ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΑΤΡΩΝ
UNIVERSITY OF PATRAS

Productivity and Efficiency Analysis

Basic Commands in STATA

Gatomati Foteini (StN 1050418)
Konti Georgia (StN 1017785)
Loukeri Aspasia (StN 1017684)
Nikolakaki Ifigeneia (StN 1050617)
Spanou Sotiria (StN 1017098)
Tzinovits Vlantana (StN 1040402)

Instructor: Kounetas Konstantinos

Recapping... (Textbook: Coelli - Rao - O'Donell - Battese)

* For Decision-Making Units (DMUs):

Productivity: Output /Input
Efficiency: Productivity /(Benchmark Productivity), where
Output: **variables** (measures of Y, e.g. #items, TR)
Input: **variables** (measures of X, e.g. K, L, E, N, H)

* Methods of Analysis:

for **Productivity**: Total Factor Productivity, Partial Indicators
for **Efficiency**: Non-Parametric (NP) & Parametric (P) ways
NP: **DEA**, FDH
P: COLS, **SFA** (FE, GLS, RE)

DEA (Data Envelopment Analysis) in Stata

* Get do-file "dea"

which dea : confirming local (in)existence of package
findit dea : looking for the .ado file in Stata websites
net install st0193 : installing (Or put **dea.ado** in c:/ado)

* Prepare your dataset - keep variables in columns

use (filename OR w.d. filename) : choosing dataset
generate dmu= _n : numbering our DMUs

* Apply the dea syntax

dea ivars = ovars, rts(crs|vrs|drs|nirs) ort(in|out)
stage(1|2) trace saving(results-filename)

DEA (Data Envelopment Analysis) in Stata - continued

* Choose your arguments

ivars = input variable list, e.g. workHours rndExpenses
ovars = output variable list, e.g. totalRevenues numberItems
rts = returns to scale (**const.**, var., decr., non incr.)
ort = orientation (**input**, output)
stage = number of stages (**1**, 2)
trace = saving intermediate results in the **dea.log** file
saving = specifying a (filename)**.dta** file for storing final results

* Results in memory

r(dearslt) = n x m matrix, where n is the number of DMUs and m includes all used inputs, outputs, slacks, ranks (DMU scores), theta (efficiency scores), reference DMUs etc

DEA: Example

```
. use "C:\res-dea.dta", clear
. dea weight Volume = fuel_consumption, rts(crs) ort(out)
```

```
options: RTS(CRS) ORT(OUT) STAGE(2)
CRS-OUTPUT Oriented DEA Efficiency Results:
```

	rank	theta	ref: 1	ref: 2	ref: 3
dmu:1	4	1.50865	0	0	7.845
dmu:2	5	2.91765	0	0	1.13524
dmu:3	1	1	0	0	1
dmu:4	1	1	0	0	0
dmu:5	3	1.16987	0	0	1.23709

	ref: 4	ref: 5	islack: weight	islack: Volume	oslack: fuel_consumption
dmu:1	0	0	0	20.1971	0
dmu:2	5.5632	0	0	0	0
dmu:3	0	0	0	0	0
dmu:4	1	0	0	0	0
dmu:5	.733069	0	0	0	0

theta : efficiency score -> rank=1 : highest theta (most efficient DMU)
1-theta : optimization margin <- slacks : additional individual i/o margins
reference weights : calculated for most efficient DMUs

SFA (Stochastic Frontier Analysis) in Stata

* Get package "frontier" and apply the frontier syntax

which frontier : (included in the Stata base .ado folder)
frontier depvar indepvars [weight] [, options]

* Choose your arguments

depvar = dependent variable, indepvars = independent variables

option vhet(varlist) : idiosyncratic-error explanatory variables
option uhet(varlist) : technical-inefficiency explan. variables
option distribution(**hnormal**, exponential, tnormal) : for uhet
option cost (if it's a frontier for cost instead of productivity), etc

* Alternatives

help xtreg, xtfrontier

SFA: Example

```
. frontier fuel_consumption weight Volume, distribution(hnormal)

Stoc. frontier normal/half-normal model          Number of obs   =          5
                                                 Wald chi2(2)    =   2.75e+08
Log likelihood = -13.937211                      Prob > chi2     =     0.0000
```

fuel_consumption	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
weight	.2130523	.2618734	0.81	0.416	-.30021	.7263147
Volume	.2169887	.0218704	9.92	0.000	.1741235	.259854
_cons	24.06524	1.630157	14.76	0.000	20.8702	27.26029
/lnsig2v	-26.26117	560.2429	-0.05	0.963	-1124.317	1071.795
/lnsig2u	4.123302	.6324557	6.52	0.000	2.883711	5.362892
sigma_v	1.98e-06	.0005557			7.2e-245	5.5e+232
sigma_u	7.858933	2.485213			4.228535	14.6062
sigma2	61.76283	39.06225			-14.79777	138.3234
lambda	3961901	2.485213			3961897	3961906

```
Likelihood-ratio test of sigma_u=0: chibar2(01) =  3.63   Prob>=chibar2 = 0.028
```

s...- _v, _u, 2; l... : stdev(v), stdev(u), var(v)+var(u); stdev(u)/stdev(v)
H0 vs Ha (Model) : all coefficients are zero vs at least one being non-zero
H0 vs Ha (sigma_u) : s..._u =0 vs >0 (absent & present technical inefficiency)
Prob : if <0.05, reject the corresponding H0 with 95% confidence

Malmquist Productivity Indicator

*** Get do-file "malmq" - Prepare your dataset**

which malmq : confirming local (in)existence of package
... (find and put **malmq.ado** in c:/ado)

use (filename OR w.d. filename) : choosing dataset

generate dmu= _n : numbering our DMUs

*** Apply the malmq syntax (arguments like in dea)**

malmq ivars = ovars, period(time-varname) ort(in|out)
trace saving(results-filename)

*** For Partial Productivity...**

help orderm, orderalpha

MPI: Example

```
. malmq i_AC = O_SPI O_CPI, ort(o) period(period)
```

Cross CRS-DEA Result:

	from	thru	t	t1
dmu:DMU101	38869	38899	128.007	2.54674
dmu:DMU115	38869	38899	.514718	7.78878
dmu:DMU118	38869	38899	64.6469	21.4819 ...

Malmquist efficiency OUTPUT Oriented DEA Results:

	period	dmu	CRS_eff	VRS_eff	
1.	38869	DMU101	1.83388	1	
2.	38869	DMU115	4.51366	1.12252	
3.	38869	DMU118	12.8484	1.02734	...

Malmquist productvity index OUTPUT Oriented DEA Results:

	period	dmu	tfpch	effch	techch	pech	sech
1.	38869~38899	DMU101	72.8157	105.487	.69028	1	105.487
2.	38869~38899	DMU115	.121	.22155	.546153	.890857	.248693
3.	38869~38899	DMU118	4.6528	7.19371	.646786	1.64446	4.37451
							...

CRS_eff, VRS_eff : efficiency scores for CRS and VRS

tfpch, pech, effch, techch, sech : changes in TFP, in technical efficiency relative to VRS (pure) and CRS, technical and in scale efficiency, respectively.


Savage Chickens
by Doug Savage
WE NEED TO IMPROVE PRODUCTIVITY!
LAST WEEK, YOU SAID WE NEEDED TO IMPROVE QUALITY. THE WEEK BEFORE THAT, IT WAS EFFICIENCY.
WE NEED TO IMPROVE PRODQUALICIENCY
©2010 BY DOUG SAVAGE
www.savagechickens.com

Thank you!