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =     205
-------------+------------------------------           F( 10,   194) =   24.28
       Model |  26.3241901    10  2.63241901           Prob > F      =  0.0000
    Residual |  19.7318612   194  .101710625           R-squared     =  0.5716
-------------+------------------------------           Adj R-squared =  0.5495
       Total |  46.0560513   204  .225764957           Root MSE      =  .31892

------------------------------------------------------------------------------
     lnrylna |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnrklna |   .3621793   .0915536     3.96   0.000     .1816112    .5427475
        lna5 |   .3658263   .1158684     3.16   0.002     .1373028    .5943499
         lna |    -.00805    .002542    -3.17   0.002    -.0130636   -.0030364
     ms5lna5 |  -.1843579   .0871792    -2.11   0.036    -.3562986   -.0124172
       ryms5 |   .2178876   1.932978     0.11   0.910    -3.594461    4.030236
        ryms |    .205556   .6148734     0.33   0.739    -1.007139    1.418251
     rfdlnan |   .0682999   .0285892     2.39   0.018     .0119143    .1246854
    lmp6_976 |   .6803618   .1167026     5.83   0.000      .450193    .9105306
    tcint6m6 |   3.943825   3.161232     1.25   0.214    -2.290969    10.17862
       pshs90 |   .0014206   .0049121     0.29   0.773    -.0082674    .0111087
        _cons |   .0057561   1.354982     0.00   0.997    -2.666631    2.678143
------------------------------------------------------------------------------
Instrumented:  lnrklna lna5 lna ms5lna5 ryms5 ryms rfdlnan lmp6_976 tcint6m6
               pshs90
Instruments:   area90 book90 doctor90 tel90 lnroad90 drw drc agn90 lnrkl90
               nofdi90 lnisiv90 ms5area905 rfdln90 lmp6_906 tnt6m906 pshs90
               area905 ryms90 ryms905
------------------------------------------------------------------------------

. matrix coeff = e(b)

. matrix cov = e(V)

.
. * alpha is coeff. of lnrklna (needed for calc. pgain_gdp)
. scalar alpha = coeff[1,1]

. * B0 is coeff. of lna^.5
. scalar B0 =  coeff[1,2]

. * B1 is coeff. of lna
```

```
. scalar B1 = coeff[1,3]

. * B2 is coeff. of (ryms^.5)*(lna^.5)
. scalar B2 = coeff[1,4]

. matrix list coeff

coeff[1,11]
      lnrklna        lna5         lna     ms5lna5       ryms5        ryms
y1   .36217934   .36582633  -.00804999  -.18435788    .2178876   .20555599

       rfdlnan    lmp6_976    tcint6m6      pshs90       _cons
y1   .06829985    .6803618   3.9438255   .00142061   .00575609

. scalar list alpha B0 B1 B2
     alpha =  .36217934
        B0 =  .36582633
        B1 = -.00804999
        B2 = -.18435788

.
. * covariance matrix of (B0, B1, B2)
. matrix Sigma = cov[2..4,2..4]

. matrix list cov

symmetric cov[11,11]
             lnrklna        lna5         lna     ms5lna5       ryms5
 lnrklna   .00838206
    lna5   .00030233   .01342549
     lna  -.00002364  -.00020867   6.462e-06
 ms5lna5  -.00009901  -.00902404   .00007221   .00760021
   ryms5  -.04363327   .08797539   .00091998  -.10895528   3.7364021
    ryms   .01007036  -.01546267  -.00046523   .02597117  -1.1562369
 rfdlnan  -.00010314  -.00019331   4.948e-06   .00009516   .00488972
lmp6_976    .0009745   .00024117  -.00005546    .0007392  -.10403191
tcint6m6   -.0994282    .0505224   .00029245  -.05517969   1.9166164
  pshs90  -.00028138  -.00007819   4.219e-06  -.00001666   .00438054
   _cons  -.04699864  -.09380384   .00061312   .08543799  -1.4613259

                ryms     rfdlnan    lmp6_976    tcint6m6      pshs90
    ryms   .37806935
 rfdlnan  -.00201417   .00081734
lmp6_976   .03665919  -.00112773   .01361951
tcint6m6  -.51147417  -.05935677   .01361926   9.9933847
  pshs90  -.00137535  -.00001746  -.00009593   .00710297   .00002413
   _cons   .41526191   .00768235   -.0409902  -.85987538   .00013744

               _cons
   _cons   1.8359758

. matrix list Sigma

symmetric Sigma[3,3]
             lna5         lna     ms5lna5
   lna5   .01342549
    lna  -.00020867   6.462e-06
ms5lna5  -.00902404   .00007221   .00760021

.
. scalar numobs = _N

. display numobs
```

```
205

. 
. * optimal level of lna
. gen lna_s = ( (B0+B2*(ryms^.5))/(-2*B1) )^2

. 
. * derivative of lna_s wrt [B0 B1 B2] is C=[C0 C1 C2]
. gen C0 = - sqrt(lna_s)/B1

. gen C1 = -2*lna_s/B1

. gen C2 = - sqrt(ryms*lna_s)/B1

. mkmat C0 C1 C2, matrix(bigC)

. list C0 C1 C2 if _n<=10

           C0         C1         C2
  1.  1679.724   45425.63   1349.611
  2.  1294.216   26967.37   1390.617
  3.  1388.866   31056.02   1399.903
  4.  695.0173   7777.076   1039.556
  5.   1619.39   42220.98   1369.821
  6.  357.1841   2054.043   619.0804
  7.  86.68349   120.9756    166.726
  8.  1372.917   30346.87   1399.221
  9.  1227.629   24263.85   1376.537
 10.  136.6176   300.4959   257.9729

. *matrix list bigC
. 
. * var(lna_s) = C * Sigma * C'
. * where C is a 1x3 row vector
. gen var = .
(205 missing values generated)

. 
. scalar index=1

. while index<=numobs {
  2.   matrix C = bigC[index,1..3]
  3.   matrix var_mat = C * Sigma * C'
  4.   quietly replace var = var_mat[1,1] if _n==index
  5.   scalar index=index+1
  6. }

. 
. * 95% confidence interval is lna_s +/- 1.96* s.d.
. gen sd    = sqrt(var)

. gen upper = lna_s + 1.96*sd

. gen lower = lna_s - 1.96*sd

. 
. * % gain in GDP per capita in moving to optimal level
. * (difference of log per capita GDP)
. count if lna>lna_s
   37

. count if lna<lna_s
  168
```

```
. gen A_s = B0*sqrt(lna_s) + B1*lna_s + B2*sqrt(ryms*lna_s)

. gen A   = B0*sqrt(lna)   + B1*lna   + B2*sqrt(mslna)

. gen pgain_gdp = (A_s-A)/(1-alpha)

.
. list id ryms lna lna_s lower upper pgain_gdp, nodisplay noobs
```

id	ryms	lna	lna_s	lower	upper	pgain_gdp
1	.6455675	452.9	182.8379	116.2984	249.3773	.7599509
2	1.154521	343.49	108.5435	77.40471	139.6823	.8311518
3	1.015957	101.99	125.0003	96.51926	153.4813	.0147584
4	2.237197	88.01	31.30268	-29.46632	92.07168	.1809544
5	.7155248	35.97	169.9391	115.5485	224.3298	.6252672
6	3.004068	72.65	8.267509	-37.25864	53.79366	.4026351
7	3.699422	34.55	.4869261	-13.36404	14.3379	.3386698
8	1.038685	38.36	122.1459	93.71292	150.5789	.2979111
9	1.257307	66.67	97.66183	61.93661	133.3871	.0372181
10	3.565617	21.74	1.209494	-19.80354	22.22253	.1602106
11	1.449046	17.76	79.88953	35.01284	124.7662	.2816344
12	.7674419	20.07	161.0569	114.3146	207.7993	.8508922
14	.8956301	133.3	141.2621	108.0254	174.4988	.0014575
15	2.091549	68.01	37.96753	-22.64917	98.58424	.0548681
16	2.109641	32.83	37.09187	-23.60573	97.78947	.0016408
17	2.069291	27.24	39.06414	-21.42818	99.55647	.013414
18	1.496338	12.15	75.95066	29.03365	122.8677	.3451286
19	1.819009	13.45	52.97477	-4.130063	110.0796	.1645661
20	.9108612	60.01	139.0894	106.896	171.2828	.2067113
21	2.26633	73.17	30.07122	-30.59543	90.73788	.11897
22	2.285325	16.6	29.28577	-31.29114	89.86269	.0225721
23	1.102664	36.64	114.4454	85.01479	143.876	.2722914
24	.8792011	292.4	143.6456	109.1422	178.1491	.3301412
25	.8293212	120.32	151.1484	111.9347	190.3622	.0221644
26	1.552673	82	71.46552	22.28887	120.6422	.004569
27	2.402792	83.93	24.72399	-34.90694	84.35492	.221472
28	1.652531	51.74	64.0328	11.34325	116.7223	.0082603
29	.8207565	33.51	152.4788	112.3307	192.6269	.5430392
30	.9820372	49.49	129.3829	100.3576	158.4082	.2376981
31	1.719338	32.2	59.40481	4.727415	114.0822	.0521614
32	1.086814	43.21	116.3086	87.25977	145.3575	.2238268
33	1.515811	43.06	74.37543	26.65555	122.0953	.0536683
34	5.18398	32.52	11.21889	-75.96727	98.40505	.4677976
35	1.107845	15.45	113.8425	84.27092	143.4141	.5731839
36	1.457461	18.49	79.1767	33.92797	124.4254	.2668448
37	1.578604	34.96	69.47346	19.3229	119.624	.0740591
38	1.13667	133.25	110.5423	80.05965	141.025	.0133766
39	.995168	74.95	127.6685	98.92435	156.4127	.0880761
40	.6491528	19.95	182.1486	116.2832	248.0139	1.029066
41	.8645754	23.14	145.8034	110.0513	181.5554	.666052
42	1.051702	19.2	120.5399	92.03029	149.0495	.5493222
43	1.466629	14.91	78.40602	32.75628	124.0558	.3146909
44	.6894092	13.72	174.6224	115.9431	233.3018	1.141554
47	.595723	187.01	192.7675	116.2655	269.2695	.0005515
48	1.011987	68.1	125.5055	96.99097	154.0201	.1098836
49	1.19671	33.46	103.9509	71.05598	136.8459	.2455865
50	1.572133	31.01	69.9664	20.0549	119.8779	.0986617
51	1.499602	21.86	75.68476	28.63163	122.7379	.2043913
53	1.227184	39.72	100.7442	66.45637	135.0321	.1760444
54	.6115161	29.02	189.5492	116.3247	262.7737	.8864489
55	1.909147	17.67	47.61493	-11.1439	106.3738	.0917889
56	1.090969	35.87	115.8174	86.67606	144.9588	.2874908

reg143[1]

57	.5109321	6.39	211.3296	115.1849	307.4743	1.820265
58	1.045652	563.06	121.2838	92.81874	149.7488	2.040785
59	1.051889	149.62	120.517	92.00576	149.0282	.0198436
60	1.26604	57.9	96.78402	60.63509	132.9329	.0626893
61	1.281852	71.89	95.21228	58.29144	132.1331	.0206423
62	1.663026	48.82	63.28809	10.26693	116.3092	.0118323
63	1.482257	54.58	77.10648	30.78386	123.4291	.0244977
64	1.651962	37.9	64.07336	11.40199	116.7447	.0431156
65	1.512632	29.63	74.63077	27.04043	122.2211	.128882
66	1.508524	21.85	74.96178	27.53972	122.3838	.2002897
67	1.221491	22.81	101.3364	67.31448	135.3584	.3532723
68	1.322968	27.9	91.22921	52.29168	130.1667	.2300493
69	1.330891	28.69	90.47849	51.1535	129.8035	.2179657
72	.987365	104.21	128.6846	99.7843	157.5848	.0162757
73	.9900807	114.7	128.33	99.48772	157.1723	.0048284
74	1.674712	70.43	62.46672	9.084829	115.8486	.0030143
75	2.084025	29.14	38.33583	-22.24193	98.91358	.0079458
76	2.029391	33.63	41.0844	-19.11528	101.2841	.0047051
77	1.160225	19.41	107.9119	76.55104	139.2727	.4516952
78	1.108194	15.82	113.802	84.22065	143.3833	.5649322
81	.9550442	33.95	132.9801	103.0844	162.8758	.4107841
84	1.333813	84	90.20298	50.73533	129.6706	.0013944
85	1.39656	37.65	84.45673	41.97932	126.9341	.1177213
86	1.489632	30.82	76.49934	29.86398	123.1347	.1288214
87	2.031658	58.78	40.96772	-19.25101	101.1865	.0202358
88	2.772536	33.27	13.36258	-39.27729	66.00246	.0563251
89	2.424039	38.51	23.95141	-35.43858	83.3414	.0217128
90	1.418173	20.75	82.55041	39.06942	126.0314	.2590542
91	1.493821	23.56	76.15622	29.34461	122.9678	.1893069
92	.583499	13.29	195.3068	116.1891	274.4245	1.346697
93	1.270642	45.49	96.32423	59.95117	132.6973	.1189419
94	1.561062	17.14	70.81617	21.31979	120.3125	.2306782
95	.750762	87.09	163.8511	114.7803	212.9219	.1518142
96	1.211579	70.1	102.375	68.81024	135.9398	.0384526
97	1.332469	14.23	90.32962	50.92756	129.7317	.4146647
98	1.727648	13.5	58.84747	3.943188	113.7518	.2016322
99	1.07289	27.17	117.9693	89.1883	146.7502	.4027367
100	1.124943	16.64	111.874	81.78622	141.9617	.5328854
101	1.88487	15.08	49.01786	-9.345004	107.3807	.1226994
102	1.427444	16.9	81.74375	37.83875	125.6488	.306787
103	1.21933	86.57	101.5621	67.64042	135.4837	.0075515
104	1.464803	19.21	78.55903	32.9888	124.1293	.2533589
105	1.805204	42.88	53.83292	-2.973685	110.6395	.0078531
106	1.260088	26.44	97.38155	61.52164	133.2415	.2819197
107	1.078544	21.61	117.2922	88.41055	146.1739	.4822632
108	.3995931	4	239.7456	111.6961	367.7951	2.294648
109	1.031032	146.64	123.0999	94.67734	151.5224	.0129886
110	1.184054	119.07	105.3096	72.96659	137.6526	.0053303
111	2.062149	98.81	39.4206	-21.02596	99.86716	.1692272
112	1.877411	44.57	49.45483	-8.779098	107.6888	.0016025
114	1.478097	72.11	77.45068	31.30584	123.5955	.0012043
115	1.732688	54.13	58.51138	3.471671	113.5511	.0010758
117	1.287003	41.55	94.70512	57.53193	131.8783	.1362572
118	1.521262	13.91	73.93923	25.99869	121.8798	.2992325
119	1.472759	28.76	77.89417	31.97887	123.8095	.1513507
120	1.773565	55.18	55.83843	-.2388437	111.9157	.0000246
122	1.07573	45.57	117.6287	88.79859	146.4588	.211656
123	.7469301	99.1	164.5008	114.8777	214.1239	.1040227
124	1.133424	48.33	110.9094	80.53913	141.2797	.1617005
125	1.326535	73.17	90.89057	51.77851	130.0026	.0121141
126	2.324223	45.49	27.71954	-32.61788	88.05697	.0276335
127	1.979567	36.21	43.70798	-15.99811	103.4141	.0044491
128	2.067302	19.3	39.1632	-21.31668	99.64307	.0438931

129	1.180652	34.33	105.6776	73.47964	137.8755	.2466576
130	2.994181	36.12	8.456549	-37.41232	54.32541	.1214432
131	3.17195	26.48	5.420965	-33.78846	44.63039	.1001954
132	2.070503	18.81	39.00388	-21.49593	99.50369	.0459591
133	1.643647	12.6	64.66847	12.26525	117.0717	.2546715
134	.7137318	12.12	170.2559	115.5802	224.9316	1.155136
135	.7030995	31.18	172.1486	115.754	228.5432	.7168883
136	1.922816	33.51	46.83785	-12.12813	105.8038	.0140486
137	.9804827	285.3	129.5874	100.5227	158.6521	.3827851
138	1.226828	42.5	100.7812	66.51001	135.0524	.1563609
139	2.081439	25.28	38.46297	-22.10067	99.0266	.0173932
140	1.077105	59	117.4642	88.60921	146.3192	.1257854
141	2.176101	30.13	33.99315	-26.84898	94.83528	.00147
142	1.58526	35.16	68.96928	18.57566	119.3629	.071202
143	1.662058	32.46	63.35649	10.36563	116.3474	.0645954
144	2.080137	37.43	38.5271	-22.02929	99.0835	.0001
145	.9578429	22.42	132.6025	102.8157	162.3893	.5802292
146	1.127337	16.54	111.6009	81.43509	141.7668	.5327802
147	.8161069	89.12	153.2064	112.5362	193.8765	.1088926
148	1.597581	36.87	68.04362	17.20753	118.8797	.0598038
149	1.343305	40.57	89.31293	49.38296	129.2429	.1198136
150	.9106349	41.33	139.1214	106.9134	171.3294	.363429
151	.8083855	25.91	154.4231	112.8631	195.9831	.6793242
152	1.193459	39.78	104.2984	71.54697	137.0499	.1925105
153	1.165287	36.94	107.3542	75.79179	138.9166	.231561
154	1.291313	33.72	94.28259	56.89803	131.6672	.192265
155	1.204608	17.41	103.1111	69.86301	136.3593	.4516124
156	1.509146	27.38	74.91158	27.46397	122.3592	.1478422
158	.3797943	19.7	245.4023	110.7963	380.0083	1.590789
159	.3658155	9.27	249.5265	110.1033	388.9496	2.052274
160	.7730818	225.88	160.1245	114.1414	206.1075	.0712072
161	2.106765	20.97	37.23014	-23.45581	97.91608	.0292499
162	1.000203	267.5	127.0172	98.35683	155.6775	.3263767
163	1.221163	22.24	101.3707	67.36394	135.3774	.3615668
164	.8800309	54.73	143.5243	109.0883	177.9603	.264998
165	2.135118	32.7	35.88231	-24.89882	96.66343	.0009324
166	.9038462	23.97	140.0857	107.4276	172.7439	.607853
167	1.177712	42.16	105.9965	73.92275	138.0703	.1824777
168	1.603547	22.59	67.59892	16.55211	118.6457	.1518782
169	3.150784	30.73	5.74299	-34.31335	45.79933	.1249952
170	1.324797	19.04	91.05543	52.02837	130.0825	.3384987
171	1.34851	15.36	88.82807	48.6454	129.0107	.3825767
173	1.324682	81.64	91.06635	52.04494	130.0878	.0032487
174	1.432169	66.74	81.33517	37.21564	125.4547	.0091004
176	.9655964	10.22	131.562	102.0542	161.0699	.8638557
177	1.091683	16.54	115.7332	86.57538	144.8911	.565039
178	2.424908	14.71	23.92014	-35.45955	83.29983	.0140597
181	.535271	50.14	205.7646	115.6274	295.9017	.6658752
182	1.395274	46.19	84.5713	42.15425	126.9884	.072694
183	1.179323	25.67	105.8217	73.67999	137.9633	.3439581
184	.7302152	15.79	167.3697	115.2624	219.4769	1.014028
185	.6214	17.88	187.5698	116.3389	258.8007	1.131186
186	1.360544	21.87	87.71568	46.95138	128.48	.2775113
187	.7514948	30.23	163.7272	114.7613	212.6931	.6721004
188	.631972	39.61	185.4812	116.3344	254.6281	.677285
190	.3522633	36.63	253.6345	109.3836	397.8853	1.230412
191	.8155594	11.51	153.2923	112.56	194.0246	1.019694
196	.856108	132.83	147.0683	110.5424	183.5943	.0045733
197	1.322664	38.24	91.25812	52.33548	130.1808	.1432565
198	2.954527	33.39	9.239522	-37.96997	56.44901	.0946676
199	1.452201	38.95	79.62166	34.60505	124.6383	.090792
200	1.330754	25.19	90.49142	51.17311	129.8097	.2548656
201	1.813084	28.61	53.34184	-3.636471	110.3202	.0482241

202	1.078593	17.64	117.2864	88.40378	146.169	.5547643
203	.826183	37.76	151.6344	112.0825	191.1864	.4803267
204	.8756146	34.86	144.1716	109.3724	178.9708	.4700791
205	1.48043	30.95	77.25748	31.01282	123.5021	.1313772
206	1.917048	25.5	47.16465	-11.71531	106.0446	.0417096
207	.6373903	37.06	184.4221	116.3242	252.5201	.7085202
208	1.2406	123.58	99.36089	64.43842	134.2834	.0166532
209	1.814006	64.53	53.2846	-3.713554	110.2827	.006789
210	.8880995	27.51	142.3495	108.5501	176.1488	.5642005
211	1.125493	92.02	111.8112	81.7056	141.9168	.0121559
212	1.451929	5.52	79.64472	34.64015	124.6493	.5456041
214	1.497073	21.04	75.89071	28.943	122.8384	.2147129
215	.8105643	177.57	154.0787	112.7726	195.3848	.0105136
216	1.603594	20.49	67.59543	16.54697	118.6439	.1723211
217	1.744491	33.21	57.72994	2.379543	113.0803	.0425077
218	2.358367	40.12	26.39057	-33.67594	86.45708	.0180794
219	2.541365	8.71	19.96003	-37.73185	77.65192	.0290216
220	1.450664	16.95	79.75206	34.80355	124.7006	.2924112
221	1.060197	14.79	119.5028	90.90535	148.1003	.6337144
222	1.724467	118.31	59.06035	4.242376	113.8783	.1285919
223	4.03905	6.72	.0846724	-6.164254	6.333599	.1006485
225	4.138813	21.31	.3288557	-12.18378	12.8415	.3233258
226	1.521476	26.6	73.92215	25.97298	121.8713	.1493771
227	.6521813	36.99	181.5688	116.2684	246.8692	.6897873
228	1.063422	31.63	119.1114	90.47306	147.7497	.3531578
229	2.372536	15.95	25.85142	-34.08628	85.78913	.015014
230	.6377602	69.89999	184.3501	116.3233	252.3769	.343501

```
. summ ryms lna lna_s lower upper pgain_gdp

    Variable |     Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
        ryms |     205    1.438255    .7004647    .3522633    5.18398
         lna |     205    52.87624    67.32792           4     563.06
       lna_s |     205    96.61912     52.0858    .0846724   253.6345
       lower |     205    49.87885    51.11002   -75.96727   116.3389
       upper |     205    143.3594     59.3965    6.333599   397.8853
   pgain_gdp |     205    .2965985    .3847779    .0000246   2.294648

.
. * note that no lna_s is less than zero
. count
  205

. count if lna_s>0
  205

. summ lna_s if lna_s>0

    Variable |     Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
       lna_s |     205    96.61912     52.0858    .0846724   253.6345

. summ pgain_gdp if lna_s>0 , detail

                          pgain_gdp
-------------------------------------------------------------
      Percentiles      Smallest
 1%     .0005515       .0000246
 5%     .0016408          .0001
10%     .0075515       .0005515       Obs                 205
25%     .0384526       .0009324       Sum of Wgt.         205
```

```
                                    reg143[1]
50%     .1692272                    Mean           .2965985
                      Largest       Std. Dev.      .3847779
75%     .3825767      1.820265
90%     .6897873      2.040785      Variance        .148054
95%     1.029066      2.052274      Skewness        2.52827
99%     2.040785      2.294648      Kurtosis       10.87314

.
. * Distribution of actual nonagricultural labor force around
. * 95% confidence interval of optimal level
. count
  205

. count if lna<lower
  104

. count if lna>=lower & lna<=upper
   88

. count if lna>upper
   13

.
. * Optimal non-agricultural labor force at various ryms levels
. drop _all

.
. set obs 40
obs was 0, now 40

. gen ryms = _n*.1

. gen lna_s = ( (B0+B2*(ryms^.5))/(-2*B1) )^2

. gen C0 = - sqrt(lna_s)/B1

. gen C1 = -2*lna_s/B1

. gen C2 = - sqrt(ryms*lna_s)/B1

. mkmat C0 C1 C2, matrix(bigC)

. gen var = .
(40 missing values generated)

. scalar index=1

. while index<=_N {
  2.   matrix C = bigC[index,1..3]
  3.   matrix var_mat = C * Sigma * C'
  4.   quietly replace var = var_mat[1,1] if _n==index
  5.   scalar index=index+1
  6. }

. gen sd = sqrt(var)

. gen upper = lna_s + 1.96*sd

. gen lower = lna_s - 1.96*sd

. list ryms lna_s lower upper

          ryms      lna_s      lower      upper
```

				reg143[1]
1.	.1	364.8521	81.57717	648.1271
2.	.2	309.8025	97.0746	522.5305
3.	.3	270.6123	106.1201	435.1045
4.	.4	239.6315	111.7136	367.5494
5.	.5	213.897	114.9507	312.8433
6.	.6	191.8891	116.286	267.4922
7.	.7	172.705	115.8002	229.6098
8.	.8	155.7565	113.1982	198.3149
9.	.9	140.6351	107.7108	173.5595
10.	1	127.0434	98.37989	155.7068
11.	1.1	114.7566	85.39546	144.1177
12.	1.2	103.6003	70.55903	136.6417
13.	1.3	93.43596	55.62507	131.2468
14.	1.4	84.15087	41.5124	126.7893
15.	1.5	75.65239	28.58268	122.7221
16.	1.6	67.86303	16.94123	118.7848
17.	1.7	60.71727	6.585283	114.8493
18.	1.8	54.15907	-2.531971	110.8501
19.	1.9	48.14008	-10.47378	106.7539
20.	2	42.61826	-17.30768	102.5442
21.	2.1	37.55676	-23.09998	98.21351
22.	2.2	32.92304	-27.91359	93.75967
23.	2.3	28.68827	-31.80703	89.18358
24.	2.4	24.82667	-34.83436	84.48771
25.	2.5	21.31517	-37.04521	79.67555
26.	2.6	18.13294	-38.48515	74.75104
27.	2.7	15.26117	-39.19598	69.71831
28.	2.8	12.68275	-39.21609	64.5816
29.	2.9	10.38211	-38.58078	59.34499
30.	3	8.344991	-37.32257	54.01255
31.	3.1	6.558327	-35.47147	48.58812
32.	3.2	5.010087	-33.05519	43.07536
33.	3.3	3.689183	-30.09945	37.47782
34.	3.4	2.585352	-26.62809	31.79879
35.	3.5	1.689089	-22.66327	26.04145
36.	3.6	.9915559	-18.22566	20.20877
37.	3.7	.4845273	-13.3345	14.30355
38.	3.8	.160332	-8.007819	8.328484
39.	3.9	.0117971	-2.262467	2.286061
40.	4	.0322087	-3.798384	3.862801

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