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MEDIUM TERM GROWTH PROSPECTS FOR THE TURKISH ECONOMY: SIMULATIONS WITH THE MODEL TURINA

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Abstract

The first parts of the contribution are devoted to a description of the dynamic interindustry model for Turkey. TURINA is a **Tur**kish **In**terindustry **A**nalysis model which is based on the philosophy of INFORUM family models. In the current version of the model the sample period covers 11 years from 1998 to 2008 and based on the 58-sector Input-output tables of 1998 and 2002. The structure of the model and its construction process is fully explained. Data consistency is secured using bridge matrices mapping national accounts statistics (SNA or ESA for some years) to I-O framework for each year from 1998 to 2010. Two basic input-output (I-O) vector equations, one for production and one for prices, are the pillars of the analysis. A set of 10-category household consumption functions, in the form of simplified PADS forms the main endogenous component of the model. Lack of data for the personal disposable income is a formidable obstacle and a theoretical deficiency of the model in general. To overcome this deficiency, per capita household consumption is basically explained as a function of per capita income and it is chosen as convergence variable of the model. Historical simulation of the model TURINA over the period 1998-2008 demonstrates a high degree of accuracy: About 72.65% of the 1740 results showed less than 3% error, and only 1.55% showed more than 10% error.

The second part of the paper deals with the use of the model for arriving at three scenarios, up to 2020, namely baseline, upside and downside. Four basic exogenous variables of the present model are: government current expenditures on goods and services, total fixed capital formation (i.e., gross investment including both public and private), exports of goods and service, and imports of goods and services). In the baseline or business as usual (BAU) scenario it is assumed that, over the forecast period (2011 – 2020), the exogenous variables will grow at an average annual rate equivalent to the average of their past five year growth performance. For the upside scenario it is simply assumed that these exogenous variables will grow about 2 to 3% more than their baseline trend. General recovery of the world economy and a possible accession of Turkey to the EU would justify this assumption. However a comprehensive analysis of the possible effects of the EU accession on the Turkish economy is beyond the scope the present paper. In the downside scenario a symmetric approach is followed in which the exogenous variables are assumed to grow 2 or 3 percent less than their paths in the baseline scenario reflecting a general slowdown in both domestic and the world economy.

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Conference Subject Numbers: 12 and/or 31

12. Conjoined Modeling Approaches using Input-Output Tables
31. Input-Output-based Policy Analysis

1. INTRODUCTION

INFORUM has had her Turkish partner on Inter-industry modelling since 1994 when Gazi Özhan from Ankara University visited University of Maryland at College Park as a visiting scholar. The 16th INFORUM international conference was held in September 2008 in the European University of Lefke, situated in North Cyprus. Starting from 2008 basically there have been two different types of input-output-based macroeconomic models for Turkey that are part of the INFORUM model family (Almon 1991, EUROSTAT 2008).

For the first one, in the summer of 2008, Paul Salmon, University of Rennes 1 in France was invited to join a small research group directed by Gazi Özhan, European University of Lefke. After a two-month work this group constructed the first version of INFORUM Turkey Model Version-1, called TINYTURK. In that version, the 59-sector input-output table of Turkey for 2002 and the time series of GDP by expenditure approach were used. The model has one explicitly defined vector equation in which the intermediate output plus final demand is equal to the gross output. This first version of the model covers the historical period of 1998 – 2007 and a baseline forecasting period from 2008 to 2020. (Salmon and Özhan, 2008). Alongside its contributions to input-output-based macroeconomic modeling for the Turkish economy, the main drawback of this first model was that all final demand categories of the input-output table, including household consumption, were treated exogenously.

The second model was built again by the same research group at the European University of Lefke. This time, in the summer of 2010, Yinchu Wang was invited to come to North Cyprus for cooperation research to do further work on the INFORUM Turkey model. The outcome of this work is called TURINA – Turkey's INterindustry Analysis Model. There are three different and sequential versions of TURINA. In the first version two comparable input-output tables of 1998 and 2002 were used (Ozhan *at al*., 2011a). Total household consumption variable in the final demand categories is endogenized and estimated with the introduction of a single regression equation into the model.

The second version of TURINA was developed in 2011 with the introduction of PADS into the system (Özhan *at al*., 2010). In this new version household consumption is separated into ten categories and estimated with a set of nonlinear regression equations formulated in a version of simplified PADS. Furthermore a set of simulation exercises are performed for many endogenous variables for 58 sectors over the period 1998 to 2008.

The third version of TURINA is a step forward in which the model is ran for future predictions over the period from 2011 to 2020. The present paper introduces this final step where three different forecasting scenarios are tried using the same structure of the model in its earlier versions. They are the baseline scenario, upside scenario and downside scenario.

The study is organized into six sections. The next section describes the general data situation required for the model. In this section some consistency checks are carried out for main macroeconomic data series. An extensive adjustment process is applied on the input-output tables, and various consistency checks between input-output and national income accounts are performed. Section three introduces the framework of the modeling. Section four explains the estimation process of household consumption equations by 10 categories. For this purpose a simplified PADS is applied. The regression results of value added vector by 58 sectors are also introduced in this section, followed by the historical simulations results of the model for the period 1998 to 2008. Section five explains the three forecasting scenarios and assumptions they are based over the period 2011-2020. Finally section six concludes.

2. DATA SITUATION, CONSISTENCY CHECKS AND ADJUSTMENT OF IO TABLES

2.1 General consideration

In any model building process priority should be given to collect a consistent set of data. For TURINA the main source of data has been the website of the Turkish Statistical Institute. On this website there are various Excel files which in some case contain different or duplicate data. In addition to these Excel files, there are also some PDF files which contain also the *Statistical Yearbook of Turkey 2011*. A valuable statistical source among those PDF files is the e-book of the historical data set named *Statistical Indicators, 1923 – 2010 (www.turkstat.gov.tr)*. An example of inconsistent data in those electronic files is related to the population series which is an important exogenous variable in macroeconomic models. Population of Turkey for 2000 in the *Statistical Indicators, 1923 – 2010* is given 67803927, which is a census data. The figure in a different Excel file called “Midyear population estimations and projections” is 64252000, which is 3552000 (about 5.5%) less than the census data.

After looking at all of these files carefully and doing some comparison on the data, three points are noticed:

- There are input-output tables for 1998 and 2002.
- Some relatively detailed sector classification time series started from 1998.
- Most economic statistics end at 2010.

From them, 1998-2008 is considered as the sample period of the INFORUM Turkey model version 2.0, named TURINA.

2.2 Adjustment on the Input-Output tables

In the meantime, some problems with respect to data checking are noticed as well. The following are some of them.

- The sector 30 (Recycling materials) is blank in 1998 input-output table while it is defined in the 2002 input-output table with some numbers in rows and columns.
- Sector 6 (Uranium and thorium ores) is blank both in the 1998 and 2002 input-output tables.
- The sum of value added (“Value added at basic price” plus “Taxes less subsidies on products”) or sum of final demand (“Final uses at basic prices” minus “imports”) from 1998 input–output table is “TL53414” million, which is different from, about 31.4% less than “TL70203” million data shown in the e-book *Turkey’s Statistical Yearbook 2007*.
- The sum of value added (“Value added at basic price” plus “Taxes less subsidies on products”) or sum of final demand (“Final uses at basic prices” minus “imports”) from the 2002 input-output table is “TL315867” million, which is different from, about 11% less than, “TL350476” million, the data shown in the e-book *Turkey’s Statistical Yearbook 2007*.

  The comparison between the IO tables and national accounts data for GDP by expenditure approach is shown in Table 2.1 and Table 2.2. More will be said in the following section about “the old” and “the new” GDP series shown in the columns of these tables[1].

Table 2.1. Comparison of input-output values and GDP expenditure, 1998

	Millions of TL			Deviations in %		
	Old GDP (Base 1987)	New GDP (Base 1998)	IO1998	NewGDP/ OldGDP	OldGDP/ IO1998	NewGDP/ IO1998
GDP	53553	70203	53414	31.1	0.3	31.4
C	36123	46669	35395	29.2	2.1	31.8
G	6633	7198	6229	8.5	6.5	15.5
I	12839	16047	12616	25.0	1.8	27.2
ΔSto	-182	-522	706	187.5		
Exp	12713	14980	13669	17.8	-7.0	9.6
Imp	14573	14167	15202	-2.8	-4.1	-6.8

Source: i. TurkStat; ii. Own calculations.

For the main categories of GDP expenditure or output approach requires the following identity to hold for every year.

$$GDP = C + G + I + X - M \quad (2.1)$$

[1] More will be said about “the old” and “the new” GDP series in Section 2.5.

where
C: Household consumption expenditures on goods and services
G: Government expenditures on goods and services
I: Gross fixed capital formation (including the changes in stocks)
X: Export of goods and services
M: Imports of goods and services

Equation (2.1) must hold not only for national income accounts or but also for the input-output table for the relevant year. Furthermore this identity must produce the same GDP figure for the same year.

Table 2.2. Comparison of input-output values and GDP expenditure, 2002

	Millions of TL			Deviations in %		
	Old GDP (Base 1987)	New GDP (Base 1998)	IO2002	NewGDP/ OldGDP	OldGDP/ IO2002	NewGDP/ IO2002
GDP	278221	350476	315867	26.0	-11.9	11.0
C	184420	238399	230311	29.3	-19.9	3.5
G	38722	44615	44372	15.2	-12.7	0.5
I	46043	58602	58009	27.3	-20.6	1.0
Sto	13134	3131	3125			
Exp	81134	88381	64538	8.9	25.7	36.9
Imp	85232	82652	84490	-3.0	0.9	-2.2

Source: i. TurkStat. ii. Own calculations.

2.3 The initial adjustments on the input-output tables

Before comparing and adjusting the IO figures with the national income statistics it is necessary to have initial treatments particularly on the input-out table itself (Wang, 1998). For that purpose four adjustments are done:

- Adjustment for the concept of basic price
- The treatment of Sector 30 in 1998 IO table
- The treatment of sector 6 in 1998 and 2002 input-output tables

i. Adjustment for the concept of basic price

The original Turkey input-output tables both for 1998 and 2002 are at basic price. The first sector's data in the third quadrant (value added block) of the 1998 table, as an example, are shown in Table 2.3.

Table 2.3. The Original Items of the Third Quadrant

Item	Numbers (Millions TL)
Intermediate input (A)	3 186 664 224

Taxes less subsidies on products (B)	172 544 289
Total intermediate consumption (C=A+B))	3 359 208 513
Compensation of employees (D)	652 584 237
Other taxes on production (E)	76 930 338
Other subsidies on production (F)	- 121 110 252
Consumption of fixed capital (G)	225 948 910
Operating surplus, net (H)	5 166 753 984
Value added at basic prices (I=D+E+F+G+H)	6 001 107 217
Output at basic prices (J=I+C)	9 360 315 730

Source: TurkStat.

On the other hand, one of the essential conditions in a typical INFORUM model is to have the relationship

Sum of value added side = Sum of final demand side (2.2)

Equation (2.2) must hold for the whole system but not necessarily for each sector. For each sector the required identity is

Row sum = Column sum (2.3)

However, the sum of value added by sector at basic prices will be not equal to the sum of final demand by sectors in the original Turkey IO tables. Their difference comes from the item B (Taxes less subsidies on production). The simplest method to deal with this problem is to put the item B into value added block by combining it with item E (other taxes on production) and F (other subsidies on production) into an item called “taxes minus subsidies” as shown in Table 2.4.

After the adjustment described in Table 2.4, the Turkey 1998 and 2002 IO tables will be subject to the condition (2) between the two totals of second quadrant and the third quadrant.

Table 2.4. Adjustment of the Third Quadrant

Item	Numbers
Total intermediate input (=A)	3 186 664 224
Wages (=D)	652 584 237
Taxes minus Subsidies (=B+E+F)	128 364 375
Depreciation (=G)	225 948 910
Operating Surplus (=H)	5 166 753 984
Value Added (=I+B)	6 173 651 506
Gross Output (=A+I+B)	9 360 315 730

Source: i. TurkStat. ii. Own calculations.

ii. The treatment of Sector 30 in 1998 IO table

Since the sector 30 “Recycling” or “Secondary raw materials” has all zero values (blank sector) in 1998 Input-output table it would cause a problem for later modeling. A simple method to deal with this problem is to assign values to this sector for the 1998 IO table.

A natural opinion is to “borrow” these values from its neighborhood sector “Manufacturing not elsewhere included, sector 29”. The practical idea was to have the ratio vectors between sector 30 and the sum of sector 29 and 30, by column and row, from the 2002 input-output table. Throughout using these ratio vectors, sector 29 is allocated into sector 29 and 30, by column and row in the table for 1998. Eventually it worked well.

iii. The treatment of sector 6 in the 1998 and 2002 input-output tables

Since sector 6 “Uranium and thorium ores” has no data in the two tables, it is better to delete it from the tables. After this adjustment the total sector number is 58, rather than 59. The classification and definition of the 58 sectors used in the model are given in the Appendix.

2.4 Treatment of the Inconsistency between IO Tables and National Accounts

In TurkStat website GDP by expenditure approach is published in 17-sector classification. It can be checked that the GDP data at purchaser’s price (the last row of the source tables) is consistent with the values of the GDP data by expenditure from other sources. It is quite good to have value added by 17 sectors, even though the sum of the value added of these 17 sectors is not the same as GDP. The difference is due to the item of “Financial intermediation service indirectly measured” and “Taxes – subsidies”. The 17-sector value added can be scaled by using the ratio between their sum and the GDP value so that the sum of the resulting 17-sector value added can be equal to GDP. After having completed this adjustment operation, it can be seen that the sum of the 17 sectors’ value added is now equal to the GDP from national accounts. These numbers are treated as the fundamental framework of the INFORUM model for the Turkish economy.

Then a second problem emerges: How will it be possible to reconcile these 17-sector GDP data with the input-output tables? To answer this question a carefully designed adjustment process is applied. The adjustment includes three steps.

First, the 58-sector value added data from input-output table is aggregated into 17 sectors. The aggregation scheme is shown in Table 2.5 below. To do the aggregation operation, it is necessary to have a comparison list between these two sector classifications. It is not too difficult to do that because basically each one of the 17 sectors has a clear corresponding sector or a group of sectors in the 58-sector IO table, except for the sector 11 and 12 of the 17 sectors which do not clearly and individually correspond to some sector or sectors of the IO table. However, if these two sectors are merged into one, the result will have clear corresponding sectors in 58 IO sectors. Therefore, the final aggregation guide list is from 58 sectors to 16 sectors as shown in Table 2.6.

By using the guide list in Table 2.5, aggregation operation was done for the 58 sector input-output table of 2002. The ratios of the 16 sectors' value added between those from national account data (originally 17) and from the aggregated input-output table for 2002 are shown in the last column of the table.

Table 2.5. Ratios of 16 Sector Value Added between Two Data Sources for 2002

SNA	IO		SNA 2002	IO 2002	
16 Sec	58 Sec	Sector Name	Value added	Value add	SNA/IO
1	"1, 2	Agriculture, hunting and forestry	39173910	34123379	1.148
2	"3	Fishing	689480	649043	1.062
3	"4…7	Mining and quarrying	3566420	3295710	1.082
4	"8...30	Manufacturing industry	68942250	62551380	1.102
5	"31, 32	Electricity, gas and water	8858739	7778761	1.139
6	33	Construction	16259344	14811283	1.099
7	"34...36	Wholesale and retail	47338870	44099262	1.073
8	"37	Hotel and Restaurants	8829104	7561761	1.168
9	"38...42	Transport, storage, communication	54198942	46212317	1.173
10	"43...45	Financial intermediation	17080361	14870439	1.149
11	"46...50	Ownership and dwelling real est.	44222784	43913996	1.007
12	"51	Public administration	17683792	14949253	1.183
13	"52	Education	10460830	9631637	1.086
14	"53	Health and social work	5602567	4619662	1.213
15	"54...57	Other community, social service	7013288	6297422	1.114
16	"58	Private hh. with employed person	555406	501799	1.107
Total VA (GDP)		Sum of 16 sectors	350476089	315867104	1.110

Source: i. TurkStat. ii. Own calculations.

It can be seen that the biggest ratio happens in sector 14 which is "Health and social work" and there is only one single corresponding sector between two sources. On the other hand, the sector 11 which is merged (from original sectors 11 and 12) has the smallest ratio between the two sources, which is close to 1.

By following the same principles and applying the same process, the adjustment for 1998 input-output table can be done as well. The ratios between SNA figures and input-output data are listed in Table 2.6 for the year 1998.

Table 2.6 SNA and IO Comparison, 1998

SNA 16 Sec	IO 58 Sec	Sector Name	SNA 1998 Value added	IO 1998 Value add	SNA/IO
1	"1, 2	Agriculture, hunting and forestry	8797375	6404772	1.374
2	"3	Fishing	244564	235597	1.038
3	"4…7	Mining and quarrying	752753	539364	1.396
4	"8...30	Manufacturing industry	17336477	12100916	1.433
5	"31, 32	Electricity, gas and water	1353221	1269096	1.066
6	33	Construction	4218576	3840190	1.099
7	"34...36	Wholesale and retail	10155673	7782527	1.305
8	"37	Hotel and Restaurants	1841768	1550414	1.188
9	"38...42	Transport, storage, communication	7986995	7167536	1.114
10	"43...45	Financial intermediation	5521054	3414376	1.617
11	"46...50	Ownership and dwelling real est.	5412295	3037870	1.782
12	"51	Public administration	2911095	4409308	0.660
13	"52	Education	1593970	169674	9.394
14	"53	Health and social work	870243	746280	1.166
15	"54...57	Other community, social service	1125868	724399	1.554
16	"58	Private hh. with employed person	81220	19780	4.106
Total VA (GDP)		Sum of 16 sectors	70203147	53412099	1.314

The second step is to use the ratios in Table 2.5 and the relationship between the two sector classifications for scaling the columns of the first (intermediate input block) and third (value added) quadrants of the aggregated 2002 input-output table- i.e., the intermediate input and cost parts (value added components), including the output by columns. This operation will have the new value added, and therefore the GDP of their total from input-output table, consistent with the national account numbers. However this process is true only for 16-sector classification. To extend the 16-sector classification of IO structure back to 58- sector classification it is assumed that, the structure information by column (coefficients of the input-output matrix, shares of the value added components, ratios between value added and output) of the new table will keep the same as the original one. Finally this enlargement process produced a new IO table fully consistent with the SNA data (national accounts statistics).

Finally the last step is to adjust the second (final demand) quadrant of the IO table. Once the total output vector is determined in the second step it is not difficult to have the new intermediate output vector. The difference between the output vector and the intermediate output vector is the final demand vector. To allocate the final demand vector into different component vectors (household consumption, government consumption, fixed capital formation, inventory change, export and import) the principle of using the national account data as control total is applied. Accordingly, the GDP by expenditure data shown in Table 2.1 and 2.2 are used as the allocation guide.

In calculation, the vectors of household consumption, government consumption, fixed capital formation, export and import are created first by using the control total from these two tables. However converting those broad totals into 58-sector input-output structure posed a set of new problem. Without going further into detail only the household final consumption expenditure adjustment process will be explained in the next section (Section 2.3).

The difference between the final demand vector and the sum of these initial vectors is the vector of inventory change. Since the change in inventories is not always a fixed proportion of output or final demand the adjustment with this vector is generally a difficult problem. To make the problem less serious in the whole process the value of inventories for some sectors are determined residually. This approach is justifiable since the share of the change in inventories in total output is negligible, less than 1 percent in most cases.

The resulting input-output table will still keep the required identities: intermediate output plus final demand equals output, and intermediate input plus value added equals output. And also the GDP from value added side and from final demand side will be consistent with the GDP from national account statistics.

2.5 The old and the new GDP series

To meet the new international requirements in national income accounting statistics outlined basically in the publications, like SNA 1968, SNA 1993, and ESA95, the national accounts statistics published by the TurkStat is revised with some intervals. After each revision GDP goes up significantly to reflect the changes in the definitions and methods in calculations at industry level. Broadening the coverage of economic activities and the inclusion of new business establishments in all branches of the economy are the main source of the revised data. The last update was made in March 2008 when the base year was shifted from 1987 to 1998. As a result some major changes in the GDP figures both in current and constant price values occurred and the new series was made available for public use.

The old GDP series, which is called “the 1987 GDP series” was established in 1993 and covers the period from 1968 to 2006. The new GDP series, which is called “the 1998 GDP series” was established in 2008 and starts from 1998 and runs until present time. These two GDP series have nine overlapping years from 1998 up to 2006. For those overlapping years the new series reveals a big jump in the GDP figures, ranging from 26.3 percent increase in 2002 to 35.1 percent increase in 1999. For example GDP for 2006 increased by 31.6 percent with the new method.

In statistical terms the above-mentioned process is a kind of backcasting, which implies that there has been some already established values of certain variables, those values can be re-estimated or recounted once more with a new method and assumptions. Thus an updated new series is obtained for the same set of variables.

What has been said so far for the two GDP series can be summarized in Table 2.8.

Table 2.8. Two GDP series, GDP87 and GDP98

Year	GDP87 (Old GDP Series)		GDP98 (New GDP Series)		
	1000000 TL (Nominal)	Average growth rate %	New TL (Nominal)	Average growth rate %	Change from GDP87 %
1968	163,515		na		
1987	74,721,925	32.2	na		
1992	1,093,368,045	53.7	na		
1997	28,835,883,135	59.6	na		
1998	52,224,945,129	81.1	70,203,147,160		34.4
1999	77,415,272,308	48.2	104,595,915,540	49.0	35.1
2000	124,583,458,276	60.9	166,658,021,460	59.3	33.8
2001	178,412,438,499	43.2	240,224,083,050	44.1	34.6
2002	277,574,057,483	55.6	350,476,089,498	45.9	26.3
2003	359,762,925,944	29.6	454,780,659,396	29.8	26.4
2004	430,511,476,969	19.7	559,033,025,861	22.9	29.9
2005	487,202,362,279	13.2	648,931,711,812	16.1	33.2
2006	576,322,230,865	18.3	758,390,785,210	16.9	31.6
2007	na		843,178,421,420	11.2	
2008	na		950,534,250,715	12.7	
2009	na		952,558,578,826	0.2	
2010	na		1,103,749,801,055	15.9	

Source: i. TurkStat. ii. Own calculations.

During the same period (first decade of the third millennium), another important development in the history of Turkish national accounts statistics had taken place. It happened when the government decided to drop six trailing zeros on the Turkish Lira and introduced the new currency called "the New Turkish Lira". The decision came into effect from January 1, 2005. After five years of transitory period, since January 2009, the currency has now been renamed again "the Turkish Lira".

To conclude this section it can be said that a consistent and comprehensive data for GDP from production side and GDP from expenditure side are available starting from 1998. The latest two input-output tables for the Turkish economy are available for 1998 and 2002 published by the TurkStat and for the purpose of this work they are made compatible with the GDP series. Therefore it is fair to say that 1998 is chosen as the ideal starting point for the databank of TURINA.

3. MODEL FRAMEWORK

3.1 General Structure

A typical INFORUM model includes two important vector equations:

$$q = Aq + f \qquad (2.4)$$

$$p = A'p + v/q \qquad (2.5)$$ [2]

where, A is input-output coefficient matrix in constant price, A' is the transpose of matrix A, q is gross output vector in constant price, f is final demand vector in constant price, v is value added vector current price and p is price index vector.

Since INFORUM model is also a dynamic model, it is necessary to have all of these matrices and vectors, mentioned above, as time series for the analysis period. However, it is difficult to have statistics and input-output tables which can naturally satisfy this condition. One of the most important tasks of the model builder is to use available statistics and limited input-output tables at hand and to create or close such condition.

The adjustment process of the input-output tables for 1998 and 2002 is mentioned in Section 2 already. But this is not the only task to be completed before going into further steps of modeling. To complete the full list of preliminary steps the following time series of vectors must be also calculated for the sample (historical) period. For the model TURINA these are

- Output vector
- Value added vector
- Price index vector
- Final demand vectors
  - Household consumption
  - Government consumption
  - Fixed capital formation
  - Inventory changes
  - Export
  - Import

Because of its big share in GDP and for limited size of the present paper, in this

[2] The second part on the right hand side represents element by element division of two vectors v and q.

section only formation of the household consumption vector will be explained[3].

3.2 Household consumption: adjustment with a bridge matrix

The vector of household consumption is considered first due to its big size. Its share is more than two thirds of the GDP by expenditure method. For some years it even exceeds 70% of GDP (Table 3.1).

Table 3.1 Share of Household Consumption in GDP

1998	2002	2004	2006	2008	2010
66.5	68.0	71.3	70.5	69.8	71.3

In the TurkStat sources there are household consumption data by 10 categories. An important point is that the sum of the household consumption in 10 categories is slightly inconsistent with the corresponding figure of household consumption in GDP by expenditure from national account. The difference is due to both definitions of the household consumption coverage are different. In the GDP by expenditure definition covers only final consumption expenditures of resident households, while the 10-category household consumption data covers both resident and nonresident household consumption on the economic territory. For example in 1998 the resident household consumption figure is 46668561 in GDP but for the 10-category consumption detail the total (residents plus nonresidents) figure is 49694150.

To follow the principle to use consistent data, and if those relatively detailed household consumption data to be used the second set of data should be scaled according to the ratio between the corresponding data from the two tables. As a result of this operation the adjusted data for household consumption are listed in Table 3.2.

Table 3.2. Adjusted Household Consumption by Category (Current price, TL1000)

		1998		2002	
		Value	Budget share (%)	Value	Budget share (%)
1	Food, beverages and tobacco	14115697	30.2	66953887	28.1
2	Clothing and footwear	5616047	12.0	21604706	9.1
3	Housing, water, electricity, gas and oth.	5055124	10.8	38698374	16.2
4	Furnishing, household equipment and routine maintenance	4371627	9.4	17395931	7.3
5	Health	1204979	2.6	8842284	3.7
6	Transport and communication	6648734	14.2	40127985	16.8
7	Recreation and culture	2751408	5.9	11429625	4.8

[3] For further details about other final demand vectors see Özhan *at al.* (2011).

8	Education	311906	0.7	2078541	0.9
9	Restaurants and hotel	3073398	6.6	14731044	6.2
10	Other goods and service	3519642	7.5	16536706	6.9
	Total consumption of household	46668562	100.0	238399083	100.0

Source: i. TurkStat. ii. Own calculations.

However this is not the end of a long story concerning household consumption vector. The data in Table 3.2 contains only 10 sectors while the input-output table has 58 sectors. Then, how is it possible to convert the 10-element household consumption vector of national accounts to 58-element consumption vector in the final demand block of the IO table? The answer to this question is to use a bridge matrix. The bridge matrix is one of the basic tools that INFORUM model builders apply. Thus, it seems necessary to build up a bridge matrix that can convert the 10-category consumption vector into 58 input-output sectors.

Suppose the household consumption by 10 categories is a vector with 10 elements, called $hcna$, the corresponding consumption vector in 58 IO sectors has 58 elements and called $hcio$, the bridge matrix, if called B, is a 58x10 (10 columns and 58 rows) matrix. Then conversion is done by

$$B_{58x10}hcna_{10x1} = hcio_{58x1} \qquad (2.6)$$

By using both of the 10-category and 58-sector classification consumption data for the same year, the bridge matrix B can be created. Then it can be used for other years in which there is only 10-category consumption data. It should be noted that the sum of the elements of vector *hcna* and the sum of the elements of vector *hcio* must be the same number. Therefore, the household consumption data from input-output table should be the one from the adjusted table which has the consistent data with national accounts, rather than the one from the original input-output table[4].

3.3 Time series of other final demand vectors

Other final demand categories cover government expenditures on goods and services, fixed capital formation, change in inventories, exports and imports of goods and services. Sources of data and the details of the calculation process of these components in vector forms are fully explained in Özhan *at al*. (2011) which reports the first version of TURINA. In addition two main vectors were also calculated that form the integral part of an input-output based multisectoral modeling. They are output and price vectors. There are enough data about the price indices, if not for all sectors of input-output table, available in the TurkStat

[4] For further detail about the structure and the use of the bridge matrix in TURINA see Özhan *at al*. (2011)

sources from which a price vector with 58 elements can be calculated. However, there is no regular statistical information reporting the output of any input-output sector, even a single number for control total. Then, a labour intensive special method is applied to produce output vector for TURINA. Without repeating the same steps in this section Table 3.3 lists a truncated version of both the price and output vectors for some benchmark years (Özhan at al. 2011).

Table 3.3. Output and price vector

		Output (TL 1000)		Price (1998 =1.000)	
	Sector	1998	2008	2002	2008
1	Agriculture, hunting and related services	12857007	117523256	4.398	8.689
2	Products of forestry, logging and related services	362594	2576098	4.211	9.574
3	Fish and other fishing products;	302636	2275692	3.257	5.072
4	Coal and lignite; peat	352566	8688655	5.938	14.025
5	Crude petroleum and natural gas;	143896	12687756	12.303	38.563
6	Metal ores	119685	6684834	6.351	17.359
7	Other mining and quarrying products	426523	9382421	4.527	8.098
8	Food products and beverages	9196317	130216800	5.078	9.38
9	Tobacco products	752602	4938421	8.208	16.834
10	Textiles	3678486	56142152	5.553	8.328
	Total	122034063	2012797316	4.838	12.446

Source: i. TurkStat. ii. Own calculations (Özhan, *at al*. 2011).

4. SIMULATION WITH HOUSEHOLD CONSUMPTION EQUATIONS

This section summarizes the estimation and simulation process of the 10-category household consumption system.

4.1 Solution algorithm

The solution algorithm of the model TURINA can be summarized in the following steps.

Step 1. Start with 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 regressions in the sample period 1998-2008. (For regression equations see Section 4.2)

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

Step 4. Get final demand vector f 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 q, in constant price, according to the equation

$$q = (I - A)^{-1} f \tag{4.1}$$

Step 6. Calculate the value added vector "va" 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 the new unit value added (value added in current price of per unit output in constant price), v/q, calculate the price index vector, p, according to the equation

$$p = A'p + v/q \tag{4.2}$$

Step 8. Have GDP in current price and in constant price, which is the sum of value added vector va and final demand vector f, respectively.

Step 9. Have GDP per capita in constant price 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 from 1998 to 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, 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.

4.2 Estimating household consumption with PADS

To simulate the household consumption, a good way is to use PADS (Perhaps Adequate Demand System) formulated by Clopper Almon (1996) and used extensively by INFORUM members and partners. The basic formula of PADS is:

$$x_i(t) = (a_i(t) + b_i(y/P)) . \left(\frac{p_i}{P}\right)^{-\lambda_i} \prod_{k=1}^{n} \left(\frac{p_i}{p_k}\right)^{-\lambda_k s_k} . \left(\frac{p_i}{p_G}\right)^{-\mu_G} \left(\frac{p_i}{p_g}\right)^{-\nu_g} \tag{4.3}$$

where the left side is the consumption *per capita* of product *i* in period *t* and $a_i(t)$ is a function of time. The b_i is a positive constant. The *y* is nominal income *per capita*; p_k is the price index of product k; *P* is an overall price index defined by

$$P = \prod_{k=1}^{n} p_k^{s_k}$$

where, s_k is the budget share of product k in the period in which the price indexes are all 1, and λ_i is the relative price elasticity. All the notations with subscript G or g are related to a concept of "group" and "subgroup" which will not be used in this analysis mainly due to insufficient data.

In TURINA, the classification of household consumption categories with their budget shares and regression results is listed in Table 4.6 at the end of this section.

From the level of available data it is fair to say it is not necessary to do the group or subgroup classification. Therefore without the parameters μ and ν, and dropping the product term on the right hand side the formula becomes

$$x_i(t) = (a_i(t) + b_i(y/P)) . \left(\frac{p_i}{P}\right)^{-\lambda_i} \tag{4.4}$$

Just like the situation pointed by Almon (1996b), "[some parts] …, could be omitted from the equation, with a great reduction in complexity in estimation".

4.2 Estimated regression equations

The household consumption by 10 categories is a simplified PADS with the formula (4.5). For a full formula of a PADS equations, there is a special program SYMCON.EXE, developed by INFORUM, which can estimate the non-linear simultaneous equations system and give results. To use SYMCON.EXE, there are seven files, two control information files plus five input data files need to be prepared. These two control files are related to groups and soft constrains. On the other hand, due to the fact that PADS to be used in TURINA is a simplified version it can be easily solved by the non-linear regression commands for single equations available in G7, which seem less complicated. Then it was decided not to use SYMCON.EXE.

The main disadvantage of using non-linear regression in G7[5] is that the result displayed without the elasticity of the income term. However, it is not difficult to overcome this problem. If the parameter λ is replaced with its estimated value in the formula (4.5) so that the non-linear term (pi/P) disappears and the regression becomes linear, from which its result display includes the income elasticity term. For example, from the result for category 5, replace the value of λ =1.180607 (a2) into the formula (4.4) and get linear regression equation

$$x_5 = a_5(t) * (p_5/P)^{-1.180607} + b_5(y/P) * (p_5/P)^{-1.180607} \qquad (4.5)$$

Accordingly from its regression result display, the income elasticity term is 0.78.

In the following only the results of the first five equations are shown with their fitness situation in associated graphs.

Tables 4.1. 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.

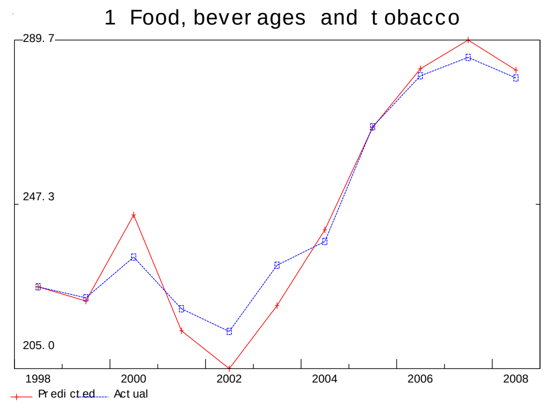

Figure 4.1. Category 1

The following is a brief account of the coefficients estimated in the regression for Category 1 (Food, beverages, and tobacco). First, the negative value of a0 shows that the share of the Food, beverages, tobacco, and alcoholic drinks in Turkish family budget should have been getting smaller over time. This is true as it can be seen in Table 4.1 where the budget share of Food item has fallen from 30.1 in 1998 to 25.9% in 2008. Second, a positive a1 value (0.306) shows that income has a positive effect on consumption behavior of households for this category in general. Third, the broad category of Food, tobacco, and all kinds of drink has a price elasticity of less than one in absolute terms. It can be shown that a2 = λ, and - λ = price elasticity, here it is – 0.331077. This result supports one piece of the basic economic theory that food is a necessity in general, so it is price inelastic, i.e. its price elasticity is less than 1 in absolute terms. However this conclusion may not be true for all items in this category.

[5] G7 is the name of INFORUM's regression and modelling package.

As for income elasticity the food category seems a superior good for the fact that its income elasticity is slightly greater than 1 (1.06). This conclusion does not deserve much support. For many items in this category income elasticity should be less than 1. At a later stage, if there is not enough data to disaggregate this category further, a soft constraint on some parameters can be tried.

Table 4.2. Category 2

SEE = 6.577104

Param	Coef	T-value	StdDev
a0	-3.804061	-2.18	1.741906
a1	0.096326	89.85	0.001072
a2	0.038585	0.02	2.327677

The income elasticity is 1.14

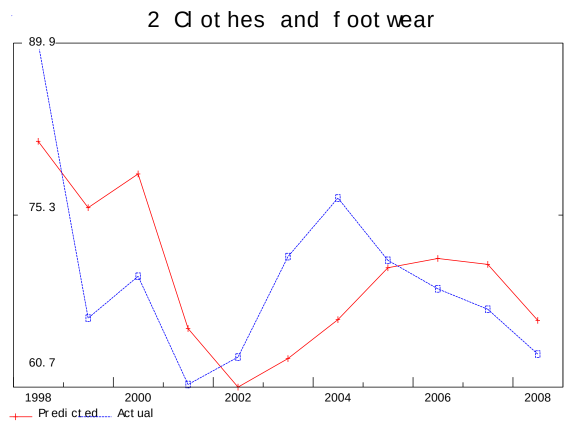

Figure 4.2. Category 2

For Category 2 Clothing and footwear the time coefficient appears with negative sign. Therefore its budget share should be getting smaller. This conclusion is confirmed with the fact that the budget share of this category has fallen from 12% to 5.7% over the sample period. A relatively small income effect is found for this category. Price elasticity is close to zero in absolute terms ((0.038). So in terms of price elasticity, cloth and footwear is a necessity for Turkish consumers. And, finally, income elasticity is quite high (1.14) which puts this item in the range of luxurious (superior) good. However, these two conclusions require further checking with new data and estimation method.

Table 4.3. 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

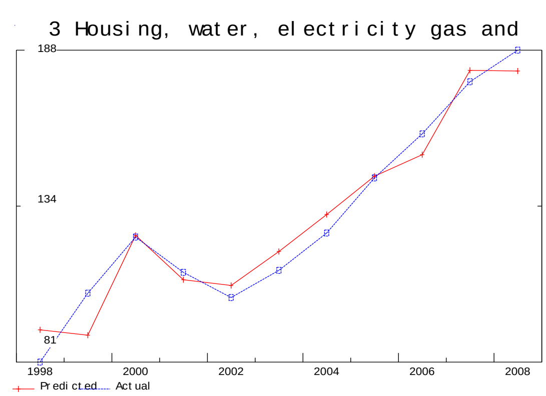

Figure 4.3. Category 3

Housing, water, electricity, and (Category 3) is also a broad category. Its budget share has been almost doubled from 10.8% to 20.3% during the course of estimation period. The consumption function for category 3 is a special one. Here there are four parameters. As for other categories a0 shows the effect of time which is positive as it is expected for this sector. The second coefficient a1 measures the effect of income which is again positive. The fourth coefficient a3 shows the absolute value of price elasticity as usual. Since this value is less than 1, housing expenditure is relatively price inelastic. The parameter a2 is included in the equation for a dummy variable to smooth the excessive jumps in the regression function. So it does not bear an economic meaning.

Table 4.4. Category 4

SEE = 3.152363

Param	Coef	T-value	StdDev
a0	-0.974917	-1.18	0.826381
a1	0.091634	24.40	0.003756
a2	2.424041	1.79	1.352643

The income elasticity is 1.08

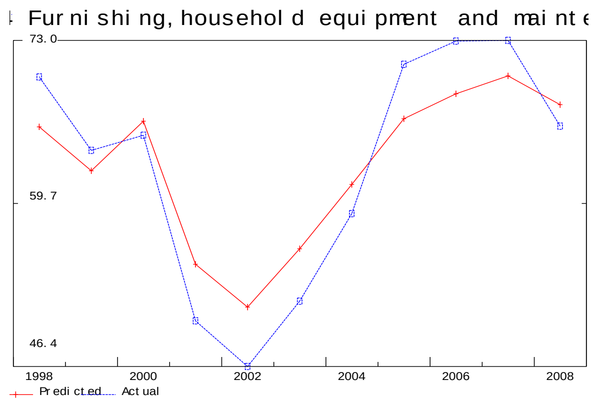

Figure 4.4. Category 4

For Furnishing, household equipment and routine maintenance of the house (excluding investment), the time effect appears with negative coefficient (a0 = -0.975). This sign is in line with a decreasing budget share of this category from 9.4 to 7.2. The role of income is considerably low (0.092). The price elasticity of this category is the second highest, 2.424. When the price of furniture goes up, the Turkish households cut their expenditures in percentage terms much more than the increase in prices. On the other hand income elasticity is greater than 1 so that the furniture is to some extent a luxury for the Turkish consumers.

Table 4.5. Category 5

SEE = 1.409359

Param	Coef	T-value	StdDev
a0	0.983779	2.10	0.468211
a1	0.026595	13.35	0.001992
a2	1.180607	7.58	0.155720

The income elasticity is 0.78

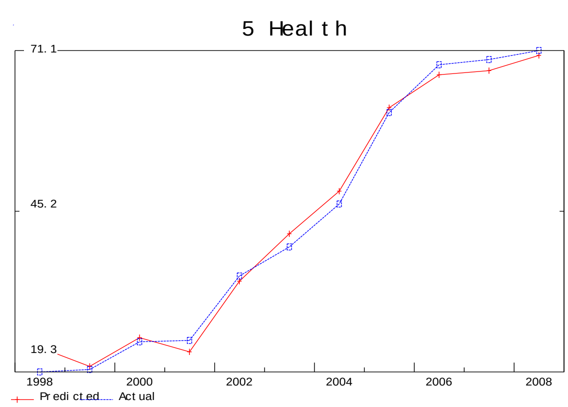

Figure 4.5. Category 5

Category 5 represents Health expenditures the budget share of which has gone up from 2.6% to 4.1%. A positive time coefficient also supports this conclusion. Income coefficient is also positive as for all other categories though with a relatively low value. Health expenditure has relatively strong price elasticity (-1.18). Income elasticity is less than 1 (0.78). However it is possible that the result would have been different if it were possible to separate household expenditures on health between public and private sector providers since the latter category is a strong candidate to be a luxurious good.

Finally regression results for household consumption are presented for all 10 categories in Table 4.6.

Table 4.6. Regression results for household consumption

	Category	Budget share %		a0	a1	Price elas.	Inc. elas.
		1998	2008				
1	Food, beverages, alcoholic drinks and tobacco	30.1	25.9	-2.504	0.306	0.331	1.06
2	Clothing and footwear	12.0	5.7	-3.804	0.096	0.038	1.14
3	Housing, water, electricity, gas	10.8	20.3	1.067	0.152	0.382	1.03
4	Furnishing, household equipment and routine maintenance of the h.	9.4	7.2	-0.975	0.092	2.424	1.06
5	Health	2.6	4.1	0.984	0.027	1.180	0.78
6	Transport and communication	14.3	18.5	2.953	0.141	0.230	0.87
7	Recreation and culture	5.8	3.9	-1.628	0.058	0.048	1.26
8	Education	0.6	1.3	0.711	0.005	1.105	0.50
9	Restaurants and hotels	6.6	6.0	-0.450	0.064	0.927	1.05
10	Other goods and service	7.6	7.1	0.381	0.077	2.480	0.97

Source: Own calculations.

4.3 Other behavioral equations

Excluding the behavioral vector equation for household consumption discussed above, another behavioral vector equation, in the model's framework, is value added vector in current price. It has 58 components or elements. Therefore, there should be 58 behavioral equations for those 58 components, one for each. A simple but efficient way to explain the value added in current price is to use the output in current price as the main explanatory variable. In the model logic, the value added vector will be calculated after getting the output in constant price by using the basic input-output formula (Equation 2.4). Therefore, a natural idea is to use the product between output in constant price and corresponding price as the explanatory variable for value added in current price. The implied relation is

$$va = f(q * p) \quad (4.6)$$

And after that, with the value added in current price per unit of output in constant price, a new price vector can be calculated by using Equation (2.5).

However, according to the experiences from the past years, this kind of structure will cause problem in model's convergence. A possible way to overcome this problem is to use the lagged price vector (with one year). Then Equation (4.6) becomes.

$$va = f[q * p(-1)] \quad (4.7)$$

One of the disadvantages of this approach is that, the sample period will be 1 year less. The calculation practice of the model which includes the behavioral equation (7) shows that this treatment is quite satisfactory.

For the particular estimations of the 58 value added equations, in order to overcome excessive jumps and downs dummy variables are used occasionally. In the following group of figures the estimation results or the fitness situation of the value added in current price are shown for only the first four sectors (Figure 4.6).

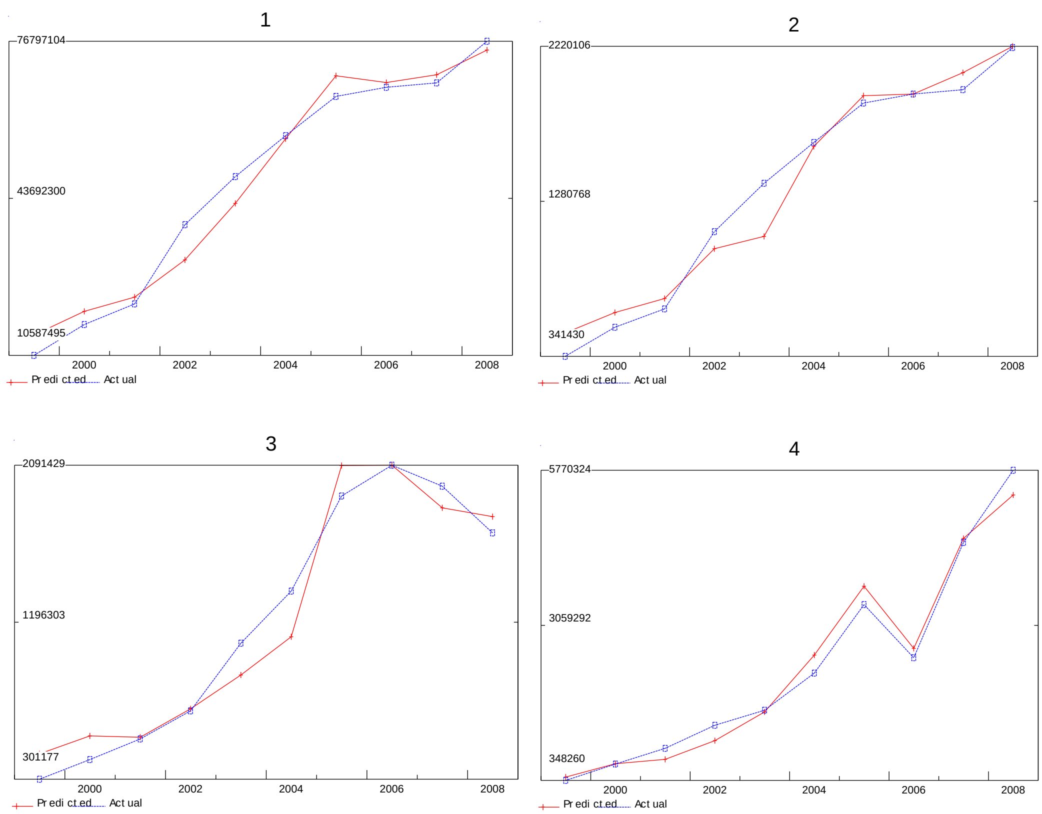

Figure 4.6. Value added regression equations

4.4 Historical simulation

The multisectoral macroeconomic modeling software programme employed by INFORUM is named INTERDYME. Some results of the simulation are listed in this section. A set of figures below shows the simulation of household consumption per capita in current price, GDP in constant price, GDP in current price, and GDP deflator respectively (Figure 4.7).

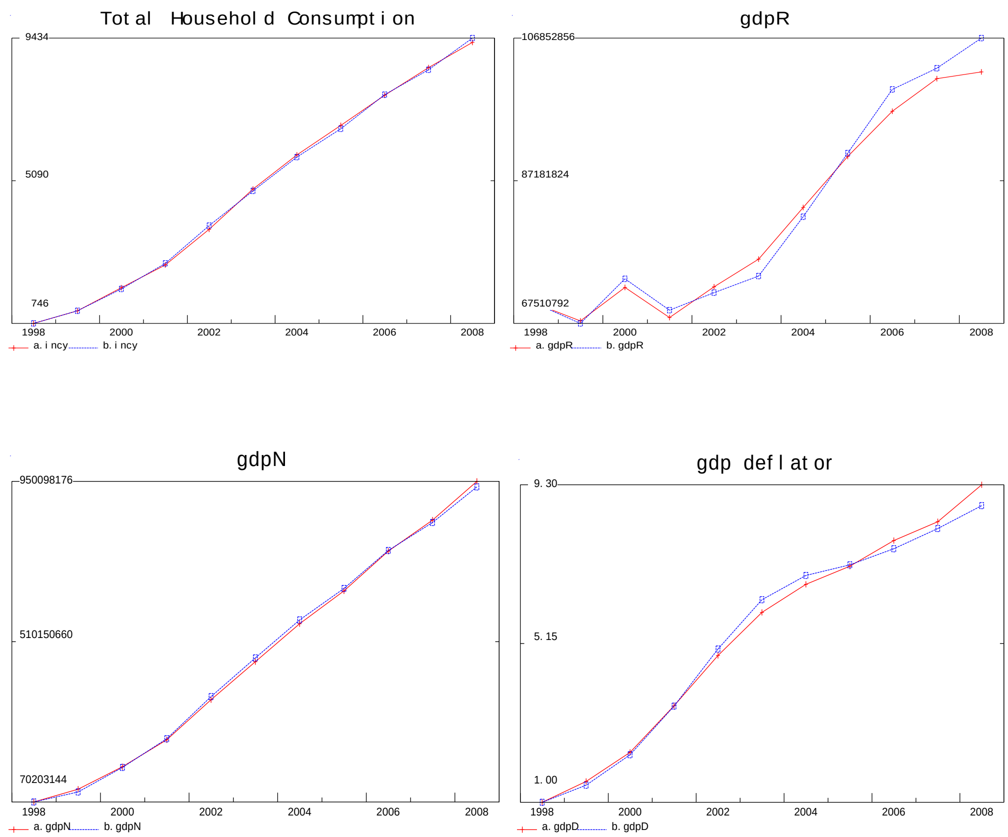

Figure 4.7. Historical Simulation

Table 4.7 shows the percentage change comparison of the simulated results of household consumption vector in constant price for some selected sectors. In the table the first line shows the actual historical values and the second line shows the percentage deviation of the fitted values from the historical values. Other two simulated vectors are output in constant price and the price vector. Results for these simulations sectors can be obtained from the authors upon request.

Table 4.7 Numerical Results of Household Consumption Vector (Historical Simulation)

	2000	2002	2004	2006	2008
1Agriculture	7693.67	4646.41	4966.57	5865.95	6034.41
	0.30	-1.29	-0.17	1.20	3.23
2Forestry	114.65	106.85	88.91	110.76	120.59
	0.30	-1.29	-0.17	1.20	3.23
3Fish	404.82	166.09	142.25	208.02	273.64
	0.30	-1.29	-0.17	1.20	3.23
4CoalLignite	178.39	221.61	252.93	317.19	318.98
	-3.72	6.55	2.47	-4.22	-13.25
8FoodBeverage	5797.96	6162.71	7027.51	8575.49	8560.78
	0.30	-1.29	-0.17	1.20	3.23
9Tobacco	410.84	224.20	205.02	229.85	278.88
	0.03	-0.90	-0.63	0.98	3.38
38LandTransp.	5211.41	3688.06	4856.49	5283.73	5685.75
	-8.97	7.09	-4.02	-1.17	1.99
43FinInterSer.	2401.98	2876.47	4246.28	6331.47	6170.14
	-0.19	-0.04	-1.00	-0.38	2.87
46RealEstate	2751.60	5850.13	7125.33	8687.06	9186.25
	-2.32	6.74	1.53	-4.57	-5.87
55MemOrgSer.	719.49	647.32	781.82	936.81	1062.56
	-0.19	-0.04	-1.00	-0.38	2.87
56REcrCulSpSer	288.64	351.10	491.76	627.95	743.20
	-4.65	0.87	1.73	-1.95	1.84
57OtherServi.	150.74	148.09	178.86	214.31	243.08
	-0.19	-0.04	-1.00	-0.38	2.87
58PriHHEmpPers	86.52	92.09	112.28	150.53	189.04
	4.03	-8.08	1.99	9.32	5.25

From Figure 4.7 above, it can be seen that the simulations for four aggregated variables (total household consumption per capita, gdpR, gdpN, and gdpD) are quite good. From the results of numerical simulations shown in Table 4.7 (and others not reported here) it is understood that most simulations have small relative error. In fact, a statistical calculation for the 1740 (= 58x3x10 = sector numbers*vector numbers*years) simulation results is done and listed in Table 4.8 below. About 73% of simulation results have less than 3% and only 1.55% showed more than 10% error.

Table 4.8. The Statistics of the Percentage Changes of the Simulation Results for 3 Vectors

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

5. FORECASTING

It can be said that the model TURINA is based on Keynesian demand driven growth hypothesis in the medium term. However as it is stated earlier, private consumption is endogenous to the system so the growth should mainly be induced by government consumption, investment and export. In the midst of current economic crises prevailing mainly in the Western world this assumption does make sense. Based on this general framework three scenarios are designed and put into test up to 2020. These are the baseline scenario, upside scenario, and downside scenario. This section is devoted to a brief description of the results of these three scenarios.

5.1 Exogenous variables and assumptions in their formation

In Interdyme modeling the set of exogenous variables are collected into a set of files with their predetermined values, growth rates, and some other rules controlling their behavior. These files can be termed the *fix* files. The following variables are chosen to be exogenous in the model TURINA:

- g: Government current expenditure on goods and services
- vf: Total (private + public) gross fixed capital formation
- vi: Change in inventories
- fe: Exports of goods and services
- fi: Imports of goods and services
- pop: Population

Forecast period runs from 2011 to 2020. From 2011 to 2014 export, import and some other figures are directly borrowed from the SPO *Medium Term Programme* 2012-2014, (www.dpt.gov.tr). In the base line scenario, the growth rates of the exogenous variables for the first five years of the forecast period (2011 to 2015) are based on their growth rates of most recent past five years. Additional assumptions and differences between the three scenarios are explained in the following section.

5.2 Specific assumptions underlying three scenarios

i. Even though GDP and its sectoral distribution are endogenous to the system its growth performance in the recent past must be evaluated carefully beforehand. Pursuing this line of thought it has been checked that the Turkish economy has shown a relatively low real rate of growth over the historical period from 1998 to 2011, averaging about 3.7% per annum. During all these 13 years the growth rate of GDP has never reached 10%. The highest rate was achieved in 2004 with a GDP growth rate of 9.4%. On the other hand the economy experienced serious negative growth rates for three different years, in 1999 (-3.4%), 2001 (-5.7%), and 2009 (-4.8%). Over the recent five years (2006-2011) the average annual growth is only 3.23%. To summarize, in the Turkish economy the growth rate of GDP shows a high degree of volatility. In other words the growth is highly volatile in the short run and sustainable in the medium and long run but only at a relatively low rate. Based on these factual observations for the baseline scenario it is assumed that the exogenous variables will grow for most of the years above their past five-year performance.

ii. It is also observed that whenever nominal GDP growth rate exceeds 10% at least half is accounted for inflation. The higher the rate of nominal GDP growth the higher the rate of inflation is. Briefly, for a growing economy, particularly for Turkey, inflation has been almost always unavoidable.

iii. Similar observation goes with the trade deficit. For the period from 1998 to 2011 trade balance has shown positive sign only for four years (1998, 1999, 2001, and 2002) two of which coincide with the years when the growth rates of GDP were negative. Accordingly it is assumed that there will be always a trade deficit for all years over the forecast period.

iv. For upside scenario, it is assumed that the economy can grow much faster than its past performance. Therefore for this scenario exogenous variables are assumed to grow about 2 to 3% percent more than their baseline scenario trends in nominal terms. This assumption for the upside scenario can also be justified in the case of a general favorable growth performance of the world economy. This leads to a growing share of foreign trade in GDP.

v. In this paper the possibility of accession of Turkey into EU is not assumed explicitly. A different scenario can be designed at a later stage under the assumption that Turkey would be a full member of the EU before 2020. The minimal positive effect of such possibility is the fact that inflationary expectation will be lowered *inter alia*.

vi. For downside scenario the assumptions made for the upside scenario are reversed. Therefore for this scenario exogenous variables are assumed to grow about 2 to 3 percent less than their baseline scenario trends.

vii. Investment growth path for the upside scenario is only slightly higher than the baseline scenario. It is assumed that general growth of the economy for this scenario will be mainly the result of new technologies and improvement in total factor productivity.

viii. It must be pointed out that SPO (State Planning Organization, recently turned into Ministry of Development) targets a GDP value of about US$2 trillion in

2023 with a growth rate of 7% per annum. Although the GDP in TURINA is an endogenous variable, this target has always been kept in mind. Similarly, the authorities target about US$500 billion exports in 2023. But not any precise target for imports.

ix. Population figures are estimated under the assumption that the average growth rate over the last five year-period will continue for some time and will decline only gradually. Accordingly, using the recent (2007-2011) statistics which shows 74724269 (= 74.7 million) population figure in 2011, the annual average growth rate of population is 1.424%. Starting with this rate the population is forecasted to reach 84.4 million in 2020. The closest number to this estimate is provided by the US Census Bureau which states that Turkey's population will reach 86.8 million in 2020. These figures are very important in order to compare them against the most common belief that "Turkey's population will never reach 100 million". However the authors of this paper (at least the first one), do not support this line of thought. According to the US Census Bureau's estimate, once the population reaches approximately 87 million in 2020, then, it would not be too early to add 13 million more in ten years in order to reach 100 million in 2030. Perhaps a few years later.

5.3 Forecast results

In the present version of TURINA he following series and vectors are forecasted under three scenarios.

- Per capita household consumption in 10 broad categories
- Total household consumption in 58 input-output sectors
- Total output in 58 input-output sectors
- Price vector in 58 input-output sectors

The model behaved reasonably well at least for the per capita total household consumption for 10 categories. This is a good sign to assess the model for the fact that household consumption accounts for about 70% of GDP. However towards the end of the forecasting period (2020) convergence was possible but not meaningful for some vector elements. Some negative numbers occurred in some years, particularly for the total production of Sector 5 Crude petroleum and natural gas in real terms (totr5).

To summarize the forecasting results of the model, household consumption is chosen for demonstration. In the following, two groups of household consumption are presented. In the first group three categories of per capita household consumption are chosen for presentation, out of 10-category list:

- Per capita household consumption in in Category 1 Food, beverages, alcoholic drinks and tobacco in constant price (phhcr1)
- Per capita household consumption in Category 4 Furniture, household equipment and routine maintenance in constant price (phhcr4)

- Per capita household consumption in Category 6 Transportation and communication ,n constant price (phhcr6)

These three categories have relatively big proportion of total household consumption for many years over the forecast period. Their time paths are shown in the following figures for three scenarios respectively (Figures 5.1, 5.2, 5.3).

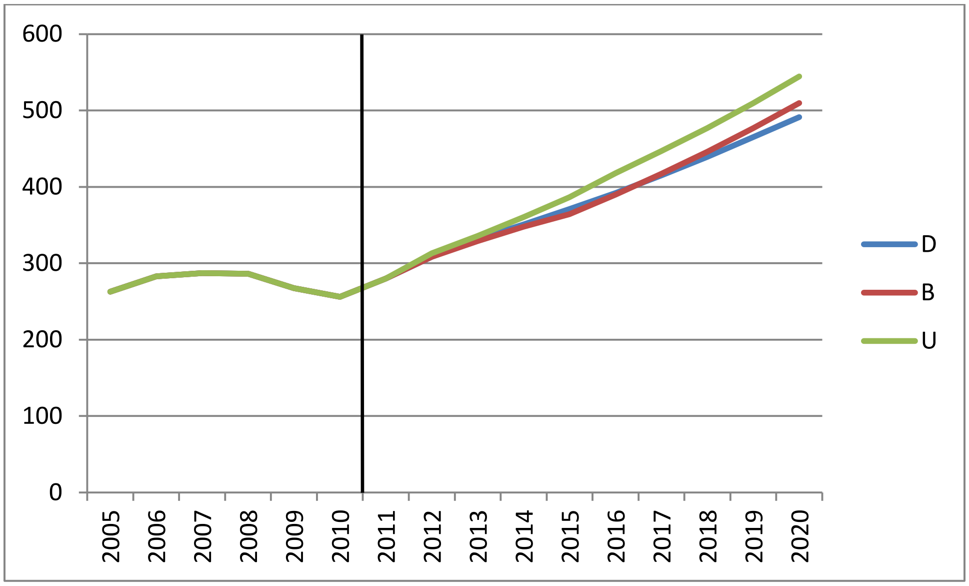

Figure 5.1. phhcr1: Food, beverage, alcoholic drinks and tobacco

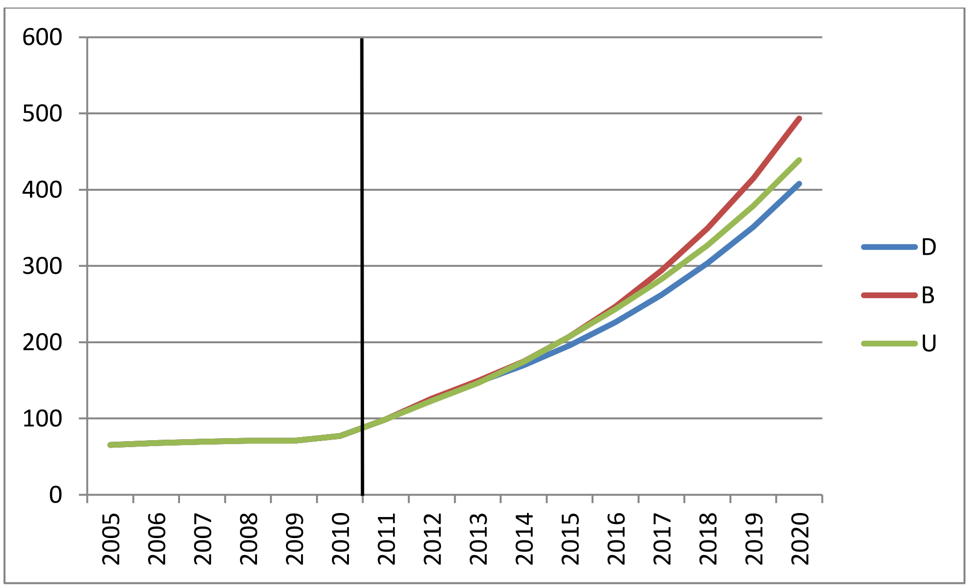

Figure 5.2. phhcr4: Furnishing and household equipment

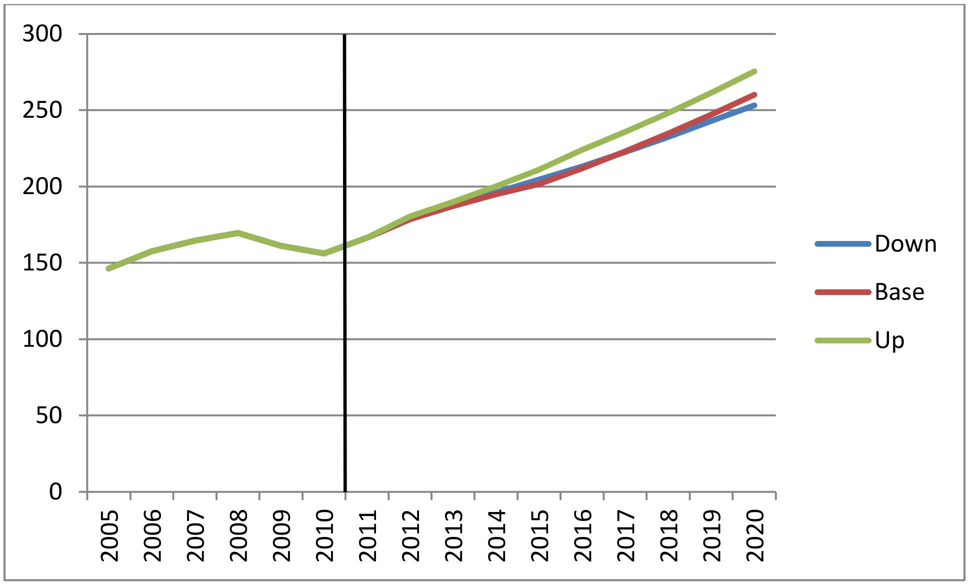

Figure 5.3. phhcr6: Transport and communication

In these three scenarios the curves move smoothly for the first two categories (phhcr1 in Figure 5.1, and phhcr4 in Figure 5.2) in the sense that their growth paths reflect their sizes proportionately, *i.e.*, the curve representing baseline scenario lies between the curves representing the upside and downside scenarios. However for Category 6 in Figure 5.3 this is not always the case. For the year 2015 the baseline scenario curve lies slightly below the downside scenario curve.

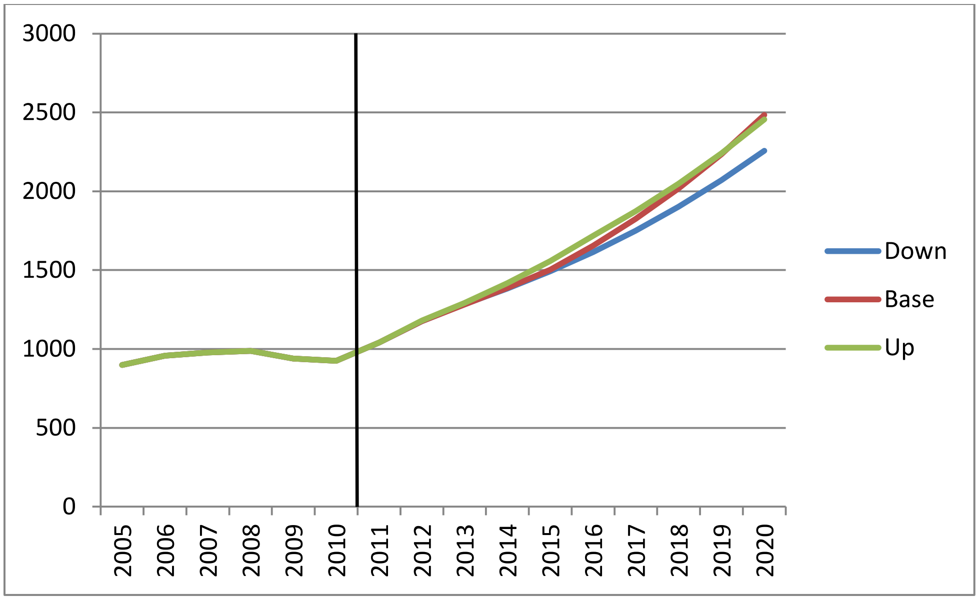

Figure 5.4. Total per capita household consumption

For total per capita household consumption (i.e., the sum of 10 categories) the baseline scenario curve lies always above the downside scenario curve and below the upside scenario curve except for the year 2019 (Figure 5.4). After 2019 the baseline curve overtakes the upside scenario curve. This divergence is clearly not controllable due to the fact that the total production in Sector 5, as stated earlier, did not converge properly. Since the model is a simultaneous one a runaway solution even only for one variable can normally infect the other variables as well. This uneasy situation enforces the authors to pursue further testing, checking, and most of all expanding the database to include more variables and longer time periods.

Still it might be insightful to present a brief numerical analysis of the forecasting results. This is done in Table 5.1 and Table 5.2.

Table 5.1 Compare Per Capita Consumption Base and Down

					Growth %			
Year	2010	2013	2017	2020	10-13	13-17	17-20	10-20
Base	926	1282	1825	2483	10.8	8.8	10.3	9.9
Down	0.0	0.1	-4.1	-9.1	10.9	7.8	8.5	8.9

In Table 5.1 the first line shows the total per capita household consumption for the baseline scenario. The second line shows the deviation of the downside scenario outcomes from the base line expressed in percentage terms. The four columns on the right show the annual average growth rates for two scenarios.

Table. 5.2. Compare per capita consumption Base and Up

					Growth %			
Year	2010	2013	2017	2020	10-13	13-17	17-20	10-20
Base	926	1282	1825	2483	10.8	8.8	10.3	9.9
Up	0.0	0.8	2.7	-1.1	11.1	9.3	9.0	9.7

Table 5.2 compares the base line scenario forecast figures in comparison with upside scenario. It is read as Table 5.1. The rate of growth of per capita household consumption in upside scenario is above the baseline growth rate up to 2020. In 2020 upside scenario growth rate "accidently" falls below for the base line scenario rate. Again for the same year the level of per capita consumption in upside scenario is 1.1% less than baseline value. (This point appears controversial and requires further checking). As a result for the whole forecast period the overall growth rate of upside scenario (9.7%) falls slightly below the baseline (9.9%) growth scenario.

One further point can help in the interpretation of the growth rates in Table 5.2 (and 5.1 as well). It is obvious that the growth rates are all above their historical levels and well above the growth rate of GDP observed in the recent past. They are also well above the GDP growth rate targeted by the SPO. This situation can only be justified for the fact that for a growing economy like Turkey the share of consumption is likely to increase over time. This is possible if only household consumption increases at a higher rate than GDP.

A second group of consumption function forecast results belongs to input-output sectors directly. Here again three main sectors with relatively high proportion of consumption among 58 sectors are chosen for illustration:

- Final consumption expenditures on Agriculture, hunting, and related activities (fcehhr1)
- Final consumption expenditures on Food products and beverages (fcehhr8)
- Final consumption expenditures on Land transport and transportation via pipeline (fcehhr38)

The forecasting results for these three sectors are shown in Figure 5.5, Figure 5.6, and Figure 5.7 respectively.

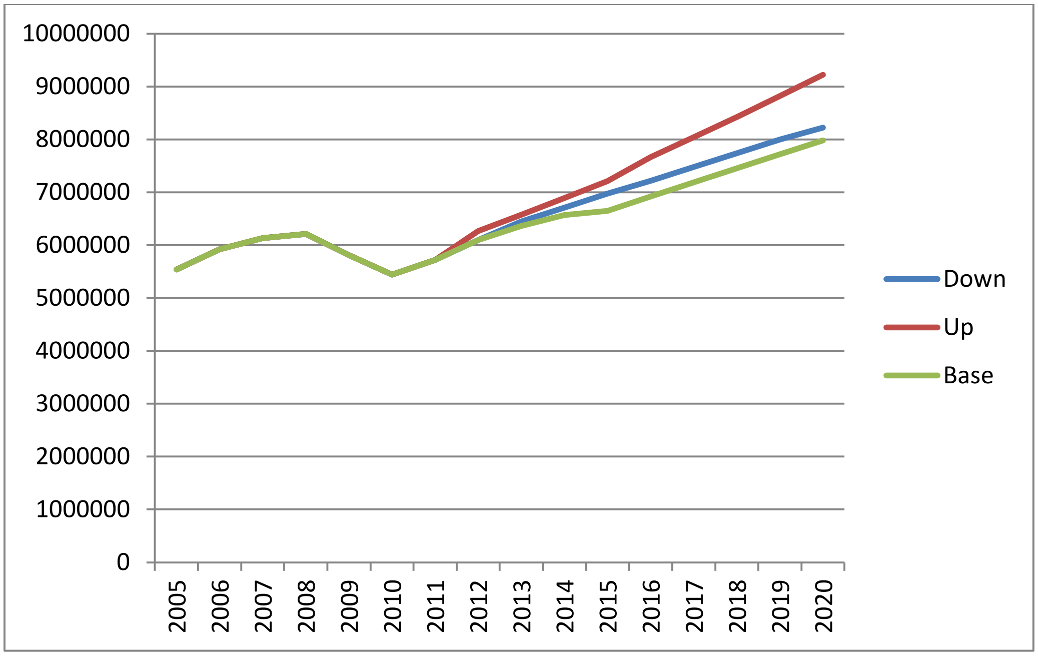

Figure 5.5. Final consumption expenditures on Agriculture, hunting, and related activities (fcehhr1)

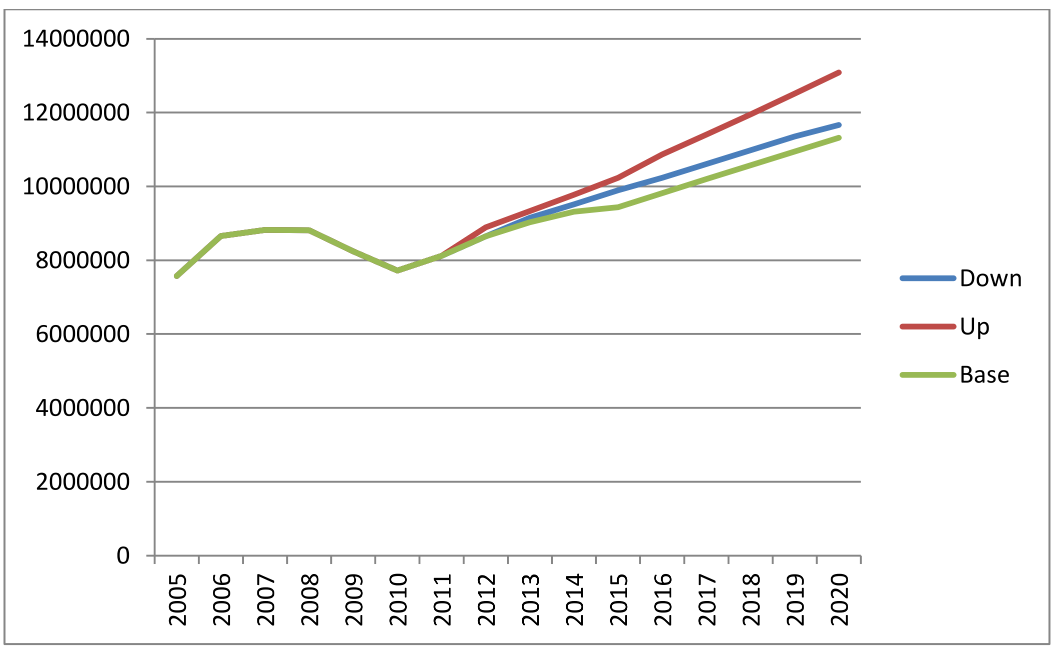

Figure 5.6. Final consumption expenditures on Food products and beverages (fcehhr8)

What looks unusual in both in Figure 5.5 and 5.6 is that the baseline scenario forecast line lies below the downside scenario line. Before jumping to a quick conclusion again the authors are set to check the situation further as for some other shortcomings of the forecast procedure referred earlier. Any possible intuitive interpretation would make no sense to justify that as income falls during the period of downside scenario the share of total agricultural output and as well as food consumption increases above their levels that can be reached in the baseline scenario. Still a rigorous examination of the case must be pursued with the future trails of the basic model.

For sector 38 Final consumption expenditures on Land transport and transportation via pipeline (fcehhr38) the situation looks better, but still inconclusive in the sense that for some years downside scenario line stays above the line representing the baseline scenario (Figure 5.7).

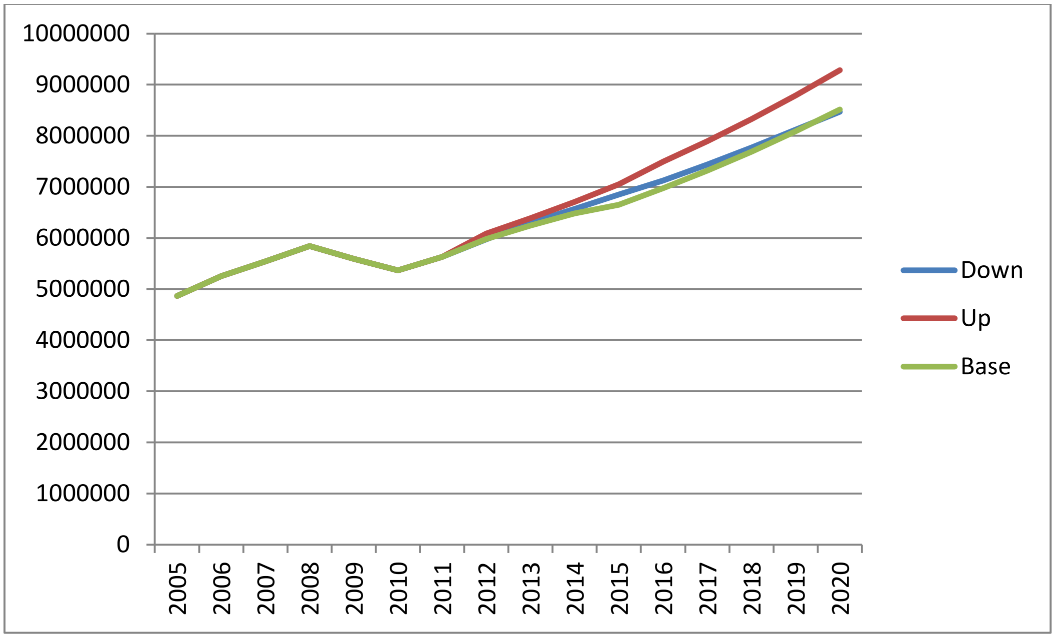

Figure 5.7. Final consumption expenditures on Land transport and transportation via pipeline (fcehhr38)

6. CONCLUSIONS

To conclude the present paper following points should be emphasized.

i. To build an input-output based macroeconomic model for a country, it is essential to have time series vector data for output, value added, price index, household consumption, fixed capital formation, import and export, and at least one year input-output table.

ii. There are input-output tables for 1998 and 2002. Various statistics are available about value added, household consumption, fixed investment, import, export, price index, and so on, but not as detailed as input-output structure. Therefore many bridge matrices are designed to reconcile these statistics with input-output tables.

iii. An intensive work has been done on the national account of GDP by expenditure. The work includes the adjustment of input-output table for 1998 and 2002 processing on nearly every time series vector to be used, applying the across-the row-procedure plus the conversion from current price to constant price.

iv. A databank is ready to be used for building an interindustry model for Turkey. In that databank, there are input-output tables for each year from1998 to 2002. The aggregation values from these input-output tables are consistent with the national account data of GDP by expenditure (final demand) and GDP by cost (value added) for every year.

v. The disposable income data is a key variable in the model iteration mechanism. However there is not official data for this variable, and those available occasionally in some sources are found not acceptable. It was then decided to use the relationship between per capita GDP and per capita consumption to replace the relationship between per GDP and per capita disposable income, and between per capita disposable income and per capita consumption when starting the next step of the model.

vi. Historical simulation results of the model TURINA over the period 1998-2008 shows high degree of accuracy. Out of about 1740 (three vectors, 58 sectors, ten years) simulation results for some basic vectors, 72.7% shows less than 3% error, and only 3% shows 1.55% error.

vii. Finally, the model is put to test for forecasting with three scenarios over the period from 2012 to 2020. Household consumption for 10 broad categories and most of the input-output sectors show reasonable time path for future growth. The shortcomings in the forecast period that are referred at various points should be tackled in the future trials of the model.

viii. The Turkish TURINA model is still small and mainly focusses on consumption, but it has the potential to also be enlarged to include more detailed models for the labor market, as is the case in the German INFORGE model (Maier et al. 2012), or the energy sector, environmental impacts or material use, as for example included in the German PANTA RHEI (Lehr et al. 2012, Meyer et al 2012, Welfens and Lutz 2012).

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Appendix
Input-output sectors :

1	Agriculture, hunting and related services	30	Secondary raw materials
2	Products of forestry, logging and related services	31	Electrical energy, gas, steam and hot water
3	Fish and other fishing products;	32	Collected and purified water, distribution
4	Coal and lignite; peat	33	Construction work
5	Crude petroleum and natural gas;	34	Trade, maintenance and repair of motor vehicles
6	Metal ores	35	Wholesale trade and commission trade services, except of motor vehicles and motorcycles
7	Other mining and quarrying products	36	Retail trade services,
8	Food products and beverages	37	Hotel and restaurant services
9	Tobacco products	38	Land transport; transport via pipeline

10	Textiles	39	Water transport services
11	Wearing apparel; furs	40	Air transport services
12	Leather and leather products	41	transport services; travel agency services
13	Wood and products of wood and cork	42	Post and telecommunication services
14	Pulp, paper and paper products	43	Financial intermediation services, except insurance and pension funding services
15	Printed matter and recorded media	44	Insurance and pension funding services, except compulsory social security services
16	Coke, refined petroleum products and nuclear fuels	45	Services auxiliary to financial intermediation
17	Chemicals, chemical products and man-made fibres	46	Real estate services
18	Rubber and plastic products	47	Renting services of machinery and equipment without operator and of personal and household goods
19	Other non-metallic mineral products	48	Computer and related services
20	Basic metals	49	Research and development services
21	Fabricated metal products, except machinery and equipment	50	Other business services
22	Machinery and equipment n.e.c.	51	Public administration and defence services;
23	Office machinery and computers	52	Education services
24	Electrical machinery and apparatus n.e.c.	53	Health and social work services
25	Radio, television and communication equipment	54	Sewage and refuse disposal services, sanitation
26	Medical, precision and optical instruments, watches and clocks	55	Membership organization services n.e.c.
27	Motor vehicles, trailers and semi-trailers	56	Recreational, cultural and sporting services
28	Other transport equipment	57	Other services
29	Furniture; other manufactured goods n.e.c.	58	Private households with employed persons