The Simulation of Household Consumption of TURINA

--TURkey's INterindustry Analysis Model

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Contents

1. Introduction

- Data base has Input-output tables for each year between 1998 and 2008
- Their value added side and final demand side are consistent with the national account data
    - They are also subject to the price vector equation

$$A'p + va / out = p$$

- Simulation and analysis for household consumption, including the output, value added and price vectors' changes.

- Since it has the highest share in GDP expenditure, household consumption is taken as the first simulation and applicaiton of the model TURINA (Table 1)

Table 1. The share of household consumption in GDP by expenditure (%), Turkey

1998	2000	2002	2004	2006	2008	2009
66.5	70.5	68.0	71.3	70.5	69.8	71.5

- TurkStat publishes household consumption only in 10 category. These categories are given in Table 2.

	Table 2. Household consumption categories	1998	2008
1	Food, beverages, alcoholic drinks and tobacco	30.1	25.9
2	Clothing and footwear	12	5.7
3	Housing, water, electricity, gas and other rules	10.8	20.3
4	Furnishing, household equipment and routine maintenance of the house	9.4	7.2
5	Health	2.6	4.1
6	Transport and communication	14.3	18.5
7	Recreation and culture	5.8	3.9
8	Education	0.6	1.3
9	Restaurants and hotels	6.6	6
10	Other goods and service	7.6	7.1

- Since we do not have detailed data on household consumption other than 10-category listing we applied a simplified version of PADS as given by

$$x_i(t) = \left(a_i(t) + b_i(y/P)\right).\left(\frac{p_i}{P}\right)^{-\lambda_i} \qquad (1)$$

Where the left side is the consumption *per capita* of product i in period t and *ai(t)* is a function of time. The *bi* is a positive constant. The *y* is nominal income *per capita*; *pi* is the price index of product i; *P* is an overall price index.

The model's logic will be summerized into the following steps:

Step 1. Give a total household consumption expenditure per capita for the year when the model runs.

Step 2. Use the consumption value to calculate the per capita household consumption in constant price by 10 categories according to the equations resulted from the regression in the sample period 1998-2008.

Step 3. Convert 10 category household consumption per capita into 58 sectors' household consumption per capita by using bridge matrix and then get total household consumption by 58 sectors through multiplying the population number in that year.

Step 4. Get final demand vector "" if all the other component vectors such as government consumption, fixed capital formation, inventory changes, export and import are exogenously given.

- Step 5. Calculate the gross output vector , in constant price, according to the equation $out = (I - A)^{-1} * fd$
- Step 6. Calculate the value added vector “” in current price, according to the regression analysis between output in constant price by last year’s price index and value added in current price from the sample period 1998-2008.
- Step 7. For new unit value added (value added in current price of per unit output in constant price), calculate the price index vector, according to the equation $A'p + va/out = p$
- Step 8. Have GDP in current price and in constant price, which is the sum of value added vector and final

- Step 9. Have GDP per capita in constant and in current price, and the GDP deflator.
- Step 10. Estimate the total household consumption per capita according to the regression analysis from the sample period 1998 and 2008.
- Step 11. If the resulted total household consumption per capita is very close to the one used in step 1, the model finishes the run for that year and goes to the next year. Otherwise, we replace the household consumption per capita in step 1 with this new value and go to step 2 for the next iteration of the model.
- Refere to the text file for the flow chart of the model!

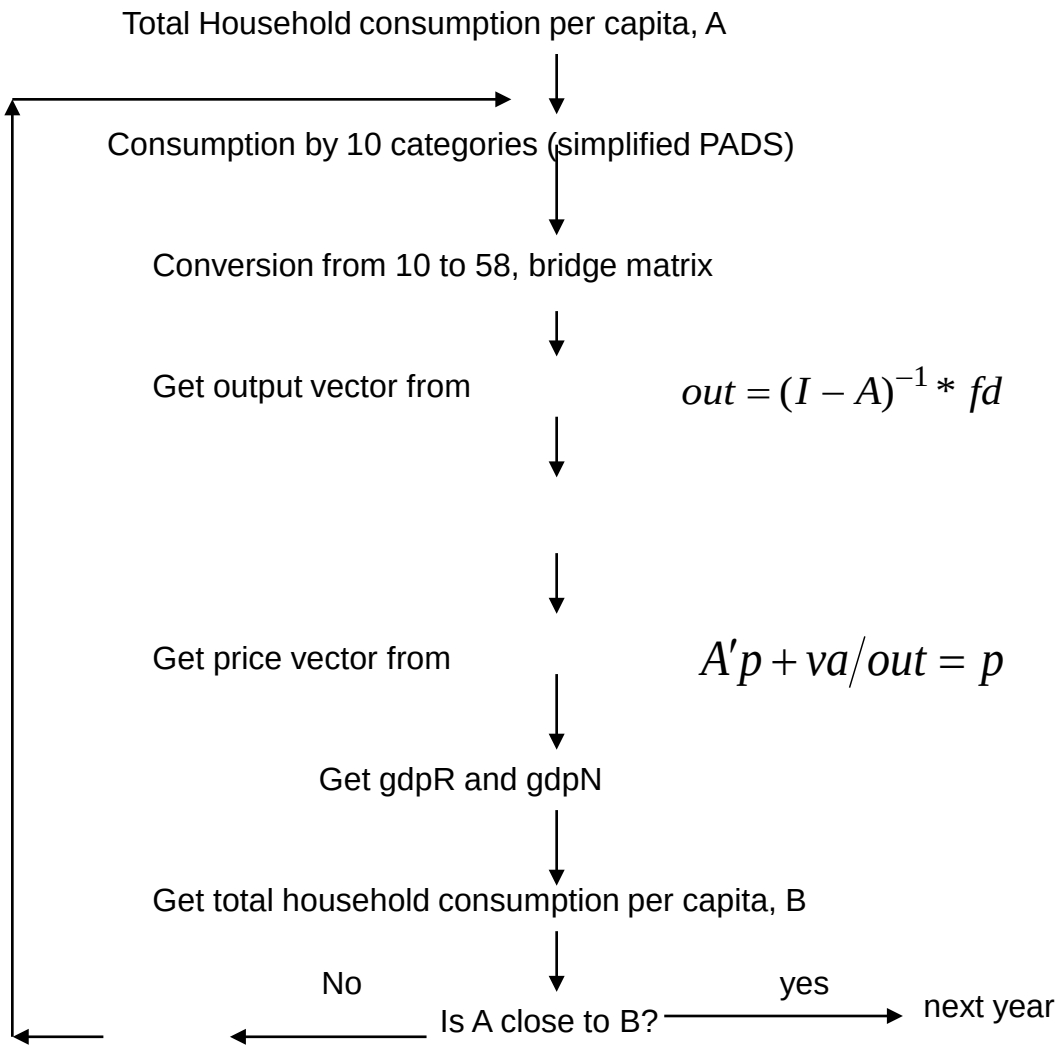

Total Household consumption per capita, A
Consumption by 10 categories (simplified PADS)
Conversion from 10 to 58, bridge matrix
Get output vector from
$out = (I - A)^{-1} * fd$
Get price vector from
$A'p + va/out = p$
Get gdpR and gdpN
Get total household consumption per capita, B
Is A close to B?
No
yes
next year

Table 4: Result of regression for Household Cons. in current price

- SEE = 72.79 RSQ = 0.9994 RHO = 0.08 Obser = 11 from 1998.000
- SEE+1 = 73.38 RBSQ = 0.9993 DW = 1.83 DoFree = 9 to 2008.000
- MAPE = 1.31
- Variable name Reg-Coef Mexval Elas NorRes Mean Beta
- 0 phhconsN - - - - - - - - - - - - - - - - - 4801.27 - - -
- 1 intercept -45.30306 5.0 -0.01 1594.91 1.00
- 2 pgdpN 0.70918 3893.6 1.01 1.00 6834.06 1.000

Figure 2. Simulation in current price

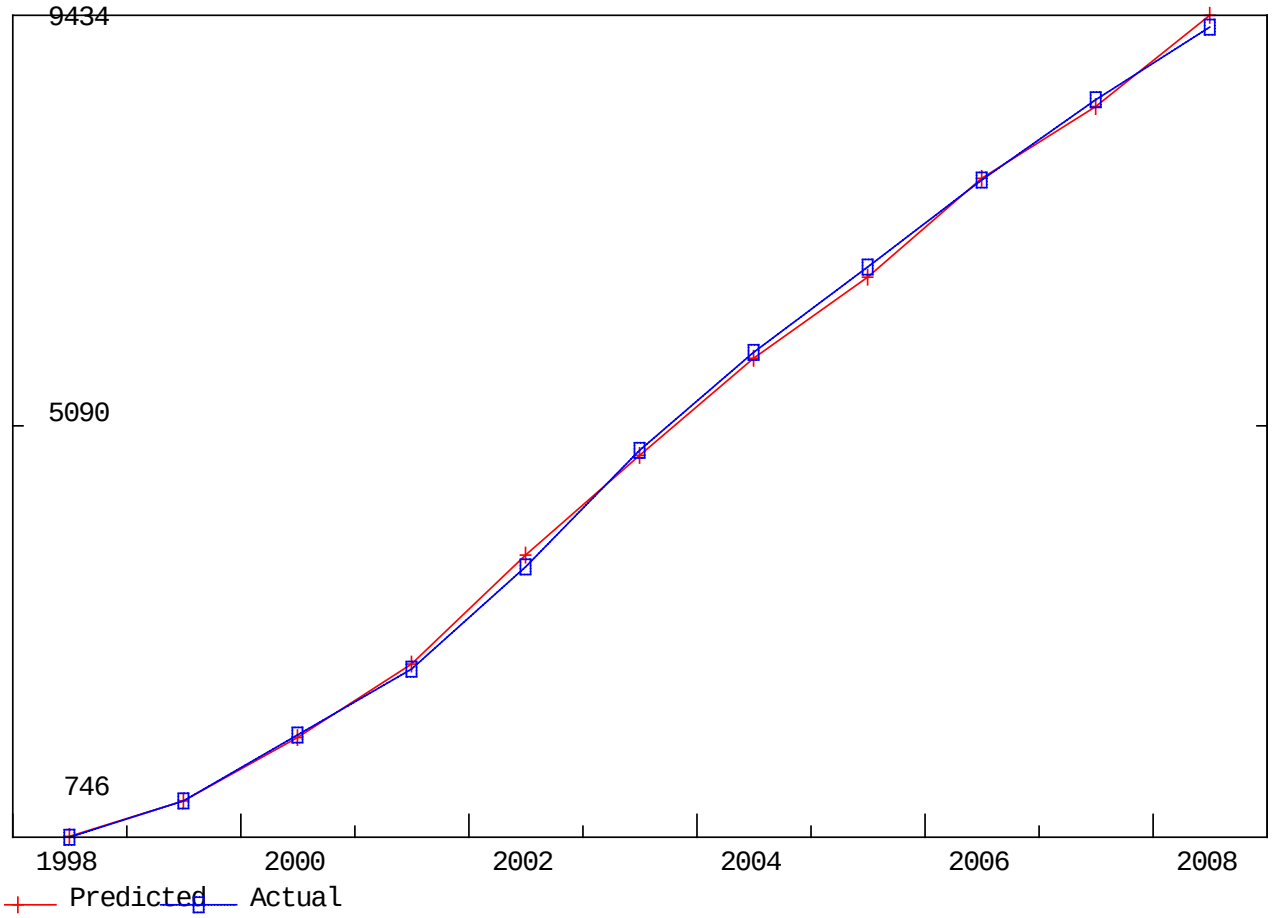
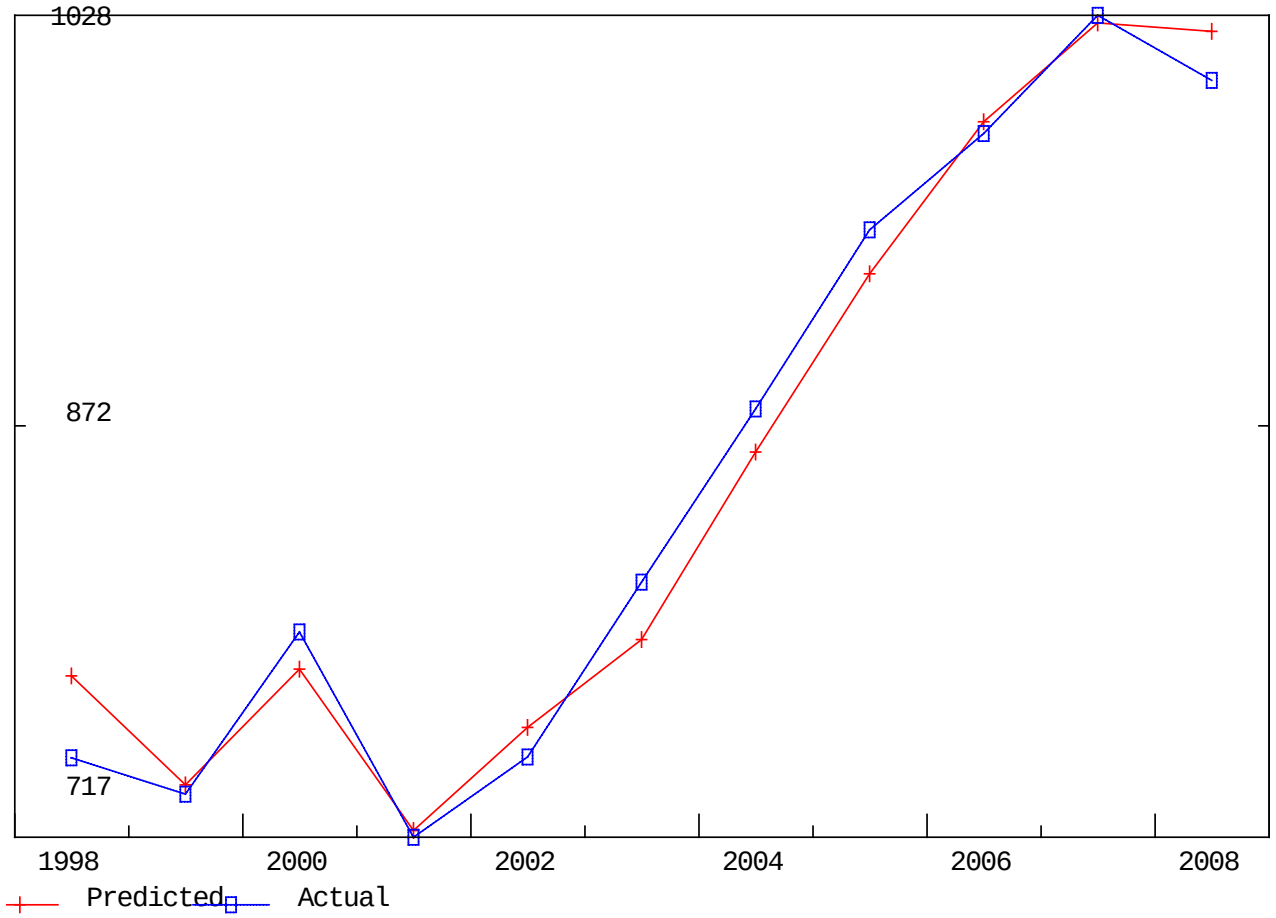


Figure 1. Simulation of Household Cons in constant price



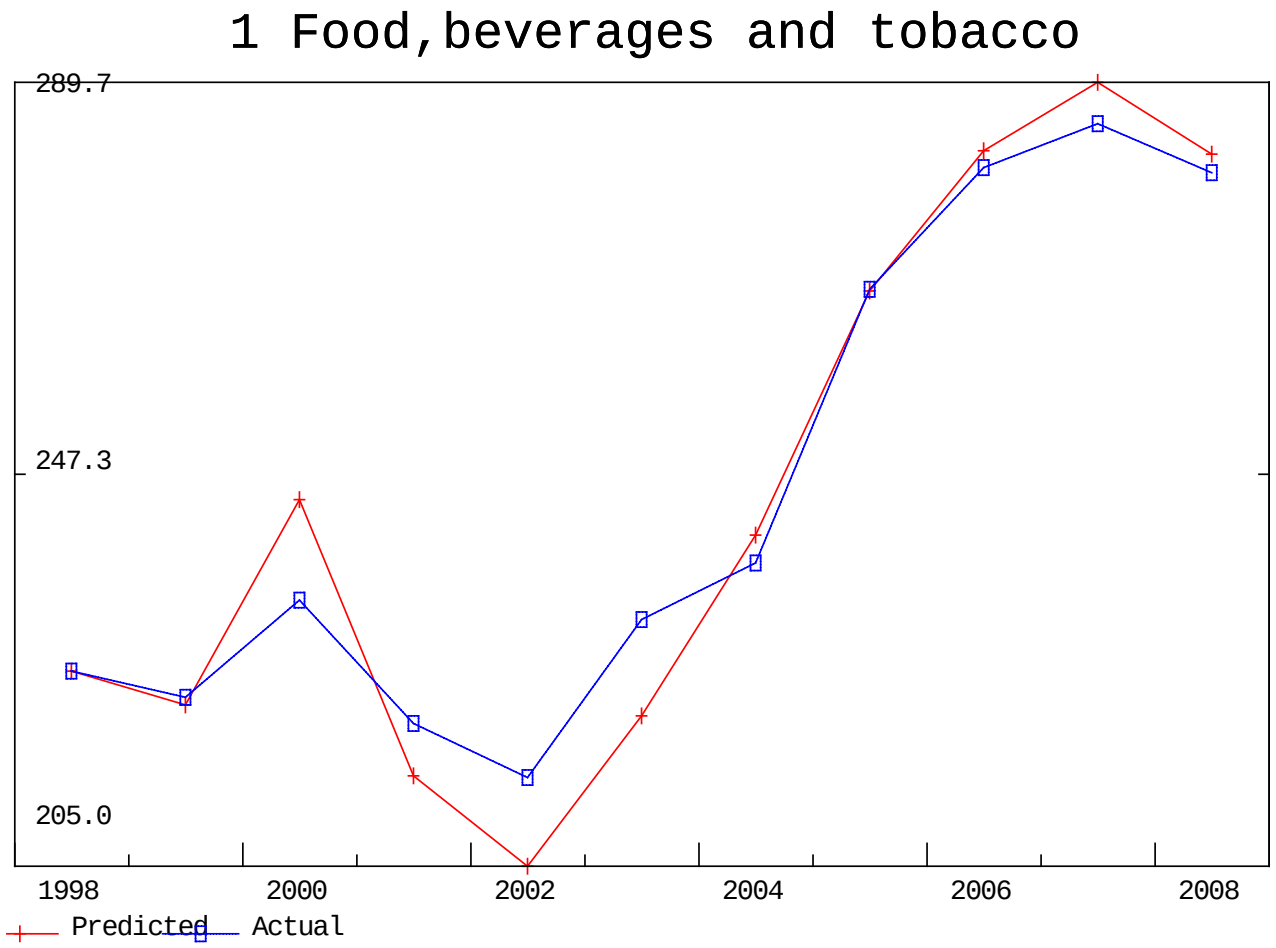
3. The Estimation of Behavioral Vector Equations

- The estimation of behavioral vector equations includes two vectors. One is the per capita household consumption in constant price by 10 categories. Another is the value added in current price by 58 sectors.
- For a full formula of a PADS equations, there is a special program SYMCON.EXE, developed by INFORUM , which can solve the non-linear simultaneous equations and give results.
- Since PADS in our model is simplified and can be easily solved by the non-linear regression command in G7, which seems less complicated, we decided not to use SYMCON.EXE.

- The command line for the non-linear regression of the equation (3), say for the household consumption category 1, is
-
- nl x1 = (a0*time + a1*y/P)*@pow(p1/P,-a2)
- 3
- 1, .5, .25
- .1 .1 .1
- It is also possible to put soft constraints on some parameters.

Regression results

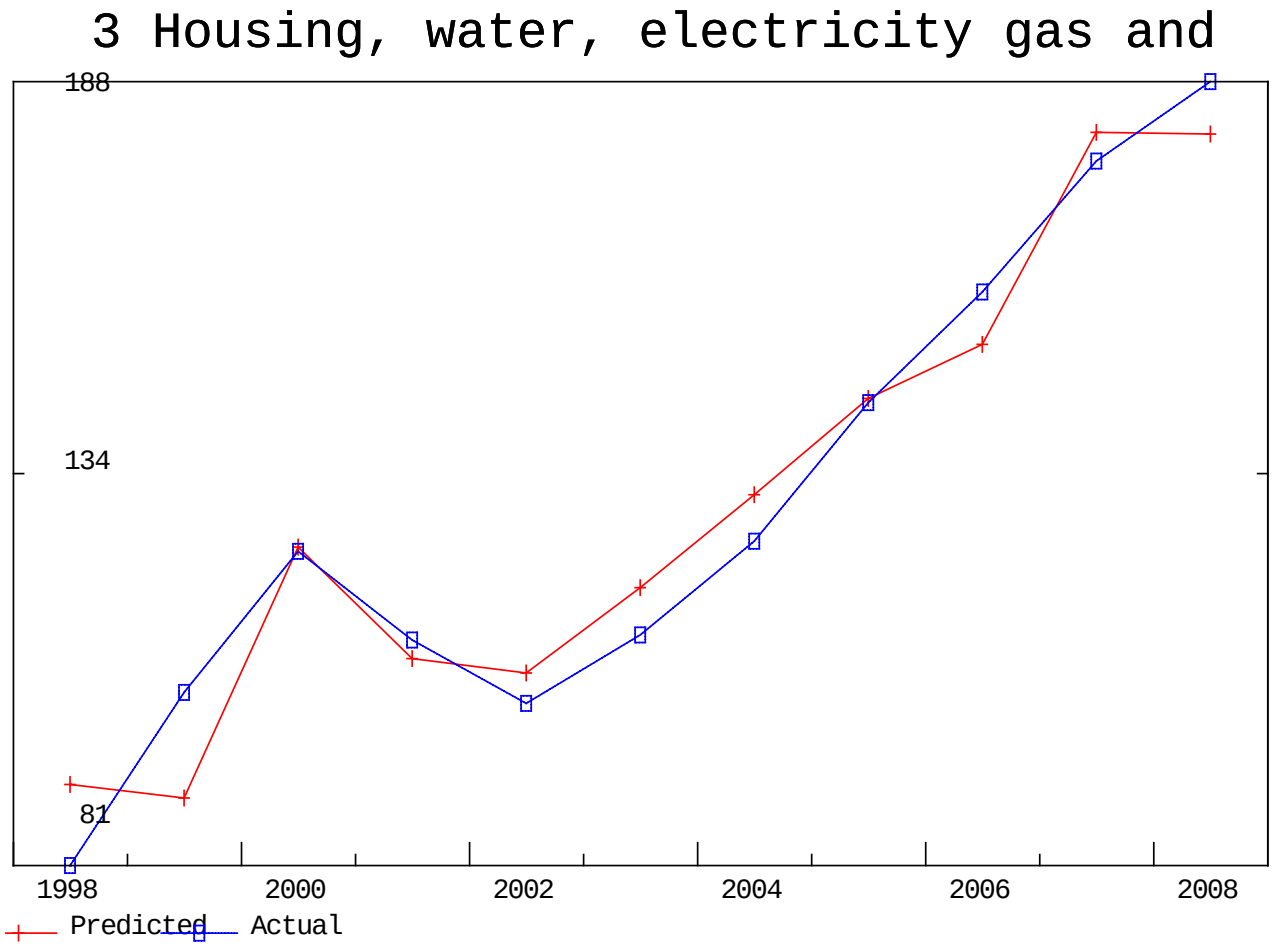
- Category 1
- SEE = 5.934833
- Param Coef T-value StdDev
- a0 -2.503816 -2.62 0.956751
- a1 0.306482 38.53 0.007953
- a2 0.331077 1.12 0.296063
- The income elasticity is 1.06


1 Food,beverages and tobacco
289.7
247.3
205.0
1998
2000
2002
2004
2006
2008
Predicted
Actual

Category 3

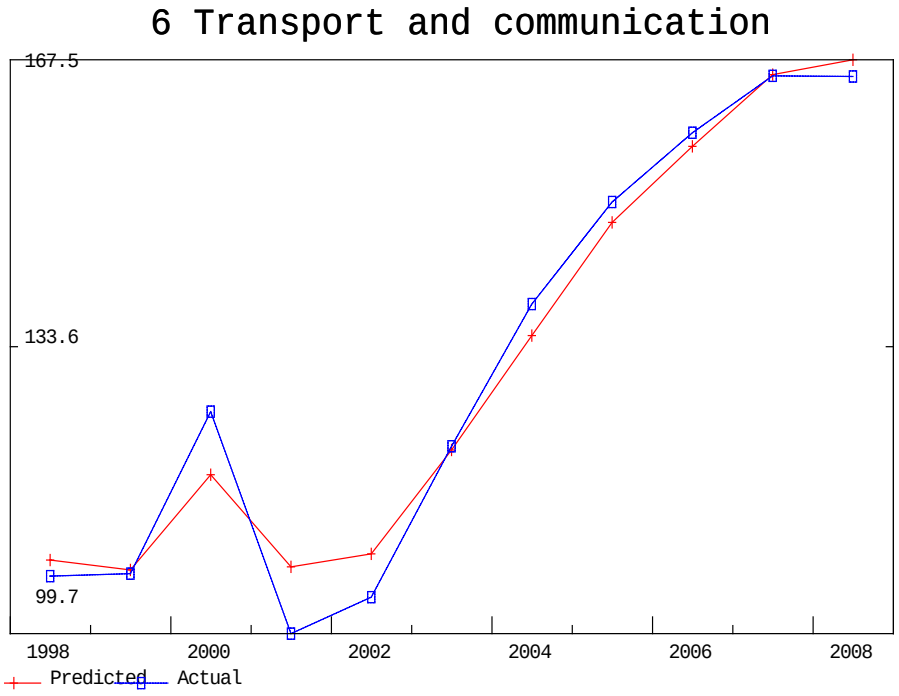
- SEE = 7.109050
- Param Coef T-value StdDev
- a0 1.068673 0.37 2.898244
- a1 0.152508 2.60 0.058655
- a2 23.290649 2.84 8.188540
- a3 0.382491 0.19 2.039955

- The income elasticity is 1.03


3 Housing, water, electricity gas and
188
134
81
1998
2000
2002
2004
2006
2008
Predicted
Actual

- Category 6
- SEE = 3.955514
- Param Coef T-value StdDev
- a0 2.953342 3.88 0.761408
- a1 0.141288 26.36 0.005360
- a2 0.230426 0.53 0.433724

- The income elasticity is 0.87


6 Transport and communication
167.5
133.6
99.7
1998
2000
2002
2004
2006
2008
Predicted
Actual

Regression results for 10 categories

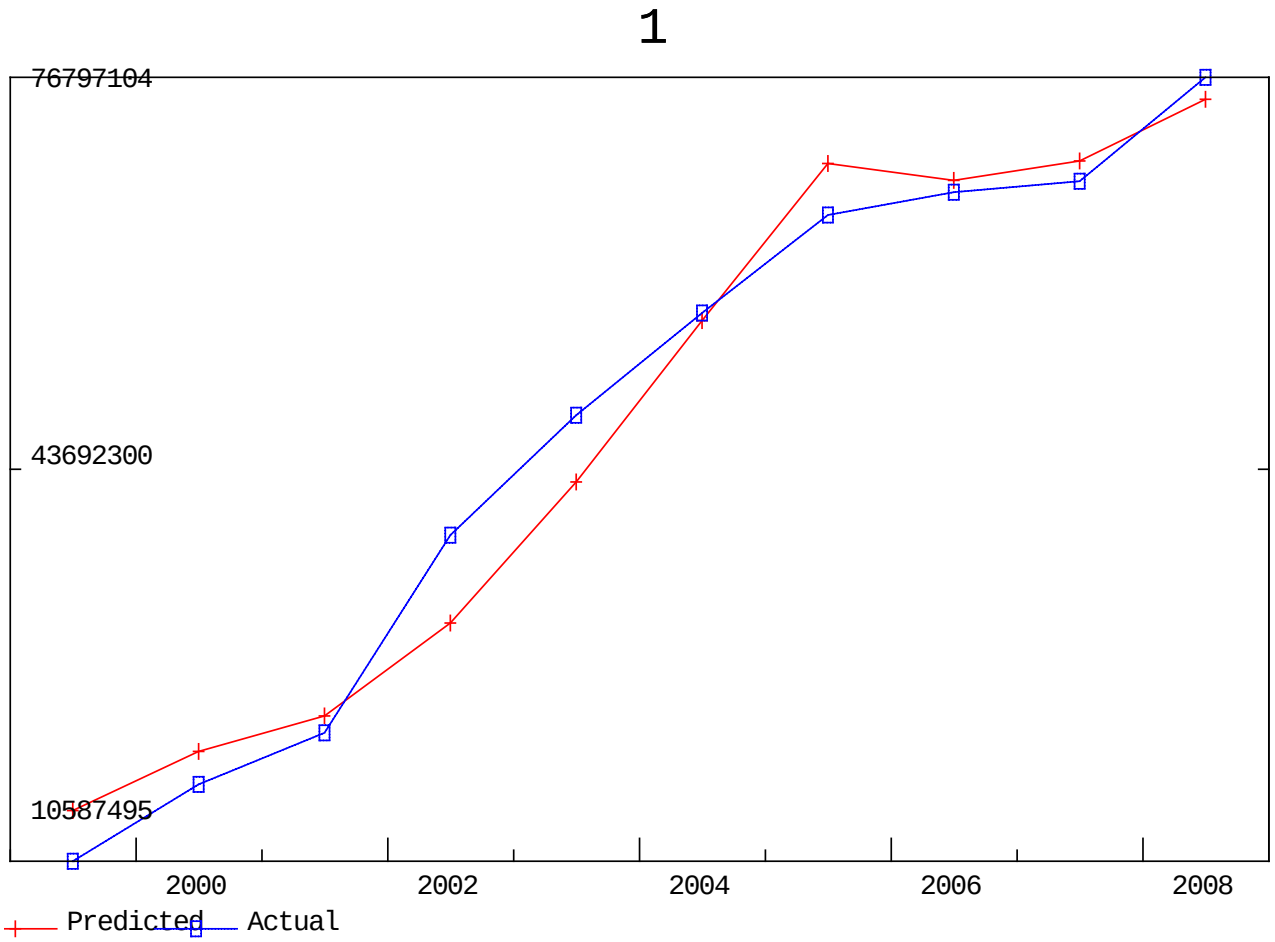
Budget share		a0	a1	PriceElas	IncElas
30.1	25.9	-2.504	0.306	0.331	1.06
12.0	5.7	-3.804	0.096	0.038	1.14
10.8	20.3	1.067	0.152	0.382	1.03
9.4	7.2	-0.975	0.092	2.424	1.06
2.6	4.1	0.984	0.027	1.180	0.78
14.3	18.5	2.953	0.141	0.230	0.87
5.8	3.9	-1.628	0.058	0.048	1.26
0.6	1.3	0.711	0.005	1.105	0.50
6.6	6.0	-0.450	0.064	0.927	1.05
7.6	7.1	0.381	0.077	2.480	0.97

- Another behavioral vector equation, in the model's framework, is value added vector in current price. It has 58 components or elements. Therefore, there are 58 behavioral equations for those 58 components, one for each.

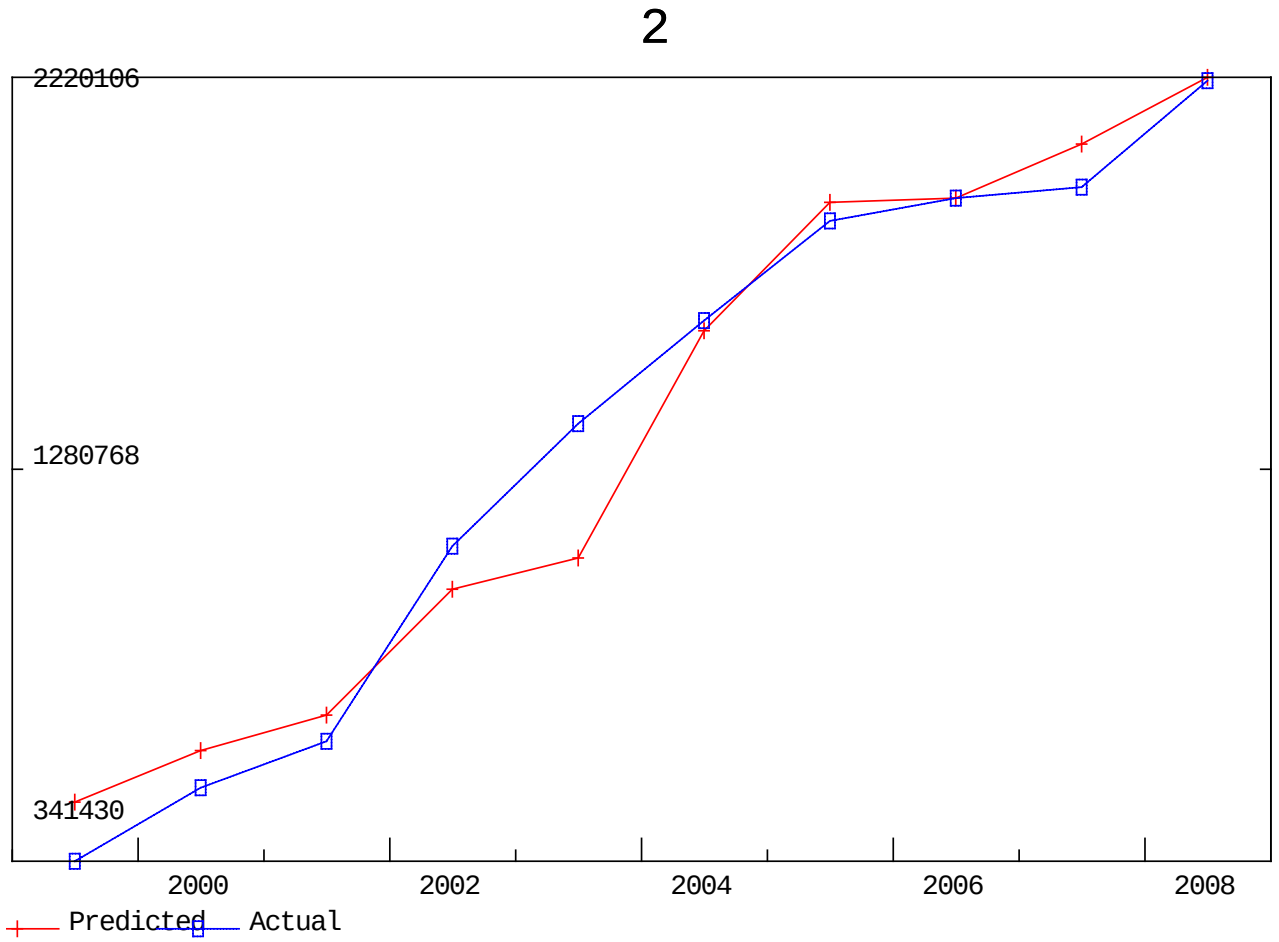
$$va = f\,(out * p(-1))$$

Regression results of value added for first four sectors are given below

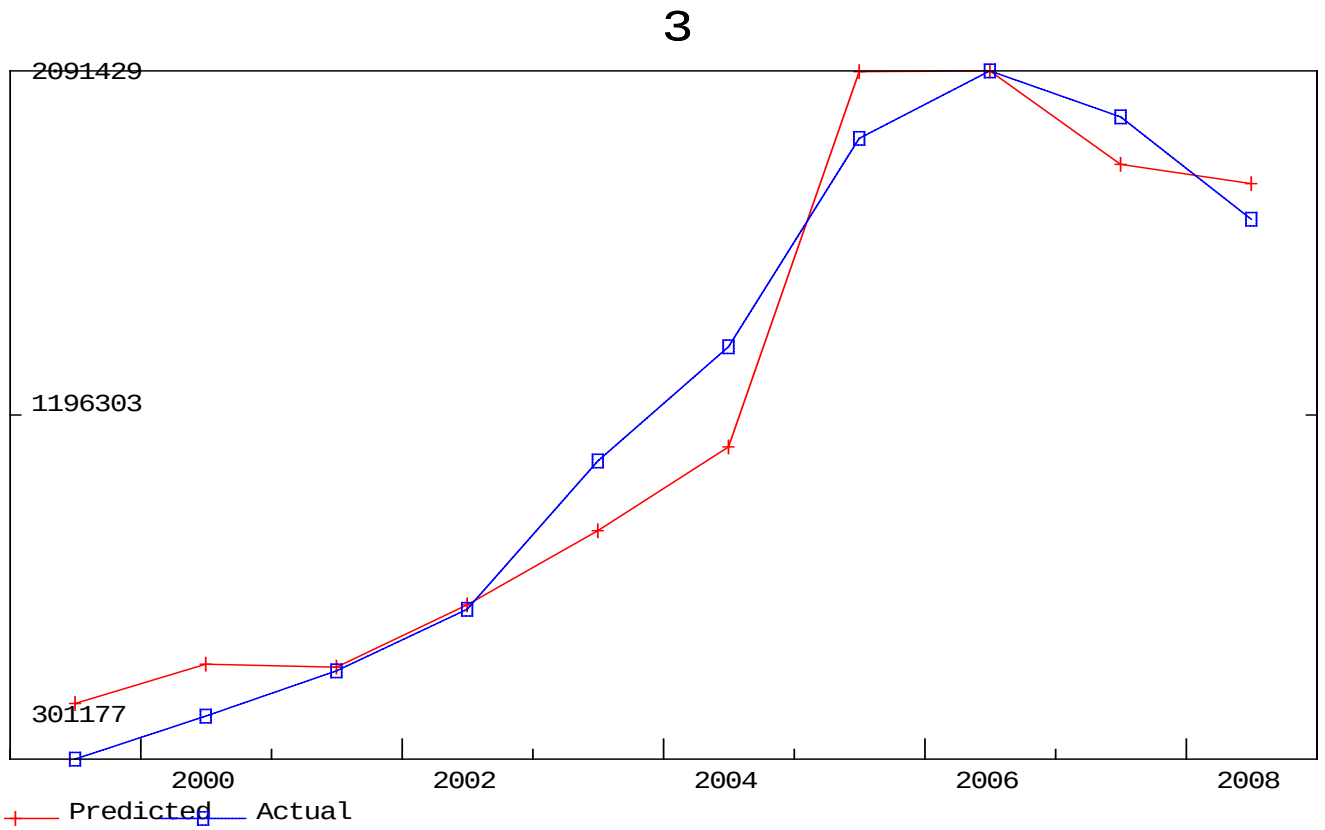
1. Agriculture, hunting and related services



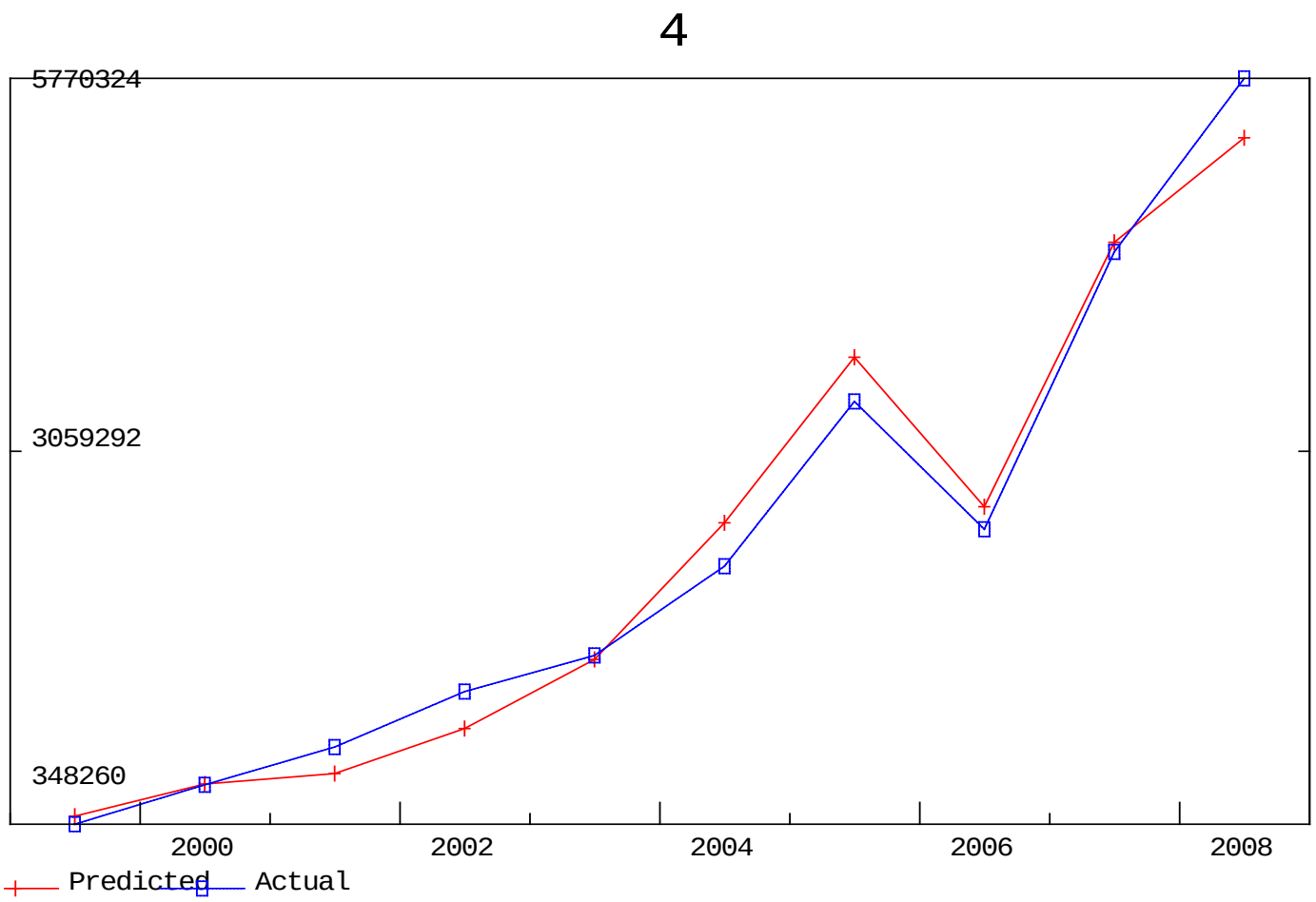
2. Products of forestry, logging and related services



3. Fish and other fishing products

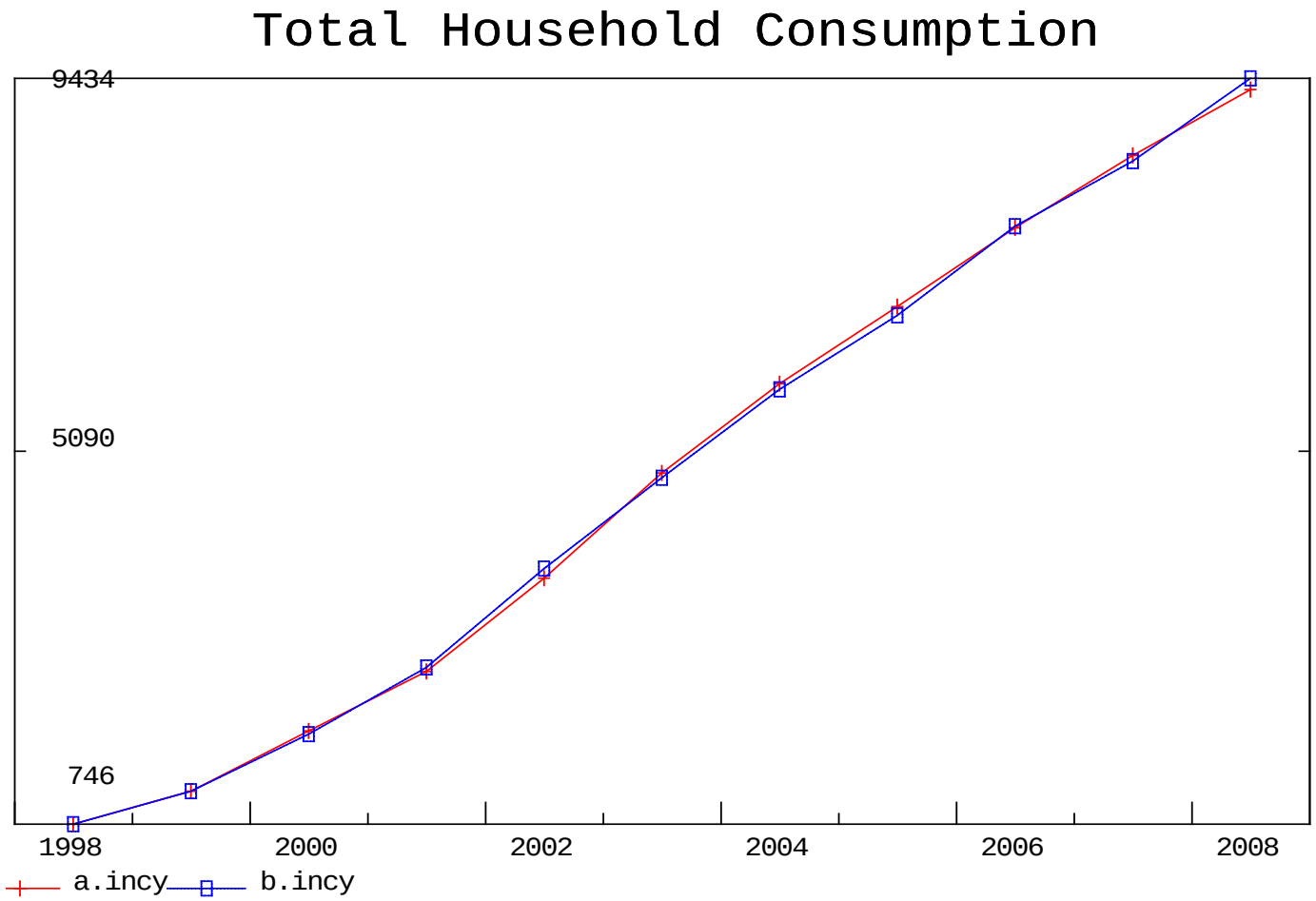


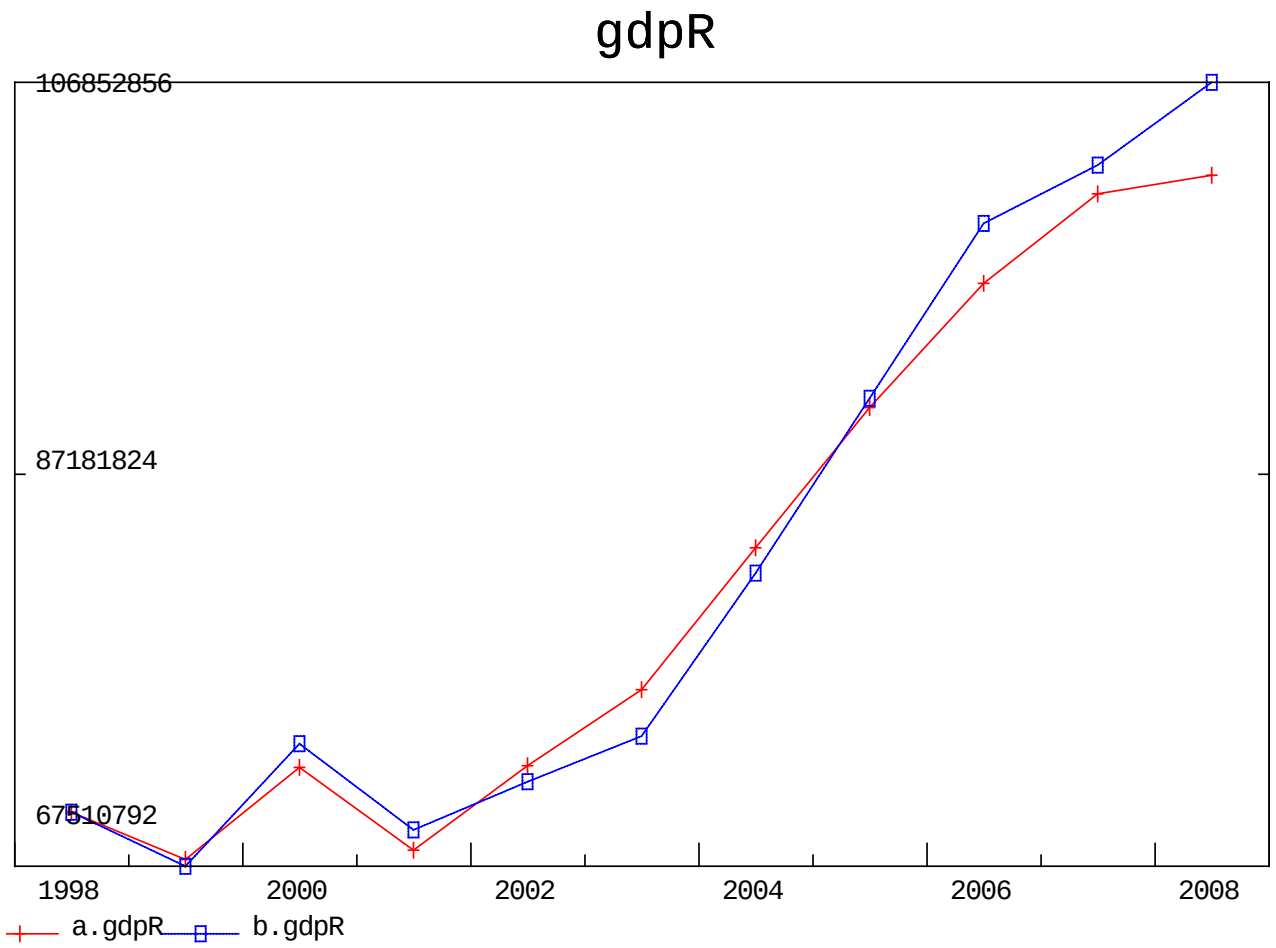
4.Coal and lignite; peat

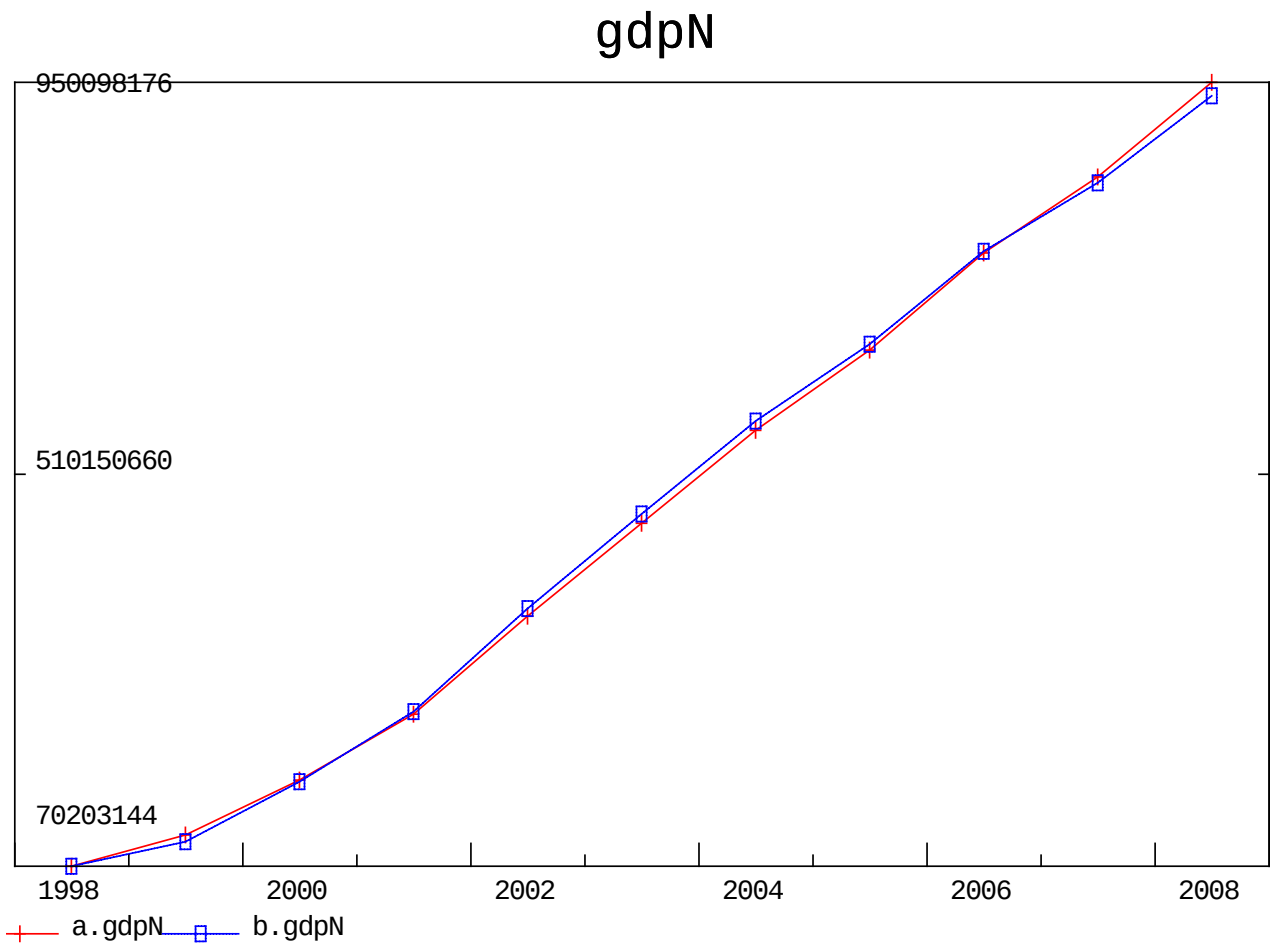


4. Simulation of the Model

- After getting ready in preparing the files such as model.cpp and so, it is not difficult to get a dyme.exe file whose content is the INFORUM model for Turkey. Simulation for the sample period is carried out. Some results of the simulation are listed in this section, first in figures, then in brief tables.


Total Household Consumption
9434
5090
746
1998
2000
2002
2004
2006
2008
a.incy
b.incy


gdpR
106852856
87181824
67510792
1998
2000
2002
2004
2006
2008
a.gdpR
b.gdpR


gdpN
950098176
510150660
70203144
1998
2000
2002
2004
2006
2008
a.gdpN
b.gdpN

The Simulation of Household Consumption Vector

	2000	2002	2004	2006	2008
1Agriculture	7693.67	4646.41	4966.57	5865.95	6034.41
	0.3	-1.29	-0.17	1.2	3.23
2Forestry	114.65	106.85	88.91	110.76	120.59
	0.3	-1.29	-0.17	1.2	3.23
3Fish	404.82	166.09	142.25	208.02	273.64
	0.3	-1.29	-0.17	1.2	3.23
4CoalLignite	178.39	221.61	252.93	317.19	318.98
	-3.72	6.55	2.47	-4.22	-13.25

Table 19. The Simulation of Output Vector

1Agriculture	13778.8	13048.7	13007	14053.7	13523.4
	-0.04	-0.68	-0.53	0.88	2.7
2Forestry	301.03	303.3	235.35	268.22	269.07
	-1.08	1.41	-0.33	-0.59	0.39
3Fish	319.06	278.07	293.75	507.59	448.58
	-0.16	-0.54	-0.44	0.36	2.19
4CoalLignite	460.54	344.99	412.88	376.31	619.5
	-3.75	6.28	0.87	-4.76	-7.64
5PetroleumGas	63.14	68.21	389.94	155.68	328.77
	-29.65	48.07	-4.34	-15.44	-6.68

Table 20. The Simulation of Price Vector

1Agriculture	196.84	439.79	658.81	719.31	868.87
	5.46	0.25	1.05	0.18	-1.63
2Forestry	199.57	421.13	810.39	838.87	957.4
	3.28	-1.54	0.61	0.93	-0.17
3Fish	159.47	325.66	608.83	536.91	507.17
	4.28	0.08	0.89	0.37	-1.41
4CoalLignite	209.8	593.78	854.79	1006.22	1402.53
	7.57	-4.72	0.35	4.62	6.18
5PetroleumGas	593.74	1230.32	1668.29	2558.28	3856.33
	37.71	-25.35	2.99	11.39	3.43

Table 21. The Statistics of the Percent Change of Simulation Results for 3 Vectors

Error	<=3%	>3% and <5%	>5% and <10%	>10%
%	72.65	16.55	9.25	1.55

5. Conclusion

- Throughout constructing simplified non-linear behavioral equations system “PADS”, the main part of the GDP by expenditure, i.e. the household consumption, is described by the model TURINA.
- The behavioral vectors, output and price vectors are calculated by the model, according to the two basic Input-output equations of INFORUM model.
- The next step should perhaps to have more detailed data for consumption so that ‘groups’ and ‘subgroups’ can be also identified.
- Nevertheless, the simulation results show that the bird “TURINA”, or ‘Turna’ for Turkish readers, starts to fly.