Inforum World Conference
26th August-6th September, 2016
Osnabrück, Germany

AN INTERINDUSTRY MACROECONOMIC MODEL FOR TURKEY USING G7

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Abstract

This paper presents the building and running an interindustry macroeconomic model for Turkey using the G7 econometric package developed by INFORUM. The basic data file is a 35-sector IO table for 2011 compiled by the WIOD. Secondary data sources for macro variables are Turkstat (Tuik) data files for GDP expenditure components. The full time span of the model runs over 30 years from 1995 to 2025, consisting of a historical period (1995 – 2015) and a forecast horizon (2015 – 2025).The input-output coefficient matrix (AM) for 2011 and the shares of value added components in total output of respective industries are kept constant for the whole period in this simple version of the model. Final demand component vectors are assumed to grow at the same rate as their totals in their respective macro series for the historical period (1995-2015). For the forecast period they are assumed to grow at 3% per year except for investment. In addition to 3% growth, investment by supplying industries is modeled in a special way to integrate a cycle into its time path. Presently, there is no regression equation in the model. The Gmodel.pre file is designed and run by a single command and results are reported in tables and figures. The most important property of the model is matrix listing which tabulates the interindustry flows and sales to final demand columns by sectors. The results are reported for some benchmark years with levels and growth rates.

Keywords: G7, Interindustry models, Input-output models, Macroeconomic models, Turkish economy.

1. Introduction

The G7 program is a data analysis and econometric program developed by INFORUM at the University of Maryland (www.inforum.umd.edu). It can be downloaded at free of charge and it can be used to build or access databanks containing millions of time series. It is particularly useful to build multisectoral macroeconomic models for a national economy using input-output tables. The aim of this paper is to construct a multisectoral model for the Turkish economy using the G7 software. For this purpose a 35-sector IO table for 2011 is employed in the current version of the model. The 2011 IO table of Turkey is the latest table of the 17-year time series of national IO tables was compiled by the WIOD (World Input Output Database) project. This project is funded by the EU Commission. The scope of the project is to construct a series of uniform IO tables for 40 countries, of which 27 are EU members and 13 are other big economies including Turkey. In addition to NIOTs (national IO tables) the WIOD also provides basic macroeconomic series at sectoral level in the form of Socioeconomic Accounts (SEA). Out of this rich data source, the TURINA (Turkish interindustry macroeconomic analysis model) team built a data bank containing a set of well-balanced IOT series consistent with the national accounts statistics (NAS).

The WIOD data for Turkey within the TURINA framework was also employed by the professional model builders at GWS (Großmann, Hohmann, Wiebe, 2012). Since the Turkstat has not published any further IOT after 2002, the rational choice is to make use of the WIOD data available at no cost. However, the format of the WIOD tables are different from the normal structure of the IOT applied by the INFORUM. INFORUM models are of interindustry dynamic macroeconomic models which is known as Interdyme. Since TURINA is a special form of INFORUM model it is necessary to convert and adjust the WIOD tables to the one adapted by INFORUM. This step is taken first in an earlier study (Ozhan, 2015).

An input-output model starts with a VAM (vectors and matrices file) file which holds, as its name implies, time series of vectors and matrices. This file is called VAM.CFG file which contains the list of matrices and vectors together with their dimensions. Figure 1 shows VAM.CFG file for the Turkish interindustry model.

Figure 1. VAM.CFG for Turkey`s IO Model

```
# Vam.cfg file for a simple IO model for Turkey using WIOD 2011 IO table.
# Years of the vam file.
1995 2025
FM       35   35  0  sectors.ttl sectors.ttl #Input-output flow matrix
AM       35   35  0  sectors.ttl sectors.ttl #Input-output coefficient matrix
LINV     35   35  0  sectors.ttl sectors.ttl #Leontief inverse
out      35    1  3  sectors.ttl # Output
pce      35    1  0  sectors.ttl # Personal consumption expenditure
gov      35    1  0  sectors.ttl # Government spending
inv      35    1  0  sectors.ttl # Investment
ex       35    1  0  sectors.ttl # Exports
im       35    1  0  sectors.ttl # Imports
fd       35    1  0  sectors.ttl # Total final demand
# Value added
dep      35    1  0  sectors.ttl # Depreciation
lab      35    1  0  sectors.ttl # Labor income
cap      35    1  0  sectors.ttl # Capital income
ind      35    1  0  sectors.ttl # Indirect taxes
depc     35    1  0  sectors.ttl # Depreciation coefficients
labc     35    1  0  sectors.ttl # Labor income coefficients
```

```
capc      35    1  0  sectors.ttl # Capital income coefficients
indc      35    1  0  sectors.ttl # Indirect taxes coefficients
# Other shares
# for final demand columns
…
x         35    1  0  sectors.ttl # Working space
y         35    1  0  sectors.ttl # Working space
fix      200    1  0  fix.ttl     # Space for fixes.Fix.ttl will be written Fixer
```

The first line shows the beginning and ending years for the VAM file. Matrices in the VAM file are shown in capital letters and vectors are shown in lower case letters. For example FM is the name of the flow matrix of 35 sectors. The name list of the sectors is given in a file called <sectors.ttl>. Accordingly, each line is read as follows.

i. The name of the matrix or vector
ii. Its number of rows
iii. Its number of columns
iv. The maximum number of lags with which a matrix or vector occurs
v. The name of a file containing the rows title of a vector or matrix
vi. The name of a file containing the columns of a matrix
vii. A # followed by a brief description of the element (i.e., comment line)

Although time series of macro variables are included in the model their names do not appear in the VAM.CFG file. Full description of the VAM.CFG file for an eight-sector economy called *Tiny* and all other programming instructions are found in Almon (2016). This paper is an adoption of the Tiny model to the Turkish economy with actual values.

The remaining sections of the paper are designed as follows. The next section describes the introduction of data series into the VAM bank and its root folder in the computer where G7 is already installed. Section three describes the basic files and steps required for building and running the model. The results of the solution in graphical forms are presented in Section four. In Section five the same results are demonstrated in a series of tables. The last section concludes the study.

2. Data Sources: Series and Files

In an interindustry macroeconomic model based on input-output framework there are four types of data series to be introduced into the model data bank. The first and most important of all is the input-output flow matrix, named FM. The second set of data is related to the value added rows in the same structure. These rows are collected in a file with the root name VD. The third one is for final demand columns. Final demand columns are collected in a file with the root name FD. The last one contains the sum of final demand columns. In this paper the root name of this file is GDP. The reason for this name is that the summation of the sum of the final demand columns equals GDP. Furthermore, the summation of the sum of the value added rows also equals GDP. In addition to the sum of final demand categories, the same file may practically contain time series of other macroeconomic variables.

Figure 2 shows this four-part structure of the IO framework.

Figure 2. IO Structure

The first three blocks in Figure 2 are introduced into the model folder for 2011. As mentioned in the previous section the main source of data is the 35-sector NIOT (national input-output table) of Turkey. Here FM contains total intermediate, domestic plus imported input flows expressed in national currency. The original data are expressed in US dollars in WIOD sources. Using the exchange rate of 1.6668 TL/$ in 2011, the data were converted into the (new) Turkish Lira. Similarly, the FD block also contains both domestic and imported goods and services into five expenditure categories. These are
pce: Personal consumption expenditures
gov: Government expenditures
inv: Gross domestic investment
ex: Exports
im: Imports (with minus sign)

Four income categories are distinguished in the VA block:
dep: Depreciation
lab: Labor income
cap: Capital income
ind: Net indirect taxes

In an earlier study (Ozhan, 2015) the whole system obtained from the WIOD sources is made consistent with the national accounts statistics published by the Turkstat for 2011.

The ways to introduce IO data for the first three blocks (FM, FD, and VA) into the model data folder are explained in Almon (2016). In Almon (2016) the two special ways of introducing data are explained for the flow matrix FM, the row vectors of VA, and the column vectors of FD with *matin* and *vmatdat* commands.

A third way to introduce data into G-model environment is related to time series of macro variables. Here we only explain how to introduce time series of macro data for the GDP block and its expenditure components. The special command for this operation is *matdat*. For this purpose an Excel file is prepared with only one sheet as shown in Table 1. Then this file is saved as Text (Tab delimited) into the <model> directory.

Table 1. Introducing Time Series of Macro Variables into Model Databank

```
# gdp by expenditure, 2011 prices, millions of TL. File name: <gdp.txt>
matdat
          gdp    pcetot   invtot   govtot    extot    imtot
1995   663316    472082   124878    95160    93184  -121989
1996   712268    498122   126833   103324   129457  -145468
1997   766242    540877   141164   108240   155154  -179192
1998   791003    547157   140853   116371   169428  -182807
…         …         …        …        …        …        …
2013  1380885    966629   297308   215804   361150  -460005
2014  1422589    980483   295351   217453   388025  -458722
2015  1479278   1024612   297223   232591   384823  -459972  ;
```

Source: Turkstat (www.tuik.gov.tr)

In Table 1 there are six series, namely GDP and its five expenditure components. The suffix 'tot' for each series indicates that the variable represents the time series of the sum of all 35 elements of corresponding expenditure sector in the IO table. For example the figure 472082 for pcetot in year 1995 indicates that all 35 industries supplied 472082 million TL of final goods and services consumed by private households. Similar interpretation goes for other components of final demand. Finally, it can be checked that for 1995 gdp is the sum of five total expenditures:

$$gdp = pcetot + govtot + invtot + exptot + imptot \quad (1)$$

$$gdp = 663316 = 472082 + 124878 + 95160 + 93184 + (-121989)$$

3. Building and Running the Model

The simplest version of IO model using only G7 can be presented in a single file named Gmodel.pre. A truncated version of this file is given in Figure 2.

Two points should be emphasized before introducing this file. The first point is that the file is truncated in order to save space. Thus original file is much longer than the printed version. The second is that the line numbers are not part of the original file but printed here only for ease of reference.

A brief description of the Gmodel.pre file (Figure 2) is as follows. The lines starting with # is just a comment which computer does not process them. They are just a reminder to the programmer or reader to follow the process and operations in a logical order.

Figure 2. Gmodel.pre File to Build a Tiny Model for Turkey Using G7

```
1.  # A partial list of commands in the Gmodel.pre file for Tiny model
2.  zap
3.  clear
4.  # bank tiny
5.  # Create the VAM file for TinyTurk
6.  vamcreate vam.cfg hist
7.  vam hist b; dvam b
8.  # Bring in the intermediate flow matrix, FM
9.  add flows.txt
10. show b.FM y 2011
11. # Bring in the final demand vectors
12. add fd.txt
13. # Bring in the value added vectors
14. add va.txt
15. # Bring in the final demand totals as macro data series
16. add gdp.txt
17. fdates 2011 2011
18. # Add up the intermediate rows
19. getsum FM r out
20. # Add on the final demand vectors to get total output
21. vc out = out+pce+gov+inv+ex+im
22. show b.out
23. # Copy intermediate flows to AM and convert to coefficients
24. mcopy b.AM b.FM
25. coef AM out
26. show AM y 2011
27. # Create value-added coefficient vectors.
28. vc depc = dep/out
29. …
30. # Copy the 2011 coefficient matrices to all the other years
31. fdates 1995 2025
32. # Copy the 2011 AM matrix into 1995 - 2025
33. dfreq 1
34. f one = 1.
35. index 2011 one AM
36. # Demonstrate that AM has been copied by showing its first column.
37. show b.AM c 1
38. …
39. #Move the five final demand columns by their totals over 1995 - 2015
40. fdates 1995 2015
41. index 2011 pcetot pce
42. show b.pce
43. # Take the Leontief inverse of the AM matrix
44. fdates 1995 2025
45. mcopy b.LINV b.AM
46. linv LINV
47. # Add up the final demands
48. vc fd = pce+gov+inv+ex+im
49. # Compute total outputs
50. vc out = LINV*fd
51. …
52. gdates 1995 2015 2025
53. fadd graphs.fad sectors.ttl
```

Gmodel.pre file initially requires a data bank created out of VAM.CFG file. This operation is defined in line 6 with the command “*vamcreate vam.cfg hist”* (without “”).The newly created file (or bank) is named *“hist”*. In line 7, the hist bank is now named with a single letter, b. In line 7 actually there are two commands doubled up in a single line. The second command is placed after “;” (without “”) as “dvam b” which assigns the bank b as the default bank of the model. It means that unless a new bank is assigned all calculations will be carried out in this bank, named b.

Now the data must be introduced into the default bank. The first set of data is the flow matrix FM and it is introduced in line 9 with the “add” command. The FM matrix for year 2011 is included in a text file named <flows.txt>. To check that this file is correctly introduced into the default bank b we type line 10. The “show” command in line 10 performs this action. Please note that the line numbers in Figure 2 are omitted in the final form of the file. In this text they are artificially inserted only for the sake easy reference.

Flow matrix introduced into the model databank by flow.txt file is given in Table 2.

Table 2. IO Flow Matrix Flow.txt File for Introducing Data into the VAM File

	FM	1	2	3	4		31	32	33	34
	2011	Agric	Mini	Food	Texti	.	PubAd	Educ	Health	OthSoS
1	Agricul	21883	147	58845	3797	.	869	62	331	53
2	Mining	104	722	361	154	.	131	140	49	81
3	Food	4939	111	22512	632	.	741	113	512	120
4	Textile	824	528	1572	98552	.	1356	460	679	300
..	..	..	..	..	..	.	..	..	..	..
31	PublicAdm	20	16	25	24	.	114	41	32	247
32	Education	1	39	38	25	.	284	216	696	175
33	Health	205	60	36	56	.	58	72	994	114
34	OthSocSer	70	53	90	141	.	339	148	231	5247
35	PrivateHh	0	0	0	0	.	0	0	0	0

Source: Compiled from the WIOD files by the author. Unit: Millions of TL, current prices.

In a similar way the vectors in the final demand block FD and the value added block VA are introduced into the model in line 12 and 14, respectively. Finally, the macro data series in the GDP block of the IO model are introduced in line 16 with the add gdp.txt command.

Actual calculations in Gmodel.pre file starts with line 19. The following is a brief account of these calculations. Line 19 takes the sum of the elements in each row of FM matrix and names the resulting column vector as “out”. This vector “out” is intermediate output vector. In line 21 *“vc”* command adds the intermediate output vector to the column vectors of the final demand block, and names the resulting vector as “out” again. But this time “out” is the name of the total output vector.

In line 24 <mcopy> command copies the FM matrix into the AM matrix in order to calculate the input-output coefficient matrix. But actual calculation is done in line 25. This line converts the AM matrix into coefficients with the help of total output vector “out”. Using ordinary matrix algebra what is done here can be expressed by the following equation

$$AM = FM\hat{q}^{-1} \qquad (2)$$

where

q = out (total output vector)

$\hat{q}$ = Diagonal matrix formed by total sectoral outputs.

$\hat{q}^{-1}$= The inverse of this diagonal matrix.

Briefly, to obtain the input-output coefficient matrix, both in line 25 and in Equation (2) the column elements of FM matrix are divided by the corresponding total output in each column.

Finally, Table 3 shows an extract of the coefficient matrix for a limited number of sectors.

Table 3. Coefficient Matrix for the Base Year 2011

	AM	1	2	3	4	.	31	32	33	34
	2011	Agric	Mini	Food	Texti	.	PubAd	Educ	Health	OthSoS
1	Agricul	0.13	0.00	0.34	0.02	.	0.01	0.00	0.01	0.00
2	Mining	0.00	0.02	0.00	0.00	.	0.00	0.00	0.00	0.00
3	Food	0.03	0.00	0.13	0.00	.	0.01	0.00	0.01	0.00
4	Textile	0.00	0.02	0.01	0.46	.	0.02	0.01	0.02	0.01
..	..	..	..	..	..	.	..	..	..	..
32	Education	0.00	0.00	0.00	0.00	.	0.00	0.00	0.02	0.00
33	Health	0.00	0.00	0.00	0.00	.	0.00	0.00	0.03	0.00
34	OthSocSer	0.00	0.00	0.00	0.00	.	0.00	0.00	0.01	0.13
35	PrivateHh	0.00	0.00	0.00	0.00	.	0.00	0.00	0.00	0.00

In the current version of the Tiny model it is assumed that the coefficient matrix remains constant for the entire period 1995 – 2025. In G7 this operation is managed by the “index” command. In line 35, <index 2011 one AM> implies that AM matrix calculated for the base year 2011 should be copied identically one after another to every year over the entire range of 1995 to 2025. To check this operation a show command in line 37 is typed. The result of this command is shown in Table 4.

Table 4. AM Column 1 for All Years from 1995 to 2025

	AM c1	1995	2000	2005	2011	2015	2020	2025
1	Agricul	0.13	0.13	0.13	0.13	0.13	0.13	0.13
3	Food	0.03	0.03	0.03	0.03	0.03	0.03	0.03
4	Textile	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	CokePetr	0.02	0.02	0.02	0.02	0.02	0.02	0.02
9	Chemical	0.02	0.02	0.02	0.02	0.02	0.02	0.02
17	EleGasWa	0.01	0.01	0.01	0.01	0.01	0.01	0.01
18	Construc	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	SaleMoto	0.01	0.01	0.01	0.01	0.01	0.01	0.01
20	Wholesal	0.02	0.02	0.02	0.02	0.02	0.02	0.02
21	RetailTr	0.02	0.02	0.02	0.02	0.02	0.02	0.02
23	InlandTr	0.02	0.02	0.02	0.02	0.02	0.02	0.02
24	WaterTra	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	Finance	0.02	0.02	0.02	0.02	0.02	0.02	0.02
32	Education	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	Health	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	PrivateHh	0.00	0.00	0.00	0.00	0.00	0.00	0.00

A similar operation, though omitted in Figure 2, is also done for the final demand categories. For example, in line 41 the personal consumption expenditure column <pce>is indexed with the growth rate of its column total, <pcetot> which itself is a macro variable. This operation is limited only for the period 1995 to 2015. From 2015 to 2025 final demand categories, except investment, are assumed to grow by %3 every year. To save space these operations are omitted in Figure 2.

Investment is treated in a special way as described in Almon (2016), but not demonstrated here.

The resulting final demand vector is shown in Table 5 as a time series for some benchmark years.

Table 5. Final Demand for All Years from 1995 to 2025

	fd	1995	2000	2005	2011	2015	2020	2025
1	Agricul	40038	47791	59937	73470	83071	96287	112618
2	Mining	3432	4626	6107	7730	8956	10248	12423
3	Food	62286	80425	104230	129151	147567	171018	200107
4	Textile	63272	68003	76122	90335	109023	125775	149054
5	Leather	3228	4487	5843	7252	8670	10006	11846
..	..	..	..	..	..	..	..	..
31	PublicAdm	46885	63188	65121	88797	114302	132799	154296
32	Education	27531	36618	39117	52533	66061	76741	89195
33	Health	18640	24867	27165	36169	45081	52369	60871
34	OthSocSer	14581	18420	22516	28435	32903	38205	44461
35	PrivateHh	1295	1591	2052	2535	2812	3267	3795

The Leontief inverse is calculated in lines 45 and 46. In line 45 the coefficient matrix AM is copied into a new matrix but with a new name LINV. Then in line 46 LINV is converted into Leontief inverse with the command “linv”. What is done in line 46 can be represented in ordinary matrix operations as follows.

$$LINV = (I - AM)^{-1} \quad (3)$$

A partial printout of Leontief inverse is shown in Table 6.

Table 6. The Leontief Inverse LINV

	LINV	1	2	3	4	5		31	32	33	34
	2011	Agric	Mini	Food	Texti	Leath	.	PubAd	Educ	Health	OthSoS
1	Agricul	1.17	0.01	0.46	0.05	0.08	.	0.02	0.01	0.02	0.01
2	Mining	0.01	1.04	0.01	0.01	0.01	.	0.01	0.01	0.02	0.01
3	Food	0.04	0.01	1.17	0.01	0.15	.	0.01	0.00	0.02	0.01
4	Textile	0.02	0.04	0.04	1.86	0.14	.	0.04	0.02	0.05	0.03
5	Leather	0.00	0.00	0.00	0.02	1.34	.	0.00	0.00	0.00	0.00
..	..	..	..	..	..	..	.	..	..	..	..
31	PublicAdmi	0.00	0.00	0.00	0.00	0.00	.	1.00	0.00	0.00	0.01
32	Education	0.00	0.00	0.00	0.00	0.00	.	0.00	1.00	0.02	0.01
33	Health	0.00	0.00	0.00	0.00	0.00	.	0.00	0.00	1.03	0.00
34	OthSocialS	0.00	0.00	0.00	0.00	0.00	.	0.01	0.00	0.01	1.15
35	PrivateHhs	0.00	0.00	0.00	0.00	0.00	.	0.00	0.00	0.00	0.00

Given Leontief inverse LINV and final demand column fd, output vector can be calculated as in Equation 4.

out = LINV*fd (4)

In Figure 2, the corresponding command for Equation 3 is given in line 50. The resulting output vector is shown in Table 7 for a set of limited sectors over the entire period.

Table 7. Output Vector for all Years from 1995 to 2025

	out	1995	2000	2005	2010	2015	2020	2025
1	Agricul	88790	109196	138141	158653	194149	224820	263659
2	Mining	16077	20178	25816	29937	37746	42942	52882
3	Food	84096	108079	139490	160638	197845	229168	268536
4	Textile	140765	155389	177936	202885	256399	295055	352110
5	Leather	6311	8288	10489	12087	15505	17870	21236
..	..	..	..	..	..	..	..	..
30	OtherBusin	40755	50230	63301	74411	91861	104881	127906
31	PublicAdmi	47341	63762	65811	87253	115340	133993	155722
32	Education	28704	38122	40864	52880	68795	79892	92940
33	Health	20003	26600	29226	37277	48233	55995	65199
34	OthSocialS	21131	26565	32559	38522	47536	55082	64479
35	PrivateHhs	1295	1591	2052	2354	2812	3267	3795

Finally, the last table below (Table 8) in this section is about labour income. It represents the labour income rows of VA blocks for some selected years. For convenience the results are presented in columns.

Table 8. Labor Income for all Years from 1995 to 2025

	lab	1995	2000	2005	2010	2015	2020	2025
1	Agricul	48496	59641	75450	86654	106041	122793	144006
2	Mining	3968	4981	6372	7390	9317	10600	13053
3	Food	5471	7031	9075	10451	12871	14909	17470
4	Textile	13591	15003	17180	19589	24756	28489	33997
5	Leather	667	876	1109	1277	1639	1889	2244
..	..	..	..	..	..	..	..	..
30	OtherBusin	3969	4891	6164	7246	8946	10213	12456
31	PublicAdmi	26188	35272	36406	48267	63804	74122	86143
32	Education	17267	22933	24582	31810	41384	48060	55909
33	Health	5769	7671	8429	10750	13910	16149	18803
34	OthSocialS	6857	8621	10566	12501	15427	17875	20925
35	PrivateHhs	1202	1477	1905	2185	2610	3032	3523

4. Results in Graphs

A simple base run or business as usual (BAU) solution of the model can be presented in two ways: in figures and in tables. In this section graphical results are presented for only four sectors out of top 10 sectors ranked with their value added shares in 2011. The list of these 10 sectors is given in Table 9.

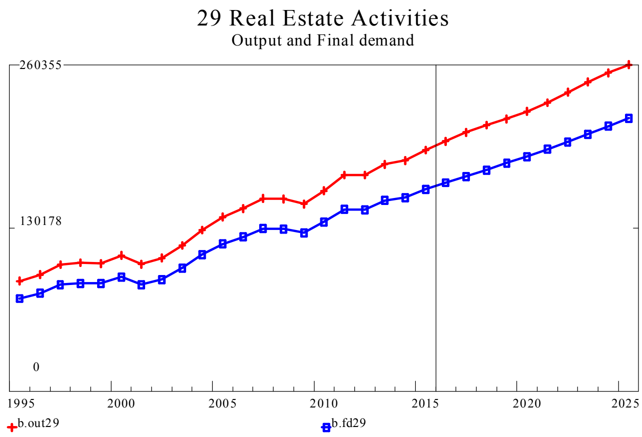
Table 9. Top 10 Sectors in Total Value Added, 2011, %

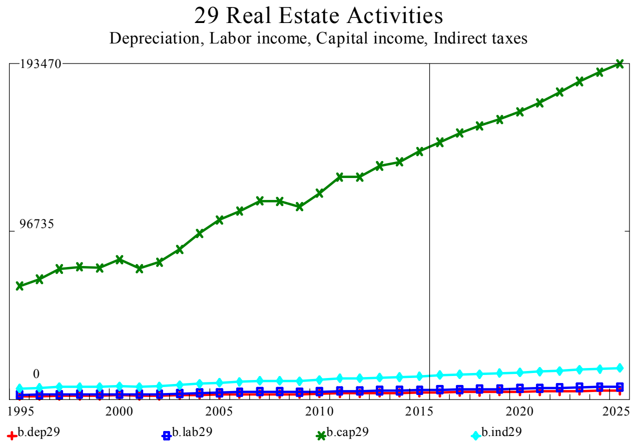
IO no	Sector	Value added shares	Rank
29	Real estate activities	12.0	1
23	Inland transport	9.5	2
1	Agriculture, hunting, forestry and fishing	9.2	3
21	Retail trade, except of motor vehicles and motorcycles; repair of household goods	5.7	4
20	Wholesale trade and commission trade, except of motor vehicles and motorcycles	5.3	5
18	Construction	5.0	6
4	Textiles and textile products	4.7	7
30	Renting of m&eq and other business activities	4.6	8
31	Public admin and defence; compulsory social security	4.6	9
32	Education	3.7	10
	Total	64.3	

In the Gmodel.pre file (Figure 2) graphical presentations are made possible in the last pair of lines. In line 52 the limits for the graphs are set with gdates command. The first year (1995) in this command shows the start date of the graphs, the second year (2015) shows the end of historical period and the last year (2025) shows the end of forecast period. As a result of this order there will be a vertical line in midyear (2015) in each graph. In line 53 fadd command requires that two files, namely graphs.fad and sectors.ttl would run in combination. The first one (graphs.fad) is called the command file and the second one (sectors.ttl) is called the argument file. This combination of two files in a fadd file is a convenient way of working with multisectoral models. The result will be a series of graphs for all 35 sectors. In these graphs the command file requires two types of graphs for each sector. In the first graph Output (out) and Final demand (fd) are presented. In the second graph four components of value added block (dep, lab, cap, ind) are presented. The argument file supplies the number and the names of sectors in the IO table.

In the following set of graphs four sectors are chosen for demonstration: Real estate activities, Agricultural activities, Construction, Textile and textile products.

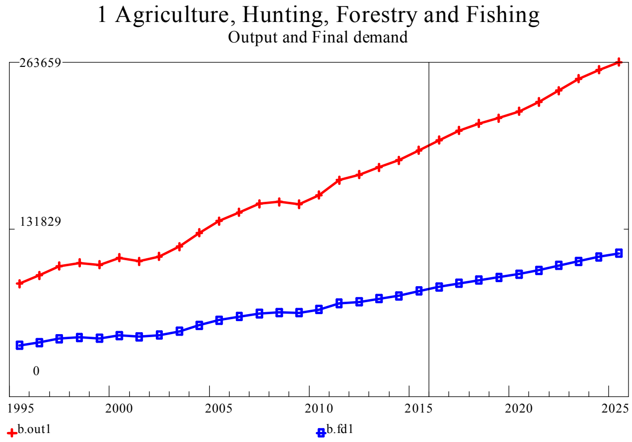
i. Real estate activities

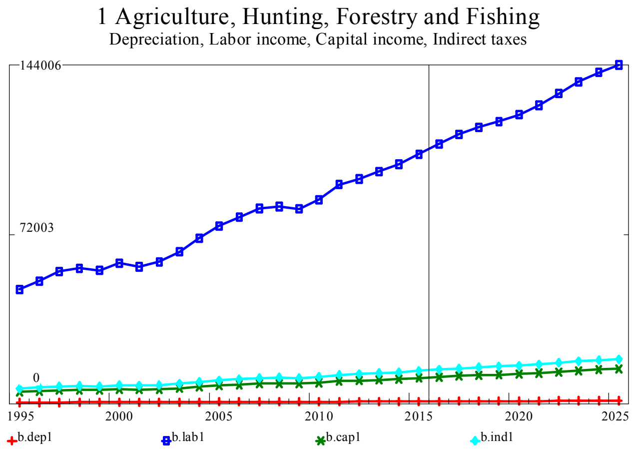




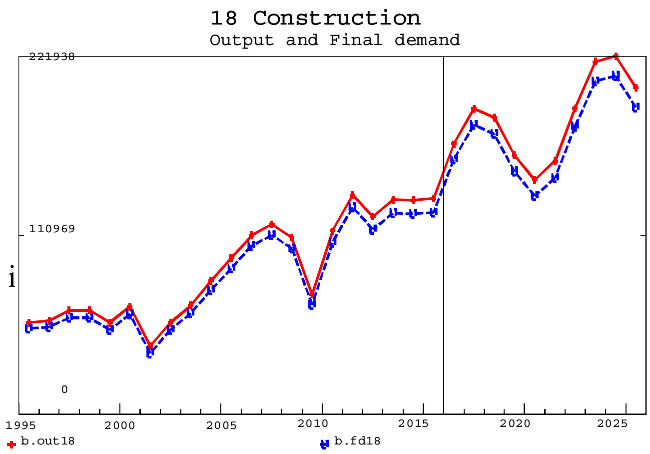
Real estate activities covers a wide range of services from renting to owner occupied housing services. Specifically it includes both direct and imputed rental income which are both part of capital or non-wage income. For this reason the share of value added in this goes directly to capital, as reflected in the green line at the top of the above figure.

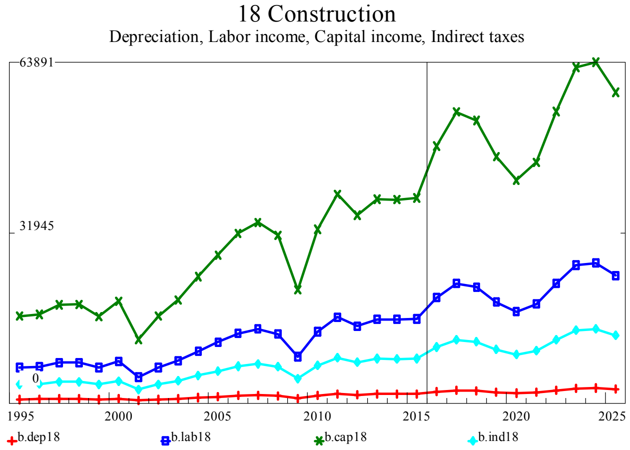
ii. Agricultural activities





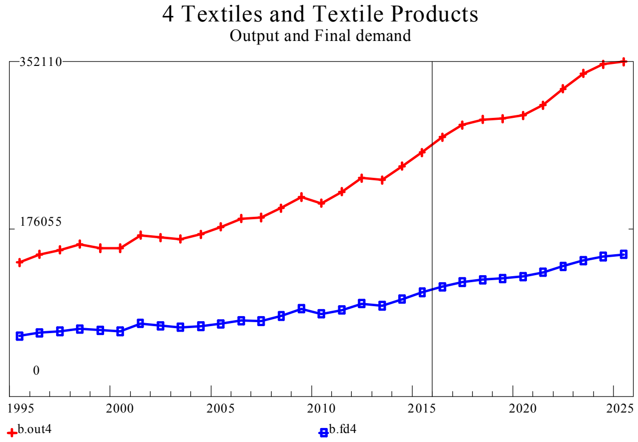
Contrary to Real estate activities Agricultural activities cover are primarily family owned farming and related businesses. Therefore unpaid family members engaged in this sector are also counted as labour. As a result of this imputation the largest share of value added in this sector goes to labour as refled in figure above.

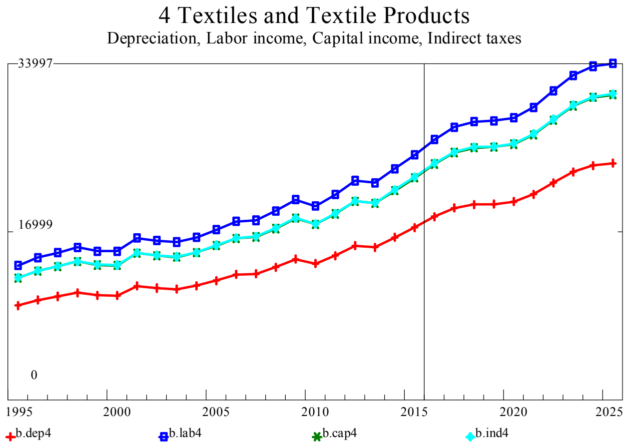




The figures for the construction industry shows excessive ups and downs. This is the result of investment function in the model. Investment function has built in cycle (wave) in its time path which reflects a dynamic property of the model. Since the construction industry is the main capital goods producing sector, the output in this industry and its final demand and value added components show big ups and downs, with even negative growth rates in some years, both at the historical period and forecast period. Another aspect reflected in the figure for construction is the fact that the line share of value added goes to capital, in spite of the fact that this sector is traditionally known as labour intensive sector.

iv. Textile





The textile industry is the only manufacturing sector occupying the seventh place among the top 10 sectors. The share of depreciation in value added in this sector is relatively high compared to other sectors. Other three components obtain almost equal shares as seen from the last figure above.

5. Results in the Form of Matrix Listing

The results of the Gmodel.pre file are listed in tables with the help of a stub file as it is the case in macro models. Accordingly, Compare program is used for the this purpose. The most important lines of the stub file are those lines which instruct the printing of the output balance of each sector in the output file. These lines are put at the end of the stub file, as given below (Almon, 2016):

```
\center Matrix Listing
\row
\cutoff .001
\matcfg matlist.cfg
\matlist 1 – 35
```

The back slashes in these lines are used for commands. The first line (\center Matrix Listing) puts the name "Matrix Listing" at the center of the first line of the table after its name. The second line, the "\row" command is a command for the Compare program to print the results in matrix computations for only rows. The "\cutoff" eliminates the printing of entries which account for less than the specified fraction of the total of the row. The "\matcfg" command specifies the name of the configuration file for matrix listing which is "matllist.cfg" already given in the same line.

Finally, the "\matlist" command indicates the matrix listing configuration file <matlist.cfg> to be run.

The matrix listing configuration file to produce the matrix listing is shown in the box below.

The MATRIXLIST.CFG File for TINY

```
Matrix listing identity; out = AM*out + pce + gov + inv + ex + im
# Title file name for the rows of out, the left hand side vector
# q; "sectors.ttl"
out; "sectors.ttl"
# Title file names for matrix columns
# am; "sectors.ttl"
AM; "sectors.ttl"
# headers for each term
header for out;    "Output"
header for AM*out; "Intermediate"
header for pce;    "Personal consumption expenditure"
header for gov;    "Government consumption"
header for inv;    "Investment"
header for ex;     "Exports"
header for im;     "Imports"
```

The first line in the Matrixlist.cfg file calculatesthe following identity for each industry

Output = intermediate demand + final demand (5)

Equation 5 is calculated for each sector with its sales to all 35 sectors and all five sectors of the final demand with significant. But only some significant figures at specified level are printed in the output file.

The whole process in making tables start with the following actions on the G7 main menu. When we click Model|Tables, we type "vam" as the type of the first bank, then give "hist" as its name; in the "Stub file" control, fill in "tiny", and in the "Output file name" box type "tiny.out".

As a result of these actions, the *Compare* program, an integral part of G7 software, produces the following four tables from Table 10 to 13.

Table 10. Output, Top 10 sectors in 2011

	out	1995	2005	2015	2025	95-05	05-15	15-25
29	RealEstate	87885	138854	192122	260355	4.6	3.2	3.0
23	InlandTran	103554	163131	230611	319099	4.5	3.5	3.2
1	Agricul	88790	138141	194149	263659	4.4	3.4	3.1
21	RetailTrad	44057	69223	98340	137929	4.5	3.5	3.4
20	WholesaleT	50175	78343	111817	156787	4.5	3.6	3.4
18	Construct	56680	96506	133668	202199	5.3	3.3	4.1
4	Textile	140765	177936	256399	352110	2.3	3.7	3.2
30	OtherBusin	40755	63301	91861	127906	4.4	3.7	3.3
31	PublicAdmi	47341	65811	115340	155722	3.3	5.6	3.0
32	Education	28704	40864	68795	92940	3.5	5.2	3.0

Table 10 shows total output levels in millions of TL in top ten sectors, ranked with their size in total value added in 2011, in four bench mark years from 1995 to 2015. The last three columns show annual growth rates of output in three periods, 1995-2005, 2005-2015, and 2015-2025 respectively.

Table 11. Personal Consumption Expenditure, in Top 10 sectors in 2011

	pce	1995	2005	2015	2025	95-05	05-15	15-25
29	RealEstate	73813	116932	160204	216252	4.6	3.1	3.0
23	InlandTran	46202	73193	100278	135361	4.6	3.1	3.0
1	Agricul	41803	66224	90731	122474	4.6	3.1	3.0
21	RetailTrad	13103	20757	28438	38387	4.6	3.1	3.0
20	WholesaleT	12540	19866	27218	36740	4.6	3.1	3.0
18	Construct	416	660	904	1220	4.6	3.1	3.0
4	Textile	77184	122274	167521	226130	4.6	3.1	3.0
30	OtherBusin	5630	8919	12220	16495	4.6	3.1	3.0
31	PublicAdmi	723	1145	1569	2118	4.6	3.1	3.0
32	Education	4399	6969	9548	12889	4.6	3.1	3.0

Table 11 shows the time path of personal consumption expenditures, pec, for the same sectors as in Table 10. Since the growth rates of personal consumption expenditures in the model are exogenously determined for three sub periods they all grow at the same rate over these periods: 4.6% over 1995-2005, 3.1% over 2005-2015, and %3 over 2015-2025.

Table 12. Government Current Expenditure, in Top 10 sectors in 2011.

	gov	1995	2005	2015	2025	95-05	05-15	15-25
29	RealEstate	0	0	0	0	0	0	0
23	InlandTran	450	625	1099	1484	3.3	5.6	3.0
1	Agricul	350	486	855	1154	3.3	5.6	3.0
21	RetailTrad	338	470	826	1115	3.3	5.6	3.0
20	WholesaleT	321	447	785	1060	3.3	5.6	3.0
18	Construct	2	2	4	5	3.3	5.6	3.0
4	Textile	3571	4964	8728	11781	3.3	5.6	3.0
30	OtherBusin	2	2	4	5	3.3	5.6	3.0
31	PublicAdmi	46306	64370	113183	152781	3.3	5.6	3.0
32	Education	23098	32108	56456	76207	3.3	5.6	3.0

Table 12 shows government current expenditure figures, gov, for the same sectors as in Table 11. The fixed growth rates for the elements of this vector over the three periods are 3.3%, 5.6%, and 3% respectively.

Table 13. Investment by Top 10 Producing Sectors in 2015

	inv	1995	2005	2015	2025	95-05	05-15	15-25	2015,%
18	Construction	53277	92140	126806	192561	5.48	3.19	4.18	42.7
15	TransportEq	11765	20347	28002	42523	5.48	3.19	4.18	9.4
13	MachineryNec	9903	17127	23571	35794	5.48	3.19	4.18	7.9
14	ElectOptic	7793	13478	18548	28167	5.48	3.19	4.18	6.2
23	InlandTran	7049	12191	16778	25478	5.48	3.19	4.18	5.6
20	WholesaleTra	5941	10275	14140	21472	5.48	3.19	4.18	4.8
21	RetailTrade	5909	10219	14063	21356	5.48	3.19	4.18	4.7
4	Textile	4703	8133	11193	16997	5.48	3.19	4.18	3.8
30	OtherBusin	3164	5472	7530	11435	5.48	3.19	4.18	2.5
16	ManufactNec	2948	5099	7017	10656	5.48	3.19	4.18	2.4
(% in Total inv)									90.1

Table 13 shows the output values of the top 10 investment good producing sectors. The last three columns, except the right most one, show the fixed average growth rates of investment by origin over the three periods. The last column shows the percentage shares of each type of investment in total in year 2015. It is not surprising to observe that about 43% of investment are in the form of construction. This figure reflects that the main source of growth in the Turkish economy is the Construction industry.

Finally, the matrixlist.cfg file produces tables for each and every sector of the economy in accordance with Equation 5. Table 14 shows only two of them: Agriculture (Sector 1), and Construction (Sector 18).

Table 14. Matrix Listing

```
Matrix Listing

                   Seller:   1 Agriculture, Hunting, Forestry and Fishing
                                   1995      2005      2015      2025     95-05  05-15  15-25
                                 Sales to sectors.ttl
     1 Agriculture, Hunt, Fore      11396.9  17731.5  24920.4  33842.5     4.4    3.4    3.1
     3 Food, Bever&Tob              28594.3  47429.6  67271.5  91307.9     5.1    3.5    3.1
     4 Textiles & Tex Prod           2489.7   3147.1   4534.9   6227.7     2.3    3.7    3.2
     6 Wood &Wood Prod                551.8    864.0   1244.6   1781.0     4.5    3.6    3.6
     7 Pulp, Paper, Print             324.2    509.1    742.2   1023.5     4.5    3.8    3.2
     9 Chemicals & Chem Pro           770.0   1163.5   1704.0   2347.7     4.1    3.8    3.2
    10 Rubber & Plastics              105.2    167.5    247.2    343.9     4.7    3.9    3.3
    22 Hotels & Restaur              3228.8   5269.1   7371.8   9989.9     4.9    3.4    3.0
    30 Renting of M&Eq & Oth           94.5    146.7    212.9    296.5     4.4    3.7    3.3
    31 Public Admin &Def              458.7    637.7   1117.6   1508.9     3.3    5.6    3.0
    33 Health & Social Work           170.5    249.1    411.1    555.7     3.8    5.0    3.0
      SUM: sectors.ttl              48752.2  78204.6 111077.0 151041.0     4.7    3.5    3.1
                              Sales to Other Final Demand
          Personal cons             41803.5  66224.2  90730.8 122473.0     4.6    3.1    3.0
          Government cons             349.7    486.1    854.6   1153.7     3.3    5.6    3.0
          Inv                        1202.7   2079.9   2862.4   4346.8     5.5    3.2    4.2
          Exp                        3155.4   8462.3  13030.8  17589.7     9.9    4.3    3.0
          Import                    -6473.0 -17315.  -24407.  -32946.      9.8    3.4    3.0
       sectors.ttl                  88790.3 138141.  194148.  263658.      4.4    3.4    3.1
```

Seller: 18 Construction

	1995	2005	2015	2025	95-05	05-15	15-25
Sales to sectors.ttl							
1 Agriculture, Hunt, Fore	166.1	258.5	363.3	493.3	4.4	3.4	3.1
17 Electricity, Gas and Water	120.6	189.2	273.4	377.4	4.5	3.7	3.2
18 Construction	710.9	1210.4	1676.4	2535.9	5.3	3.3	4.1
19 Sale, Maintenance and Repair	61.1	97.0	137.8	192.4	4.6	3.5	3.3
20 Wholesale Trade and Commis	115.2	179.9	256.8	360.0	4.5	3.6	3.4
21 Retail Trade, Except of Moto	81.8	128.6	182.6	256.2	4.5	3.5	3.4
22 Hotels and Restaurants	47.0	76.6	107.2	145.3	4.9	3.4	3.0
23 Inland Transport	65.8	103.6	146.4	202.6	4.5	3.5	3.2
27 Post and Telecommunications	83.5	130.9	184.7	252.3	4.5	3.4	3.1
29 Real Estate Activities	1347.0	2128.3	2944.7	3990.5	4.6	3.2	3.0
31 Public Admin and Defence	542.7	754.4	1322.1	1785.0	3.3	5.6	3.0
32 Education	58.6	83.5	140.6	189.9	3.5	5.2	3.0
33 Health and Social Work	96.3	140.7	232.2	313.9	3.8	5.0	3.0
34 Other Community, Social Ser	67.3	103.7	151.3	205.3	4.3	3.8	3.0
SUM: sectors.ttl	3863.6	6045.6	8793.5	2245.3	4.5	3.7	3.3
Sales to Other Final Demand							
Cons	416.5	659.8	903.9	1220.1	4.6	3.1	3.0
Inv	3277.4	92140.0	126805.	192560.	5.5	3.2	4.2
Exp	1318.9	3537.2	5446.8	7352.4	9.9	4.3	3.0
Imp	-2197.5	-5878.4	-8285.9	-11184.	9.8	3.4	3.0
sectors.ttl	56680.4	96506.3	133667.	202199.	5.3	3.3	4.1

The first part of Table 14 shows the value of sales from Agriculture to other sectors of the economy. For example the first line shows that Agricultural sector sells 11396.9 million TL of its output in 1995 to itself. The value of these sales goes up to 17731.5 million in 2005, 24920.4 million in 2015, and 33842.5 million in 2025, respectively. The second line shows the sales of Agriculture to Food, beverage, and tobacco industry. The last three columns in this table measure the growth rates of these intermediate sales in three consecutive periods as explained in earlier tables.

The second block in the first part of Table 14 shows the value of sales from Agriculture to final demand categories, namely Personal consumption, Government consumption, Investment, Export, and Import (with minus sign).

The second part of Table 14 shows the sales from Construction sector to other sectors. Since Construction is the main investment goods producing sector its sales primarily goes to Investment in column in the final demand block of the IO structure. For example the total investment goods produced by the Construction sector in 2015 will be 192560 million TL.

The matrix listing property is perhaps one of the superior properties of the Inforum modeling approach compared to other IO based mutltisectoral macroeconomic modeling practices. We, the Turkish team members, are happy that we are now able to apply this approach using the actual figures for our economy provided by WIOD and Turkstat.

6. Conclusions

The main findings of the paper can be summarized as follows.

- The model presented in this paper is a simple form of dynamic interindustry macroeconomic model for Turkey.
- The structure of the model is based on the framework of 35-sector IO table of Turkey for 2011.

- Calculations and presentations of the results are combined and centered in a single file called Gmodel.pre.
- With the help of additional files the model is run both in the G7 command line and in G7 editor window.
- Since the Tiny model is a generic one, the size of the IO table can be made as big as possible.
- The dynamic property of the model is integrated not by a regression but with a special investment function.
- Regression equations, particularly for consumption and investment both at macro and sectoral level will be introduced into the model at a later stage.
- The current version of the model demonstrates that one can predict or forecast the state of the economy up to 2025. This is one of the most important properties of any macroeconomic model.
- In this context the level of economic activities, final demand, and factor incomes are estimated in only one run.
- This run can be named as business as usual scenario (BAU).
- The model shows that the private final consumption expenditure (pce), which accounts for at least two thirds of GDP, had grown at 4.6% per year from 1995 to 2005, and at 3.1% from 2005 to 2015. Thereafter, it will grow at 3.0% p.a. over the next 10 years, from 2015 to 2025.
- This growth rate of pce as well GDP is only possible on the condition that, the gross fixed capital formation (inv) must grow at about 4.2%.
- The last, but not least, is that, the Turkish team members, are now able to apply the matrix listing approach in mutisectoral macroeconomic modeling.

References.

Almon, C. (2014): *The Craft of Economic Modelling* – Part 1. January 2014. Department of Economics, University of Maryland.

------------- (2016): *The Craft of Economic Modeling* – Part 3. April 2, 2016. Department of Economics, University of Maryland.

INFORUM (2014): *Inforum Help Documentation, Release 1.04*, August 29, 2014. Department of Economics, University of Maryland.

Ozhan, M. (2015): "Adapting WIOD Tables to National IO Tables for Turkey", *International Journal of Social Sciences and Education Research*, 1(1), 2015.

Tuik (2016): www.tuik.gov.tr

Wiod (2016): www.wiod.org