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NEW STRUCTURE OF TURINA (TURKEY'S INTERINDUSTRY ANALYSIS MODEL)

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Two workshops on Turina held at ITI Tokyo

2nd Workshop: 25 Jan – 6 Feb, 2014

1st Workshop: 25 Aug – 5 Sep, 2013

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This paper is a summary of two workshops held at ITI in Tokyo.

ITI: Institute for International Trade and Investment

Left to Right: Ono, Imagava, Gazi, Sasai

Contents

1. Introduction

- TURINA- Turkey`s Interindustry Analysis Model is an INTERDYME –type model.
- INTERDYME models require at least one IO table and a set of time series data for basic macroeconomic variables.

2. Basic Computer Programs

The following programs are installed into D drive:

i. PDG (G7)

ii. BC45

iii. UTIL

iv. CMD

v. TURINA

Structure of TURINA folder

Subfolders in TURINA folder

- RAWDATA: It contains mainly excel files for original data obtained from various sources.

  Main data sources:

  i. WIOD

  ii. TURKSTAT

  iii. MINISTRY OF DEVELOPMENT

Subfolders in TURINA (Cont)

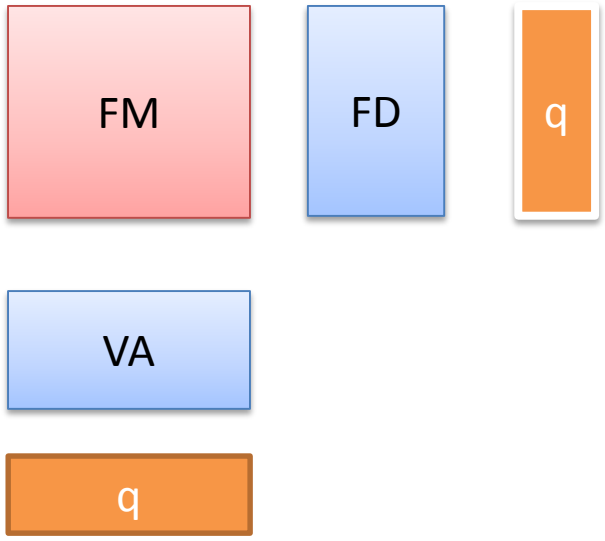
- RAW DATA: Excel files containing original data
- DATA: Raw data are transferred from Excel into text files and stored into this folder.
- Folders for regression equations:

  FCEHH, GFCF, DEP, PRO, EXP …
- DOCS: Folder for documents and reports about methods, sources, programs, results…

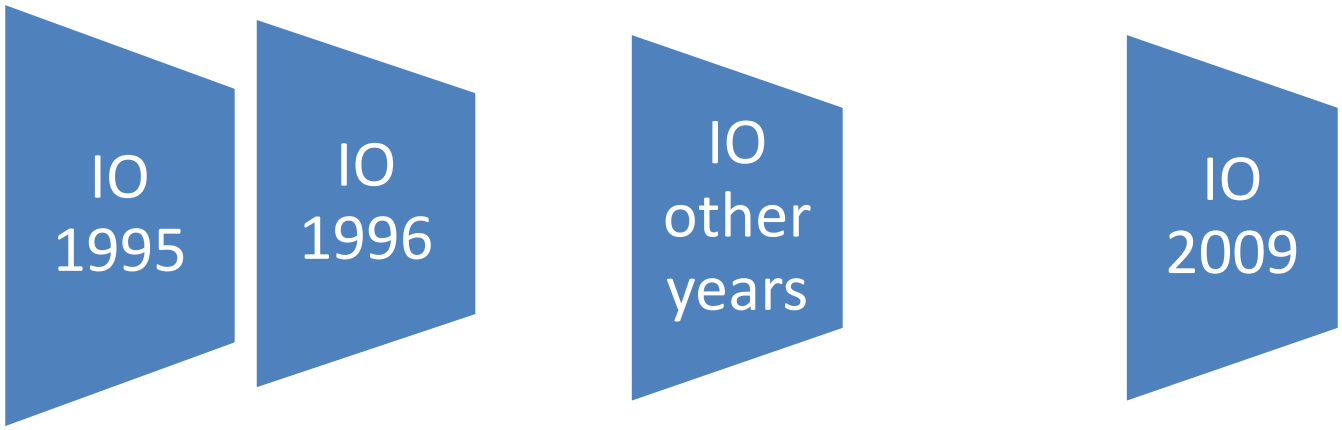
3. Input-Output System (Table)

Matrix equations describing IO system are needed to build an Interdyme model.

Below is the structure of an IO table (system):



Time Series of IO Tables



Matrices and vectors

- FM: Flow matrix (n by n)
- FD: Final demand matrix (n by k)
- VA: Value added matrix (j by n)
- q: Output vector (1 by n or n by 1)
- n: Number of sectors, n = 35 in TURINA
- j: Number of final demand columns
- k: Number of value added rows

Output equations

- $q = Aq + f$ (Eq. 1)

  where A is input-output coefficient matrix. It is obtained by dividing all column elements of FM to total sector output for each column.

  q = Total output vector.

  f = Final demand vector, row sums of FD matrix.

Finding output by matrix inversion

- Solution to (Eq 1)

  $q = (I-A)^{-1}f$ (Eq. 2)

- Given a non-negative final demand vector f and a non-negative A matrix, output vector q will be non-negative.
- $(I-A)^{-1}$ is called the Leontief inverse. All elements of the Leontief inverse are nearly non-zero (positive).

Numerical Example

IO table for a three-sector economy (hypothetical)

	Agr	Ind	Ser	Sum	f	q
Agr	10	20	30	60	140	200
Ind	40	50	60	150	150	300
Ser	70	80	90	240	260	500
Sum	120	150	180	450	550	1000
v	80	150	320	550		
q	200	300	500	1000		

FD (Final demand matrix)

- Row sums of FD gives f (total final demand)

FD =

con	gov	inv	ex	im	f
70	5	0	80	-15	140
120	20	50	100	-120	150
180	35	5	50	-10	260
370	60	55	230	-145	550

Value added matrix VA

- Column sums of VA gives v (Total value added)

VA				
Dep	4	10	30	44
Lab	55	85	180	320
Cap	23	40	80	143
Tax	-2	15	30	43
v	80	150	320	550

A Matrix

Input-output coefficient matrix A and Identity matrix I

A				I		
	Agr	Ind	Ser			
Agr	0.050	0.067	0.060	1	0	0
Ind	0.200	0.167	0.120	0	1	0
Ser	0.350	0.267	0.180	0	0	1
Sum	0.600	0.500	0.360			
v	0.400	0.500	0.640			
q	1.000	1.000	1.000			

Leontief Inverse

- Linverse = $(I - A)^{-1}$

$$\begin{matrix} 1.115 & 0.121 & 0.099 \\ 0.353 & 1.297 & 0.216 \\ 0.590 & 0.473 & 1.332 \end{matrix}$$

Finding output vector

- $q = (I-A)^{-1}f$

$(I - A)^{-1}$			f	q
1.115	0.121	0.099	140	200
0.353	1.297	0.216	150	300
0.590	0.473	1.332	260	500

Finding output vector without matrix inversion

- In actual input-output computations, the Leontief inverse is seldom used... (Almon, The Craft…, Vol. 3, p. 32).
- Instead, the iterative method or the Seidel method is used.
- In Interdyme models the Seidel method is employed.

The iterative method demonstrated

$q^{n+1} = Aq^n + f$

Let $q^0 = f$,

then

$q^1 = Af + f$

$q^2 = Aq^1 + f$

$q^3 = Aq^2 + f$

Finding output vector (Iterative method)

- Iteration continues until the difference

  $q^{n+1} - q^{n}$ approaches 0 (zero)
- With some predetermined level of error or number of iterations the method converges, i.e., the solution to output vector is possible.
- Next slide shows the method using our three-sector model.

Convergence of output vector

After eight iterations output vector converges

f								
q0	Aq0	q1	Aq1	q2	Aq2	q3	Aq3	q4
140	33	173	48	188	55	195	58	198
150	84	234	121	271	137	287	144	294
260	136	396	194	454	220	480	231	491

	Aq4	q5	Aq5	q6	Aq6	q7	Aq7	q8
	59	199	60	200	60	200	60	200
	148	298	149	299	150	300	150	300
	236	496	238	498	239	499	240	500

Price model

- Price model in IO analysis is presented by the following equation
- $p = pA + v$ (Eq. 3)

Where p is the price vector in row form. For the initial (base) year all elements of p are 1.00.

A: input-output coefficient matrix

v: Coefficient vector for value added (row)

Numerical example

- Solution to the price model is given by
- $p = v(I - A)^{-1}$ (Eq. 4)
- It can be shown that the initial price level is 1.

0.400	0.500	0.640	1.115	0.121	0.099
			0.353	1.297	0.216
			0.590	0.473	1.332

1.000	1.000	1.000

4. Introducing Data: Flow matrix

- Importing Flow Matrix from Excel

matin FM 2000 1 35 1 35 15						
#	Agriculture	Mining	Food, Bev Tob	Textiles	.....	
Agriculture	8,138	34	20,935	1,694	.....	
Mining	41	244	110	70	.....	
Food, Bever Tob	1,730	29	7,568	287	.....	
Textiles	211	70	401	26,149	.....	
.....	.....	.....	.....	.....	.....	;

Importing VA matrix

- Importing VA rows for one year from Excel

vmatdat r 6 1 1 35 0					
2009 totint dep wag pro tms va					
29276	6449	55606	65328	.....	
361	364	1940	4672	.....	
40089	3207	3468	6967	.....	
4093	4023	6208	7178	.....	
5112	1379	4557	4564	.....	
49655	8973	16173	23380	.....	;

Importing FD matrix

- Importing FD columns for one year from Excel

vmatdat c 8 1 1 35 0								
2002 fcehh	fcenp	fcegov	gfcf	civv	exp	imp	out	
16015	0	94	15	-408	2364	-1748	37125	
940	0	43	9	288	1.23	-5699	3588	
21126	0	329	44	1034	2257	-1440	31697	
9890	0	213	277	704	14445	-2863	39173	
1011	0	27	7	154	323	-308	2309	
.....	.....	.....	.....	.....	.....	.....	.....	;

5. Export and Import Prices

- Problem: Export and Import price vectors are not available in ESA (WIOD). However IO tables containing Export and Import data are available at current and constant prices (pyp = previous year prices) in dollars, but not in TL. Four steps are taken:
- Step 1: Obtain the dollar price index numbers for exports and imports.

Export & Import Prices (Cont)

- The price vectors of Exp and Imp in dollars for all 35 sectors and 15 years were constructed. Call these price vectors “pex$” and “pim$”, respectively.
- Step 2: Find the exchange rate series for TL/$, and form an index for this, starting from 1995 = 1.000. Call this index series as “indTL$”.

Export & Import Prices (Cont)

- Step 3: Multiply the export price vectors (pex$) by the TL/$ exchange rate index throughout for 15 years. The resulting series are export price vectors in terms of TL, which is denoted by “pex”.
- Step 4: Data validation. It was checked that the “pex” vector is identical with the “output price vector” in TL terms in WIOD sources.

Data for Export Price

#Insert pex.txt file into Turina

vmatdat c 1 15 1 35 15

pex		1995	1996	1997	1998	....	2009
1	Agriculture, Hunting, For	1.0000	1.1170	1.0293	1.2075	....	1.6195
2	Mining and Quarrying	1.0000	0.9656	0.9211	0.8323	....	2.5761
3	Food, Beverages and Tob	1.0000	1.0124	1.0853	0.9765	....	1.2333
4	Textiles and Textile Produ	1.0000	0.9106	0.8302	0.7559	....	0.6542
...	....	....	....	....	....	....	....
33	Health and Social Work	1.0000	1.0327	1.0403	1.0474	....	2.2418
34	Other Community, Social	1.0000	1.0327	1.0403	1.0474	....	1.7459
35	Private Households with I	1.0000	1.0327	1.0403	1.0474	....	1.8198 ;

6. Regression Equations in TURINA

- There are two data banks:

  Macro data bank: Data bank for macroeconomic variables.
- *VAM bank*: Bank for matrices and vectors
- Regression folders: They use data from both banks.
- Five regression folders in Turina for:

  FCEHH, GFCF, DEP, PRO, EXP.

How to run regression equations

After estimating regression equations in G7, do the following:

CMD: Double-click on the command prompt on the desktop: C:_

C:\windows\Systems32>D: (Type ‘D:’ and Ent)

D:\cd TURINA (Type ‘cd Turina’ and Enter)

D:\TURINA>st (Type ‘st’ and Enter, to start)

Three lines of PATH statements appear.

How to run regression eqns (cont)

- Open G7 from the desktop, and press OK.

  To run regression equations for the final consumption expenditure of households (FCEHH subfolder) in TURINA main folder do the following.

  In the command box of the G7 window type

  vam turina a <enter>

  dvam a <enter>

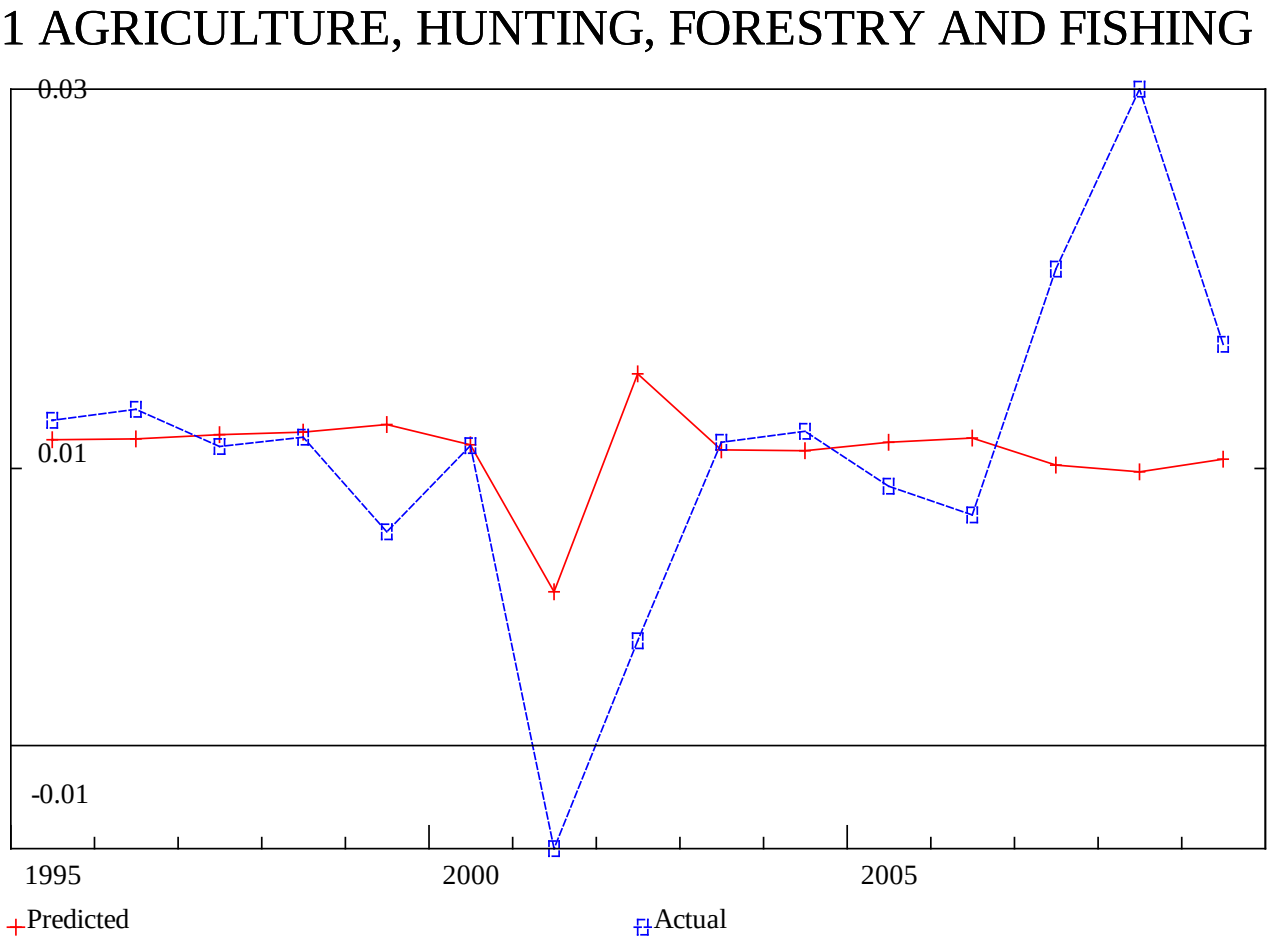
Running Regressions (Cont)

<add fcehh\fcehhreg.ini> <enter>

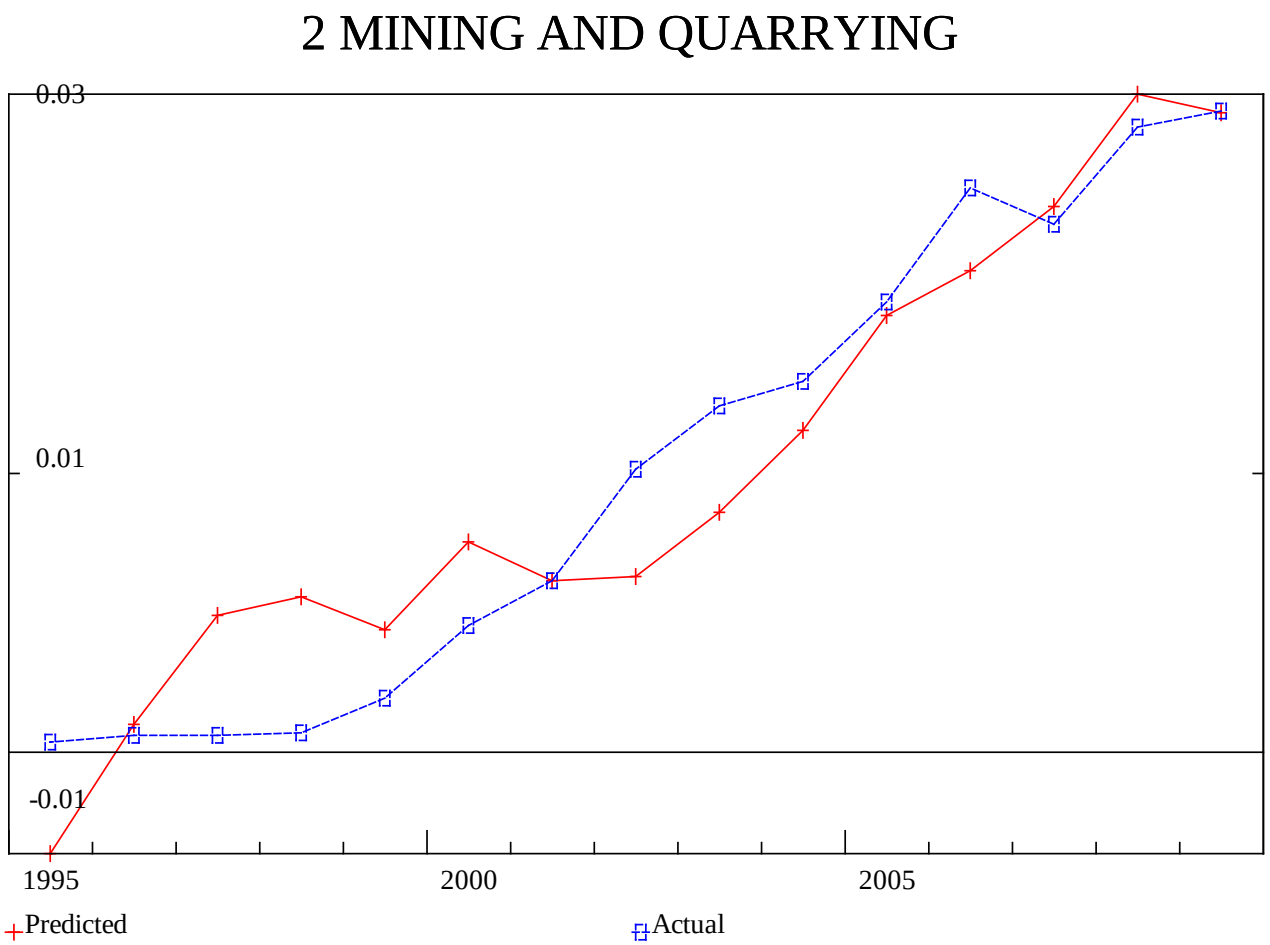
We can see the results of regression equations for per capita final consumption expenditures of households for 35 sectors.

Both estimated coefficients and graphs will be printed for each sector.

Bad Regression Example



Good Regression Example



7. What's Next

- Improve the databank with new variables, employment, capital stock, and else…
- Revise regression equations which do not comply with the economic theory.
- Run the model for the next 10 or 15 years.
- This concludes today's presentation.

Thanks
for
your attention!