TINYTurk, a tiny model based on Turkish data

First steps to build an Inforum model

Paul Salmon
Gazi Özhan and Meral Özhan
Initial project

- To build Inforum models for Turkey and North Cyprus
- To do so
  - Create a small research group (people, fund, contracts)
  - Set up of software for each machine
  - Teach economic model building to the research group
  - Build and manage models
- But we have a big problem with data
  - Only one Input-Output table and a partial structure for National Accounts are useable in each case
- From dream to reality
Real project

• A lot of difficulties to create a small structure for the economic modeling
• The project is limited in two « Tiny models »
  – TinyTurk
  – TinyNorthCyprus
• But this experience has shown us the way to follow and the difficulties to solve.
• The most difficult has been done : we have begun
Organization of the work

• Important problems of data
  – Input-Output tables
  – Integrated Economic Accounts
  – Disposable income

• What to do to reach our goal?
  – Several immediate constraints
    • To teach model building to the group
    • Create a first structure of an Inforum model
Our choices

• Our sources
  – Inforum (2000)
    • Interdyme, a package of programs for building Interindustry dynamic macroeconomic model
  – Clopper Almon
    • The craft of economic modeling
      – More especially Part 3 (2008)

• Following Clopper Almon’s book we decide to build « tiny models »
Priorities

• Build a « Tiny model » for Turkey (TurkTiny)
• Build a « Tiny model » for North Cyprus Republic (NorthCyprusTiny)
• Create documents for the group for learning model building from the two tiny models.
A « tiny » model

• A tiny model is a « simple input-output model using only commands available in G »
• Clopper gives us an example build with a particular set of data. The data are built from the US data.
• A tiny model is only the simplest king of Input-output model
TinyTURK

- TinyTurk is a « tiny model » as defined previously
- But
  - Data comes from Turkstat
  - The framework of data is ESA 95
  - Classification is in 59 sectors
- Thus
  - TinyTurk is an application of Tiny concepts to an ESA 95 Input-Output framework
Main differences with Tiny

• Different structure of data
  – A very simplified Input-Output table
  – A real Input-Output table in a SEC 95 Framework

• The data source files have a MS Excel structure

• Consequences
  – TinyTurk represents the first steps to build an Interindustry dynamic macroeconomic model in the ESA 95 Framework.
Philosophy of the paper

• The paper is for beginners in model building but not in Economics, not in National accounts and not in Input-Output techniques.
• A « basic » knowledge of G is compulsory.
• The paper tries to give explanations of the building of the model from scratch in a real situation.
• The paper wants to underline the relation between the information needs by G / Interdyme, the structure of an Input-Output model, computation and economics.
• The paper tries also to answer to questions the learners have asked (How do you know the contents of a Vam.cfg file ?)
TurkStat (HomePage)
TurkStat (National Accounts)
**TurkStat**

- List of the Input-Output tables published by Turkish National Institute of statistics

<table>
<thead>
<tr>
<th>Date</th>
<th>Type</th>
<th>SNA</th>
<th>Dim</th>
<th>Prices</th>
<th>Constant/Current</th>
<th>Dom./Imp.</th>
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</thead>
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<tr>
<td>1959</td>
<td>Input-output table</td>
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<tr>
<td>1963</td>
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<td>Input-output table</td>
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<td>1973</td>
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<td>1979</td>
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<td>59</td>
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<td>current prices</td>
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</tbody>
</table>
TurkStat (Input-Output tables)
TurkStat (Supply and Use Tables)
TurkStat (GDP by Expenditure)
TinyTurk’s data for the model

• 2002 Input-Output table in basic prices, Current prices
• GDP by expenditure for the period 1998-2007
• The two tables do not match very well
  – Revision of the GDP in March 2008
• To build our database, we use growth rate of the time series.
GDP by expenditure approach

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Expenditure on Goods and Services</th>
<th>Government Consumption</th>
<th>Household Consumption</th>
<th>Non-Household Consumption</th>
<th>Net Exports</th>
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<tbody>
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<td>1999</td>
<td>58,350,000</td>
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<td>9,000,000</td>
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<tr>
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<td>17,000,000</td>
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**GDP expenditure approach**

- **Accounts identities**

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<th>Category</th>
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<td>Final Consumption Expenditure of Resident Households</td>
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</tr>
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<td>Final Consumption Expenditure of Resident and Non-Resident Households on the economic territory</td>
<td>fcer nrhhet</td>
<td>259441149</td>
</tr>
<tr>
<td>Final Consumption Expenditure of Non-Resident Households on the economic territory</td>
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<td>238865095</td>
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<tr>
<td>Final Consumption Expenditure of Resident Households in the Rest of the World</td>
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</tr>
<tr>
<td>Government Final Consumption Expenditure</td>
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<td>Compensation of Employees</td>
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<td>Purchases in Goods and Services</td>
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<td>Gross Fixed Capital Formation</td>
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<tr>
<td>→ Machinery-Equipment</td>
<td>pub sme</td>
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<tr>
<td>→ Construction</td>
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<tr>
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<tr>
<td>→ Machinery-Equipment</td>
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<td>→ Construction</td>
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<td>Changes in stock</td>
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<tr>
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2002 Input-Output table (structure)
2002 Input-Output Table (characteristic)

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
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</thead>
<tbody>
<tr>
<td>2002 CGS (excl. Inland and Foreign Direct Investment)</td>
<td>2002 CGS (incl. Inland and Foreign Direct Investment)</td>
<td>2002 CGS (incl. Inland and Foreign Direct Investment)</td>
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<tr>
<td>Agricultural and Related Services</td>
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<td>2002</td>
<td>2002</td>
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<tr>
<td>Forests, Logging and Related Services</td>
<td>2002</td>
<td>2002</td>
<td>2002</td>
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<tr>
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<td>2002</td>
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<tr>
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<td>2002</td>
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<tr>
<td>Agriculture, Hunting, Forestry and Fishing</td>
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<tr>
<td>Total</td>
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<td>2002</td>
<td>2002</td>
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</tr>
</tbody>
</table>

**Note:** The table above represents the 2002 Input-Output Table (characteristic) for various economic sectors, including agriculture, mining, manufacturing, construction, energy, water, and related services. Each cell contains numerical data reflecting transactions within the specified sector.
2002 Input-Output Table
(characteristic)
Sketch of an Interindustry Dynamic Macroeconomic model
### FM-AM

<table>
<thead>
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<th>Flow Matrix</th>
<th>1</th>
<th>2</th>
<th>...</th>
<th>j</th>
<th>...</th>
<th>n-1</th>
<th>n</th>
<th>Total of rows</th>
</tr>
</thead>
<tbody>
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<td>1</td>
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<td></td>
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<td>i</td>
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<td></td>
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<td>ic(_{ij})</td>
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<tr>
<td>Total of columns</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
a_{ij} = \frac{ic_{ij}}{oapb_{ij}}
\]
**Final demand (FD)**

**Identities and relations obtained by summation of rows**

\[ f_{cenpish_{tot}} = \sum_{i=1}^{59} f_{cenpish_{i}} \]

\[ f_{ceg_{tot}} = \sum_{i=1}^{59} f_{ceg_{i}} \]

\[ f_{ce_{i}} = f_{ceh_{i}} + f_{cenpish_{i}} + f_{ceg_{i}} \]

\[ f_{ce_{tot}} = \sum_{i=1}^{59} f_{ce_{i}} \]

\[ g_{cf_{tot}} = \sum_{i=1}^{59} g_{cf_{i}} \]

\[ c_{ii_{tot}} = \sum_{i=1}^{59} c_{ii_{i}} \]

\[ c_{iv_{tot}} = \sum_{i=1}^{59} c_{iv_{i}} \]

\[ c_{iiv_{i}} = c_{ii_{i}} + c_{iv_{i}} \]

\[ c_{iv_{totapp}} = c_{iv_{tot}} + c_{iv_{tlsopfd}} \]

\[ c_{iiv_{totapp}} = c_{iiv_{tot}} + c_{iiv_{tlsopfd}} \]

\[ g_{cf_{totapp}} = g_{cf_{tot}} + g_{cf_{tlsopfd}} \]

\[ expcob_{totapp} = expcob_{tot} + expcob_{tlsopfd} \]

\[ f_{uabp_{tlsopfd}} = f_{ce_{tlsopfd}} + g_{cf_{tlsopfd}} + expcob_{tlsopfd} \]

\[ tuabp_{tlsopfd} = - \]

\[ f_{uabp_{totapp}} = f_{uabp_{tot}} + f_{uapp_{tlsopfd}} \]

\[ tuabp_{totapp} = ticabp_{tot} + f_{uabp_{tlsopfd}} \]
GDP Approaches (Identities)
Acronyms

- Worksheet to build the acronyms for the I-O table
VAM.CFG

# Vam.cfg file for the Input-Output Table 2002 - Basic Prices - Current
#
# 1996-2020
#
# Matrices
#
FM..... 59.59.0::sectors02.ttl sectors02.ttl # Intermediate consumption matrix
AM..... 59.59.0::sectors02.ttl sectors02.ttl # Intermediate coefficient matrix
LINV..... 59.59.0::sectors02.ttl sectors02.ttl # Leontief Inverse
#
# Vectors
#
# Final Demand
#
totr..... 59.1.0::sectors02.ttl # Total Intermediate consumption row
fconh..... 59.1.0::sectors02.ttl # Final consumption expenditure by households
fconpish..... 59.1.0::sectors02.ttl # Final consumption expenditure by profit
fcongov..... 59.1.0::sectors02.ttl # Final consumption expenditure by government
fconcf..... 59.1.0::sectors02.ttl # Final consumption expenditure by capital formation
fconciv..... 59.1.0::sectors02.ttl # Changes in valuables
fconcii..... 59.1.0::sectors02.ttl # Changes in inventories and valuables
<table>
<thead>
<tr>
<th></th>
<th>A: Gayri Safi Yurtici Hasila (Gross Domestic Product)</th>
<th>B: Yerlesik Hanecaklarnin Tuketimi (Final Consumption Expenditure of Resident Households)</th>
<th>C: Yerlesik ve Yerlesik Olmayan Hanecaklarnin Yurtici Tuketimi (Final Consumption Expenditure of Resident and Non-Resident Households)</th>
<th>D: Yerlesik Hanecaklarnin Yurtici Tuketimi (Less) Final Consumption Expenditure of Non-Resident Households on the Economic Territory</th>
<th>E: (Eksi) Yerlesik Olmayan Hanecaklarnin Yurtici Tuketimi (Foreign Consumption Expenditure of Non-Resident Households in the Rest of the World)</th>
<th>F: Yerlesik Hanecaklarnin Yurtici Tuketimi (Foreign Consumption Expenditure of Resident Households)</th>
<th>G: Devletin Nihai Turkim Harcamalar Gunem Final Consumption Expenditure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tablo 7. Harcamalar Yontemileyde Gayri Safi Yurtici Hasila (Cari Fiyatlari), 1998-2007</td>
<td>Table 7. Expenditure on the Gross Don</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>1998</td>
<td>1999</td>
<td>2000</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>1. dönm - 1. quartar</td>
<td>13 216 010</td>
<td>19 276 278</td>
<td>33 363 460</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>2. dönm - 2. quartar</td>
<td>15 629 411</td>
<td>24 010 020</td>
<td>38 344 610</td>
<td></td>
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<tr>
<td>5</td>
<td>3. dönm - 3. quartar</td>
<td>20 352 112</td>
<td>30 161 687</td>
<td>48 240 935</td>
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<tr>
<td>6</td>
<td>4. dönm - 4. quartar</td>
<td>20 505 684</td>
<td>31 757 931</td>
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<td>7</td>
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<td>33 363 460</td>
<td>33 363 460</td>
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<td>9</td>
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<td>38 344 610</td>
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<tr>
<td>10</td>
<td>3. dönm - 3. quartar</td>
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<td>48 240 935</td>
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<tr>
<td>11</td>
<td>4. dönm - 4. quartar</td>
<td>31 757 931</td>
<td>46 709 016</td>
<td>46 709 016</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How to read?
Basic code to read

```r
xl::open("\modeles\turkey\data_g\ExpendituresGDP_cur98.xls")
do{
  xl::open(worksheet=1)
xl::read(C,%1,down="fce",%2,%2)
  (3.8,13,18,23,28,33,38,43,48) (1998-2007)
type="fce",1998:2007"
}```
Result of the basic code
Result of corrected code
GDP Expenditure identities

```groovy
# ExpGDP98_identities.add
#
# This file contains the statement to compute the identities of ExpendituresGDP_cur98.xls
#
#
# Final Consumption of resident Households
f fcerhh = fcernrhhet - fcenrhhet + fcerhhrow
#
# Government Final Consumption Expenditure
f gfce = gfcece + gfcepigas
#
# Gross Fixed Capital Formation - Public Sector
f pubs = pubsme + pubsc
#
# Gross Fixed Capital Formation - Private Sector
f pris = prisme + prisc
#
# Gross Fixed Capital Formation
```
Preparation to read IO table

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Location in the worksheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM</td>
<td>Matrix</td>
<td>D11:BJ69</td>
</tr>
<tr>
<td>fcehh</td>
<td>Vector</td>
<td>BL11:BL69</td>
</tr>
<tr>
<td>fcnpish</td>
<td>Vector</td>
<td>BM11:BM69</td>
</tr>
<tr>
<td>fcegov</td>
<td>Vector</td>
<td>BN11:BN69</td>
</tr>
<tr>
<td>gfcf</td>
<td>Vector</td>
<td>BP11:BP69</td>
</tr>
<tr>
<td>civ</td>
<td>Vector</td>
<td>BQ11:BQ69</td>
</tr>
<tr>
<td>cii</td>
<td>Vector</td>
<td>BR11:BR69</td>
</tr>
<tr>
<td>expfob</td>
<td>Vector</td>
<td>BU11:BU69</td>
</tr>
<tr>
<td>tlsop</td>
<td>Vector</td>
<td>D71:BJ71</td>
</tr>
<tr>
<td>compemp</td>
<td>Vector</td>
<td>D73:BJ73</td>
</tr>
<tr>
<td>ontop</td>
<td>Vector</td>
<td>D74:BJ74</td>
</tr>
<tr>
<td>otop</td>
<td>Vector</td>
<td>D75:BJ75</td>
</tr>
<tr>
<td>osop</td>
<td>Vector</td>
<td>D76:BJ76</td>
</tr>
<tr>
<td>cofc</td>
<td>Vector</td>
<td>D77:BJ77</td>
</tr>
<tr>
<td>osn</td>
<td>Vector</td>
<td>D78:BJ78</td>
</tr>
<tr>
<td>impcif</td>
<td>Vector</td>
<td>D82:BJ82</td>
</tr>
</tbody>
</table>
Reading of the IO table

# Creation of the Vam file and definition of default vam bank
#
vamcreate vam_iot2002_bp.cfg hist2002
vam hist2002 b
dvam b
#
# Opening the Excel file
#
xl open \modeles\turkey\data_G\IOT2002_BP.xls
xl open worksheet 1
xl replace 0.0
#
# Reading the components of Value added
#
xc Read a full matrix for Excel, store in Vam Matrix
xl matread c(4-62) r(11-69) b.FM c(1-59) r(1-59) 2002
#
# VAB
#
do{
    xl read BL %2 down b.fcehh%1 2002 2002
    xl read BM %2 down b.fcenpis%1 2002 2002
    xl read BN %2 down b.fcegov%1 2002 2002
    xl read BP %2 down b.gfcf%1 2002 2002
    xl read BQ %2 down b.civ%1 2002 2002
    xl read BR %2 down b.cii%1 2002 2002
    xl read BU %2 down b.expfob%1 2002 2002
}(1-59)(11-69) m
#
# Reading the components of Final Demand
#
# Taxes less subsidies on products
#
xl read D 71 right b.tlsop1 2002 2002
xl read E 71 right b.tlsop2 2002 2002
...
xl read BI 71 right b.tlsop58 2002 2002
xl read BJ 71 right b.tlsop59 2002 2002
#
# Compensation of employees
#
xl read D 73 right b.comemp1 2002 2002
xl read E 73 right b.comemp2 2002 2002
...
xl read BI 73 right b.comemp58 2002 2002
xl read BJ 73 right b.comemp59 2002 2002
Identities of the IO tables

---

# ROW
# Intermediate consumption (total rows)
getsum FM c totc
# Total intermediate consumption
vc totic = totc + tlsop
# Operating surplus, gross
vc opg = cofc + opn
# Value added at basic prices
vc vaabp = compemp + ontop + otop + osop + opg
# Output at basic prices
vc outputbp = totic + vaabp
# Supply at basic prices
vc supplyabp = outputbp + impcif

---

# COLUMNS
# Intermediate consumption (total Columns)
getsum FM r totr
# Final Consumption Expenditure
vc fce = fcshh + fcenish + fcegov
# Changes in inventories and valuables
vc ciiv = cii + civ
# Gross Formation capital
vc gcf = gfcf + ciiv
# Final uses at basic prices
vc fuabp = fce + gcf + expfob
# Total uses at basic prices
vc tuabp = totr + fuabp
TurkTiny (code)

- TurkModel.txt
Results

1 - Agriculture, hunting and related services
Output and Final demand

1 - Agriculture, hunting and related services
Components of Value Added
Troubles

5 - Crude petroleum and natural gas
Output and Final demand

5 - Crude petroleum and natural gas
Components of Value Added
Conclusion

• Negative
  – Lack of data
  – Revision of the SNA 93
  – Are national accounts for model builders?

• Positive
  – Availability of data in the next years in ESA 95 Framework
  – Creation of a model building structure
  – Dissemination of the basic knowledge

During all the preparation of this paper, we have discussed with TurkStat, we have discovered the entire problem that exists from the statistical point of view to integrate European Union. This exercise is a very good practice to become a model builder if you are a beginner and a very good way to think of your practice and your knowledge if you are an advanced model builder.

If it is not yet possible now to build a complete Inforum model for Turkey, it will be possible to do it in a near future.

This paper comes in addition of the Clopper Almon’s work with a European touch.