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AN INTERINDUSTRY MACROECONOMIC MODEL FOR TURKEY USING G7

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1. Introduction

- This paper presents the building and running an interindustry macroeconomic model for Turkey using the G7 econometric package.
- The basic data file is a 35-sector IO table for 2011 compiled by the WIOD.
- Secondary data sources for macro variables are TurkStat data files for GDP expenditure components.
- The time span of the model runs from 1995 to 2025, consisting of a historical period (1995 – 2015) and a forecast horizon (2015 – 2025)
- Calculation and presentations of the results are combined and centered in a simple file called Gmodel.pre
- With the help of additional files the model is run in the G7 command line and editor window.
- The input-output coefficient matrix AM for 2011 and the shares of value added components are kept constant for the whole period.
- The most important property of the model is matrix listing which tabulates the interindustry flows and sales to final demand columns by sectors.
- The results are reported for some benchmark years with levels and growth rates.
- Reference: The Gmodel.pre file is adopted from *The Craft Part III* (2016).

2. Background Study

- First Tiny model for Turkey was built in 2008 using IOT 2002, 59 sectors.
  i. Simulations over 1998-2007
  ii. Forecasting over 2007 – 2020. With G-only, no Interdyme.

- Turina: Second interindustry model built in 2010 - 2011 using 2002 IOT, 58 Sectors. With Interdyme
  i. Simulations over 1998 – 2008.
  ii. Simulation of household consumption

- Modelling with WIOD Tables in 2012: Interdyme with 35 sectors. Simulations over 1995 – 2008.

- Modelling with WIOD Tables in 2013-2014: Interdyme with 35 sectors. Simulations and forecasting with regression equations: 1995 – 2028.

- Today`s presentation, 2016: A Tiny model using WIOD Table of 2011 with 35 Sectors: G-only, no Interdyme.
  Simulations and forecasting: 1995 – 2025.

3. VAM.CFG File for TinyTurk Model

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

VAM.CFG File for TinyTurk Model (Cont)

```
capc     35    1  0  sectors.ttl # Capital income coefficients
indc     35    1  0  sectors.ttl # Indirect taxes coefficients
# Other shares
# for final demand columns
pcec     35   1   0 sectors.ttl # Personal consumption shares
govc     35    1   0 sectors.ttl # Gov shares
invc     35    1   0 sectors.ttl # Investment shares
exc      35     1   0 sectors.ttl # Export shares
imc      35    1   0  sectors.ttl # Import shares
x        35     1  0  sectors.ttl # Working space
y        35     1  0  sectors.ttl # Working space
fix     200     1  0  fix.ttl     # Spacefor fixes.Fix.ttl will be written Fixer
```

4. Introducing Time Series of Macro Variables

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

5. Introducing Flow Matrix

	matin FM 2011 1 35 135 15									
	FM	1	2	3		31	32	33	34	
	2011	Agric	Mini	Food	.	PubA	Educ	Health	OthSs	
1	Agricul	21883	147	58845	.	869	62	331	53	
2	Mining	104	722	361	.	131	140	49	81	
3	Food	4939	111	22512	.	741	113	512	120	
..	..	..	..	..	.	..	..	..	..	
31	PublicAdm	20	16	25	.	114	41	32	247	
32	Education	1	39	38	.	284	216	696	175	
33	Health	205	60	36	.	58	72	994	114	
34	OthSocSer	70	53	90	.	339	148	231	5247	
35	PrivateHh	0	0	0	.	0	0	0	0	:

6. Introducing FD Columns

		vmatdat c 5 1 1 35 0					
		2011 pce	gov	inv	ex	im	
1	Agricul	81807	664	2944	10536	-22481	
2	Mining	3814	250	2037	4335	-2706	
3	Food	104949	2665	5563	33012	-17038	
4	Textile	151045	6781	11512	48658	-127661	
..	..	..	..	..	..	..	
31	PublicAdmin	1415	87935	23	1016	-1592	
32	Education	8609	43862	134	34	-106	
33	Health	7794	27065	105	1264	-59	
34	OthSocialSer	21313	6649	289	1495	-1311	
35	PrivateHhs	2535	0	0	0	0;	

7. Introducing VA Rows

	vmatdat r 4 1 1 35 0										
	2011 dep lab cap ind										
#	1	2	3	4	..	31	32	33	34	35	
#	Agri	Min	Food	Textile	..	PubAdm	Edu	Health	OthSoS	PrivHh	
dep	842	1373	6299	14568	..	2328	1340	2289	1284	0	
lab	93116	8134	11259	20728	..	49611	32975	11200	13353	2353	
cap	9541	9449	19968	18783	..	-172	7859	5947	6624	0	
ind	12246	2122	14981	18831	..	4162	2337	1931	2626	181;	

8. Building and Running the Model

Gmodel.pre

- # A partial list of commands in the Gmodel.pre file for Tiny model for Turkey
- zap
- clear
- # bank tiny
- #Create the VAM file for TinyTurk
- vamcreate vam.cfg hist
- vam hist b; dvam b
- # Bring in the intermediate flow matrix, FM
- add flows.txt
- show b.FM y 2011
- # Bring in the final demand vectors
- add fd.txt
- # Bring in the value added vectors
- add va.txt
- # Bring in the final demand totals as *macro* data series
- add gdp.txt
- fdates 2011 2011

Gmodel.pre (Cont)

- # Add up the intermediate rows
- getsum FM r out
- # Add on the final demand vectors to get total output
- vc out = out+pce+gov+inv+ex+im
- show b.out
- # Copy intermediate flows to AM and convert to coefficients
- mcopy b.AM b.FM
- coef AM out
- show AM y 2011
- # Create value-added coefficient vectors.
- vc depc = dep/out
- …
- # Copy the 2011 coefficient matrices to all the other years
- fdates 1995 2025
- # Copy the 2011 AM matrix into 1995 - 2025
- dfreq 1
- f one = 1.
- index 2011 one AM
- # Demonstrate that AM has been copied by showing its first column.
- show b.AM c 1

Gmodel.pre (Cont)

- #Move the five final demand columns by their totals over 1995 - 2015
- fdates 1995 2015
- index 2011 pcetot pce
- show b.pce
- # Take the Leontief inverse of the AM matrix
- fdates 1995 2025
- mcopy b.LINV b.AM
- linv LINV
- # Add up the final demands
- vc fd = pce+gov+inv+ex+im
- # Compute total outputs
- vc out = LINV*fd
- …
- fdates 2015 2025
- index 2015 g03 pce
- gdates 1995 2015 2025
- fadd graphs.fad sectors.ttl

9. Coefficient Matrix for Base Year

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

10. Final Demand for All Years

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

11. The Leontief Inverse

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

12. Output Vector for All Years

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

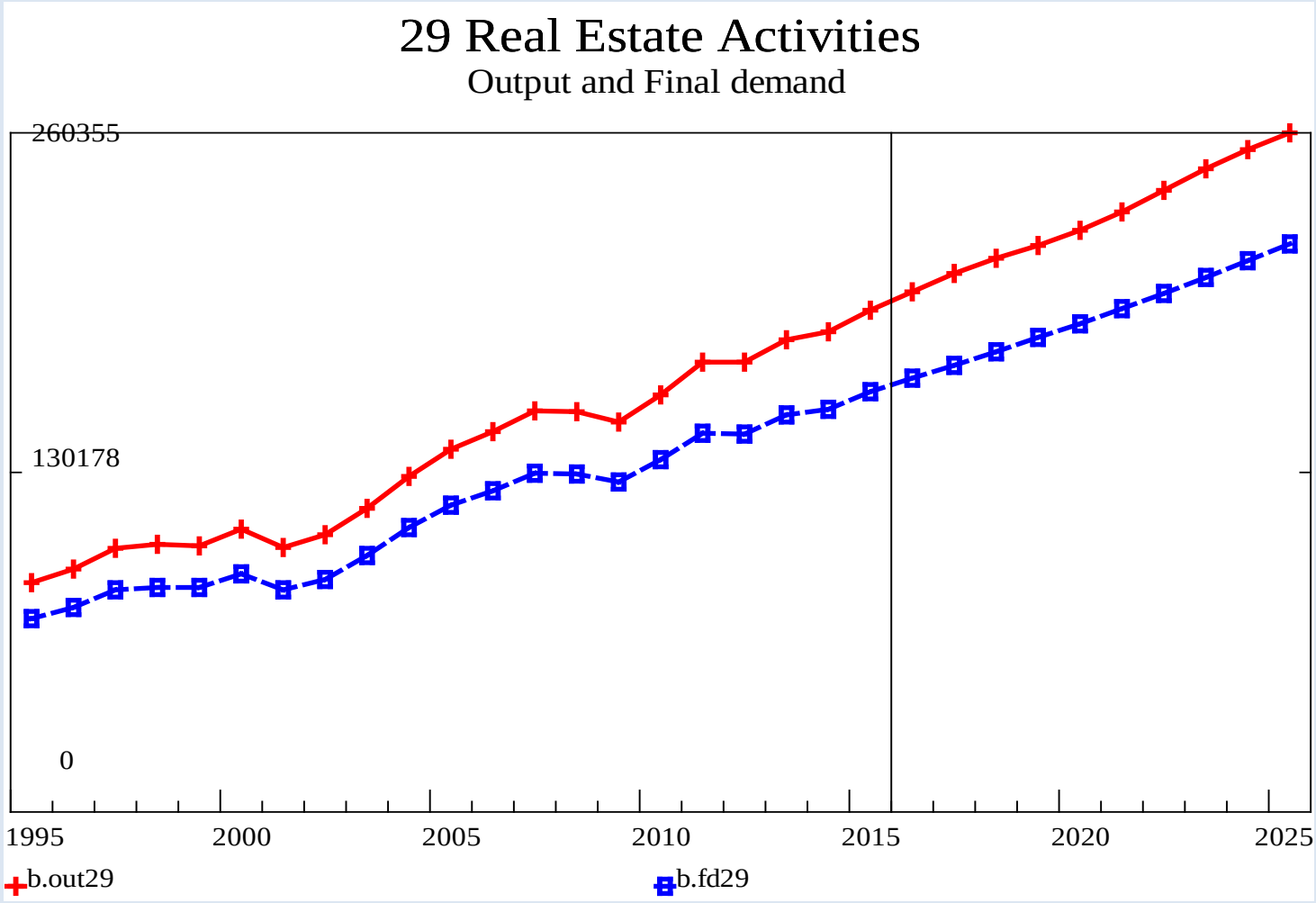
13. Labor Income for All Years

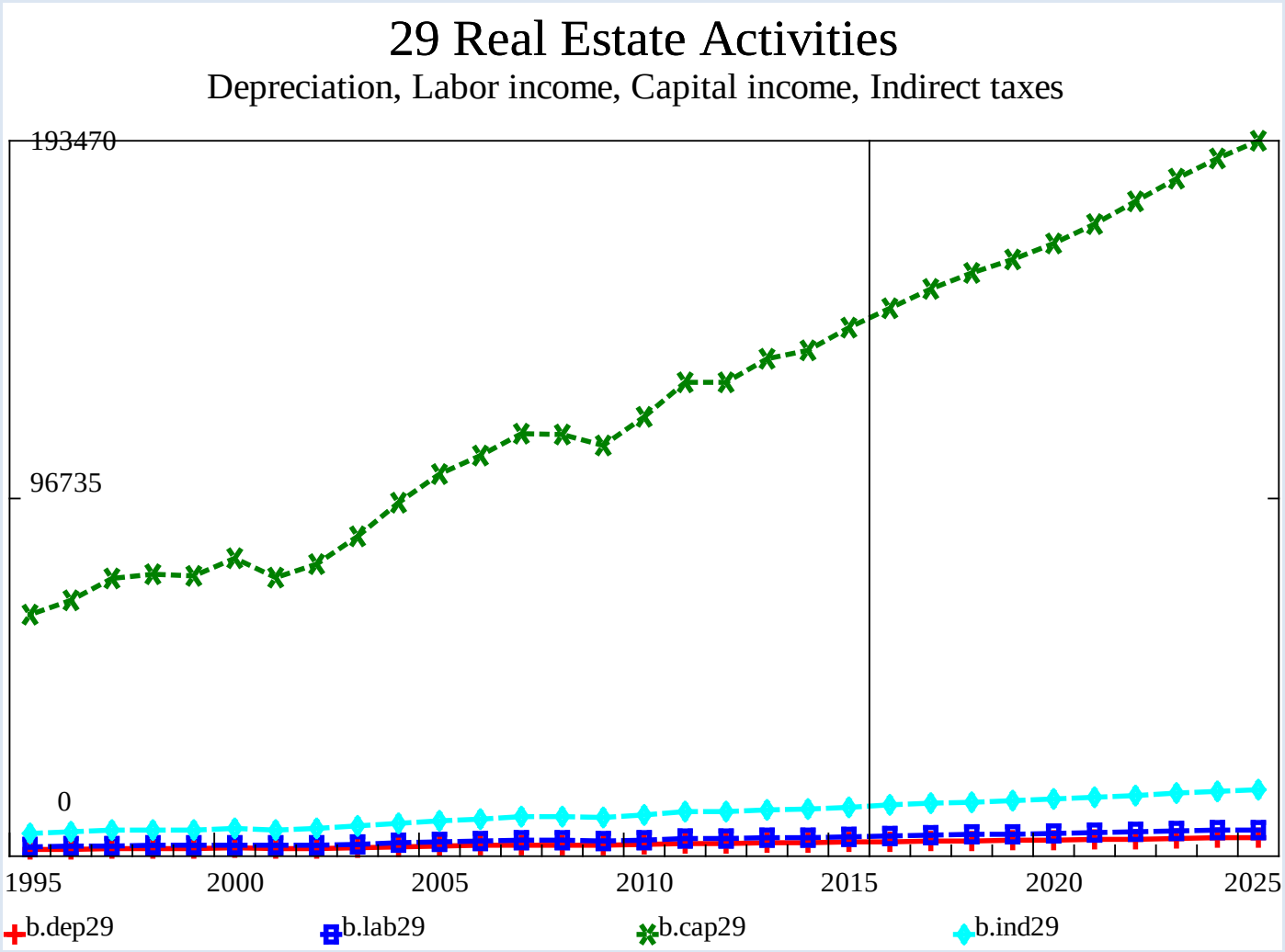
	lab	1995	2000	2005	2010	2015	2020	2025
1	Agricul	48496	59641	75450	86654	106041	122793	144006
2	Mining	3968	4981	6372	7390	9317	10600	13053
3	Food	5471	7031	9075	10451	12871	14909	17470
4	Textile	13591	15003	17180	19589	24756	28489	33997
5	Leather	667	876	1109	1277	1639	1889	2244
..	..	..	..	..	..	..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

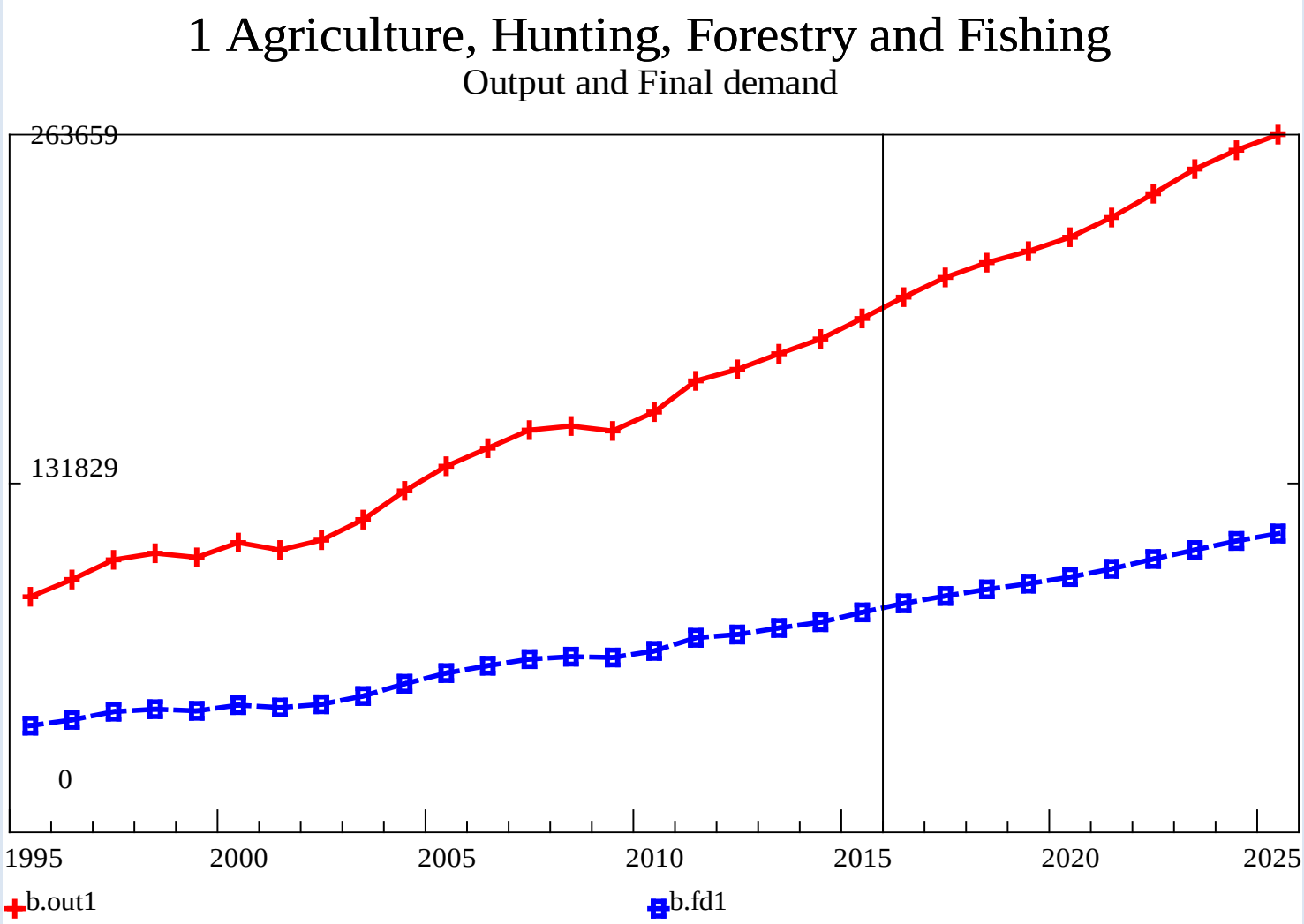
14. Top Ten Sectors in Value Added, 2011

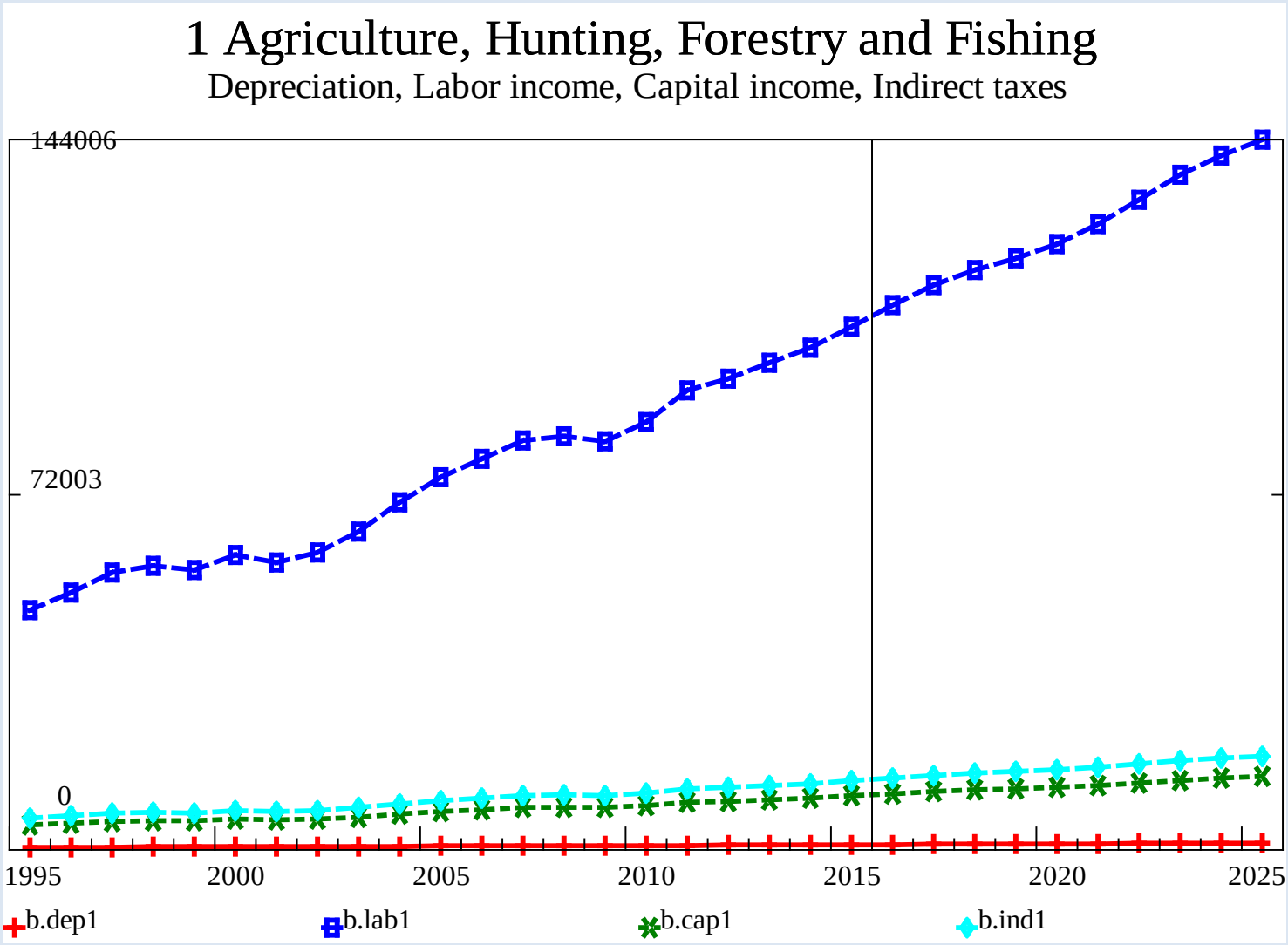
IO no	Sector	Value added share %	Rank
29	Real estate activities	12.0	1
23	Inland transport	9.5	2
1	Agriculture, hunting, forestry and fishing	9.2	3
21	Retail trade, except of motor vehicles and motorcycles; repair of household goods	5.7	4
20	Wholesale trade and commission trade, except of motor vehicles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

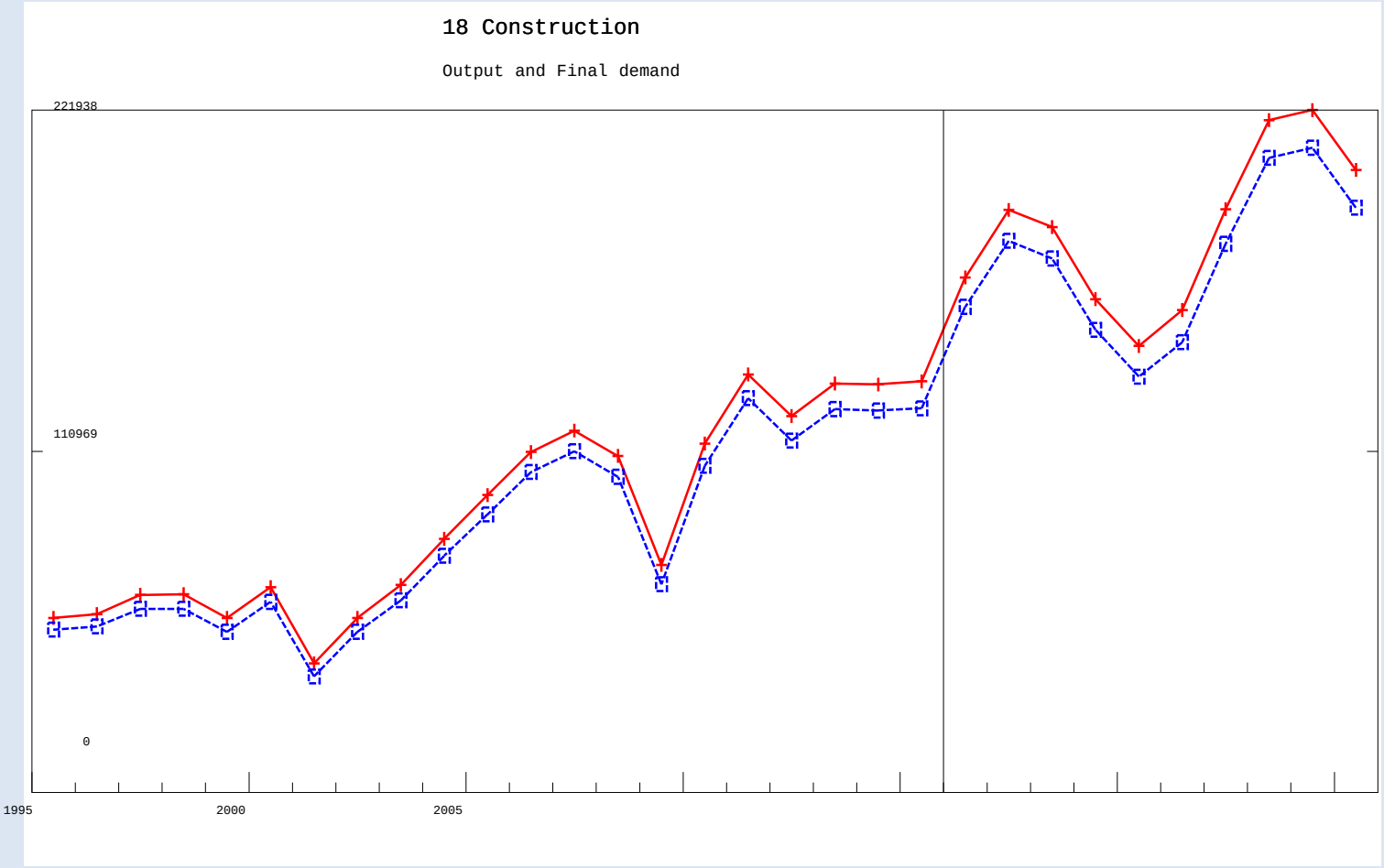
15. Results in Graphs

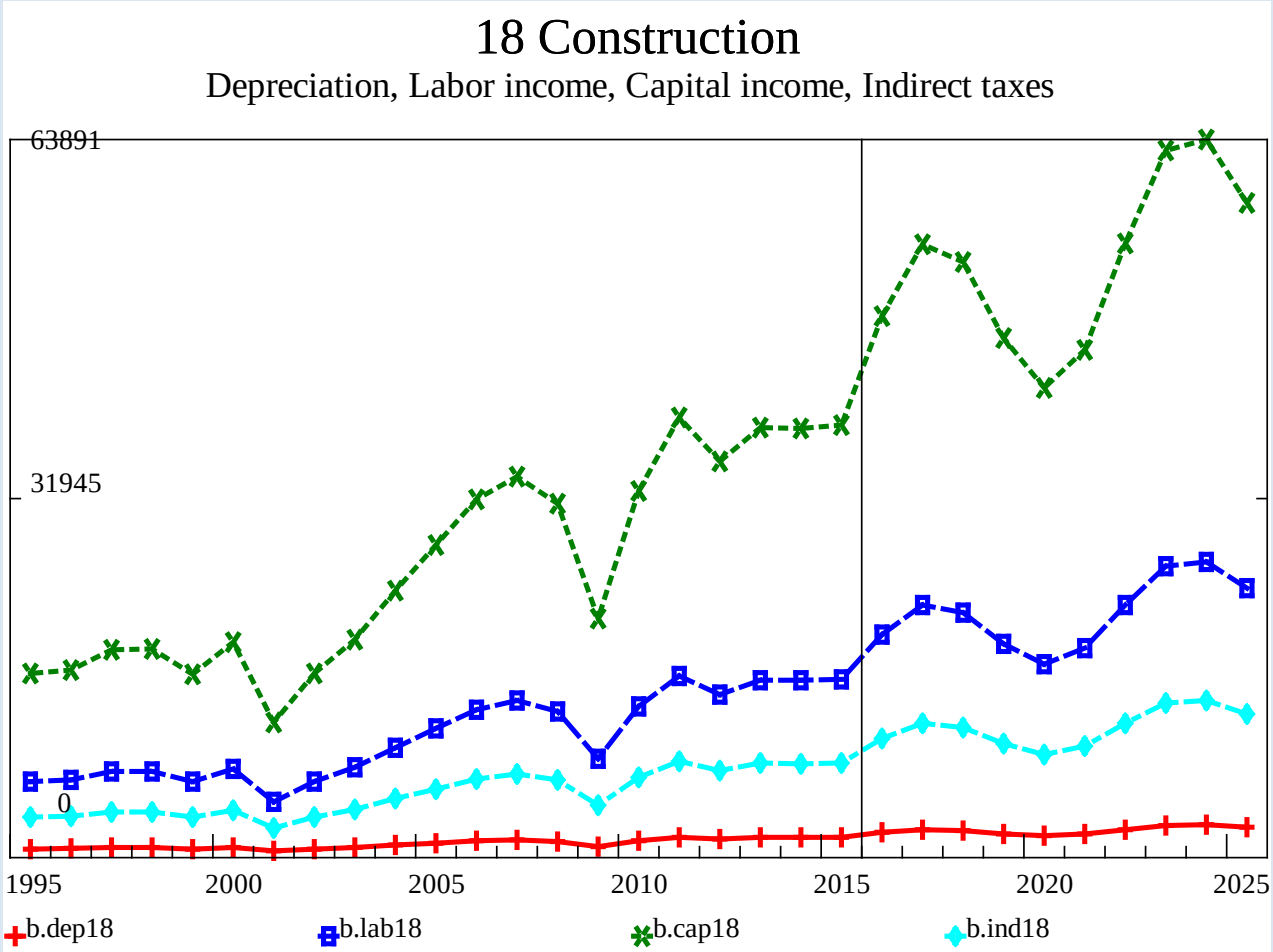


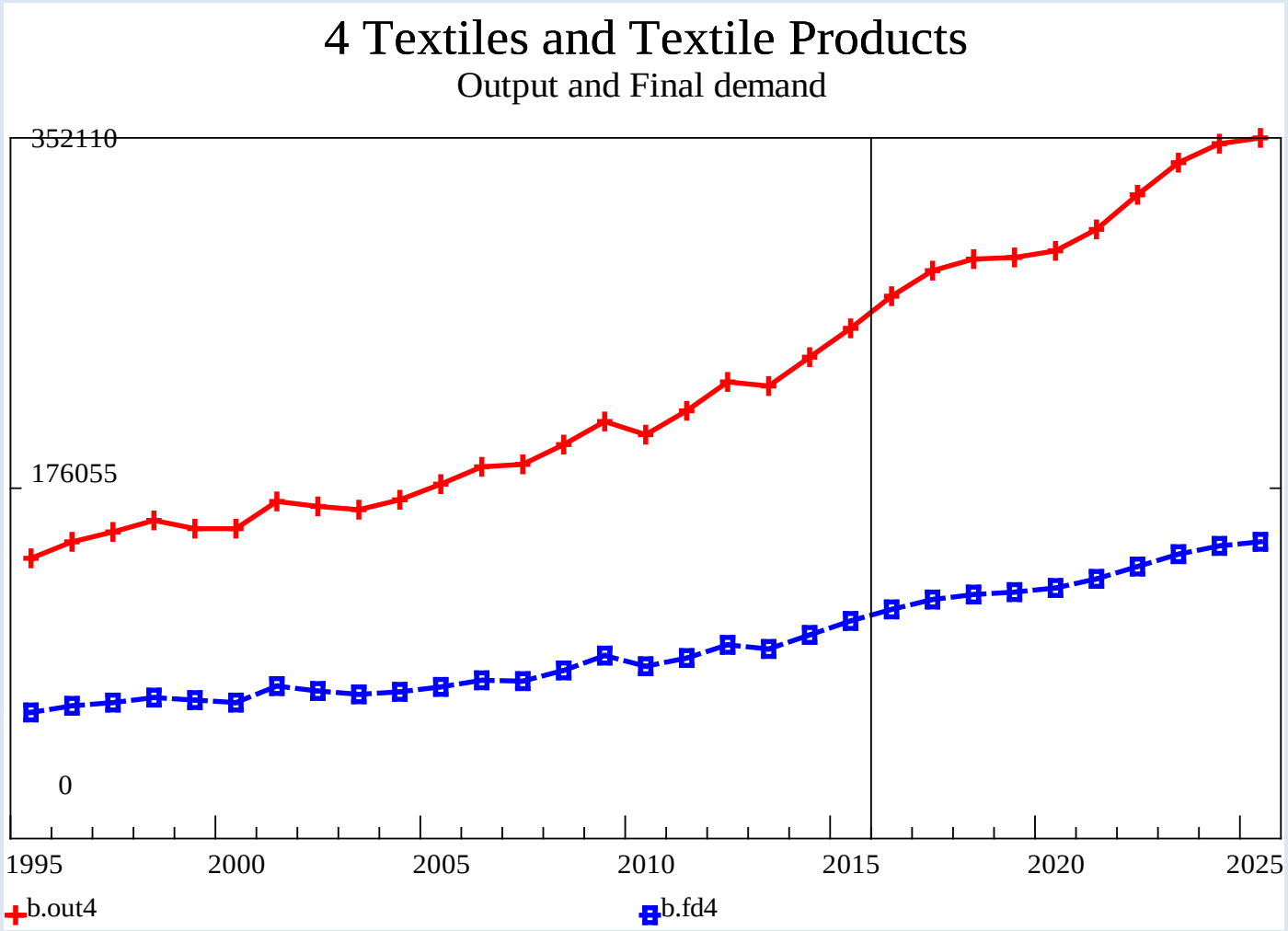

29 Real Estate Activities
Depreciation, Labor income, Capital income, Indirect taxes
193470
96735
0
1995
2000
2005
2010
2015
2020
2025
b.dep29
b.lab29
b.cap29
b.ind29

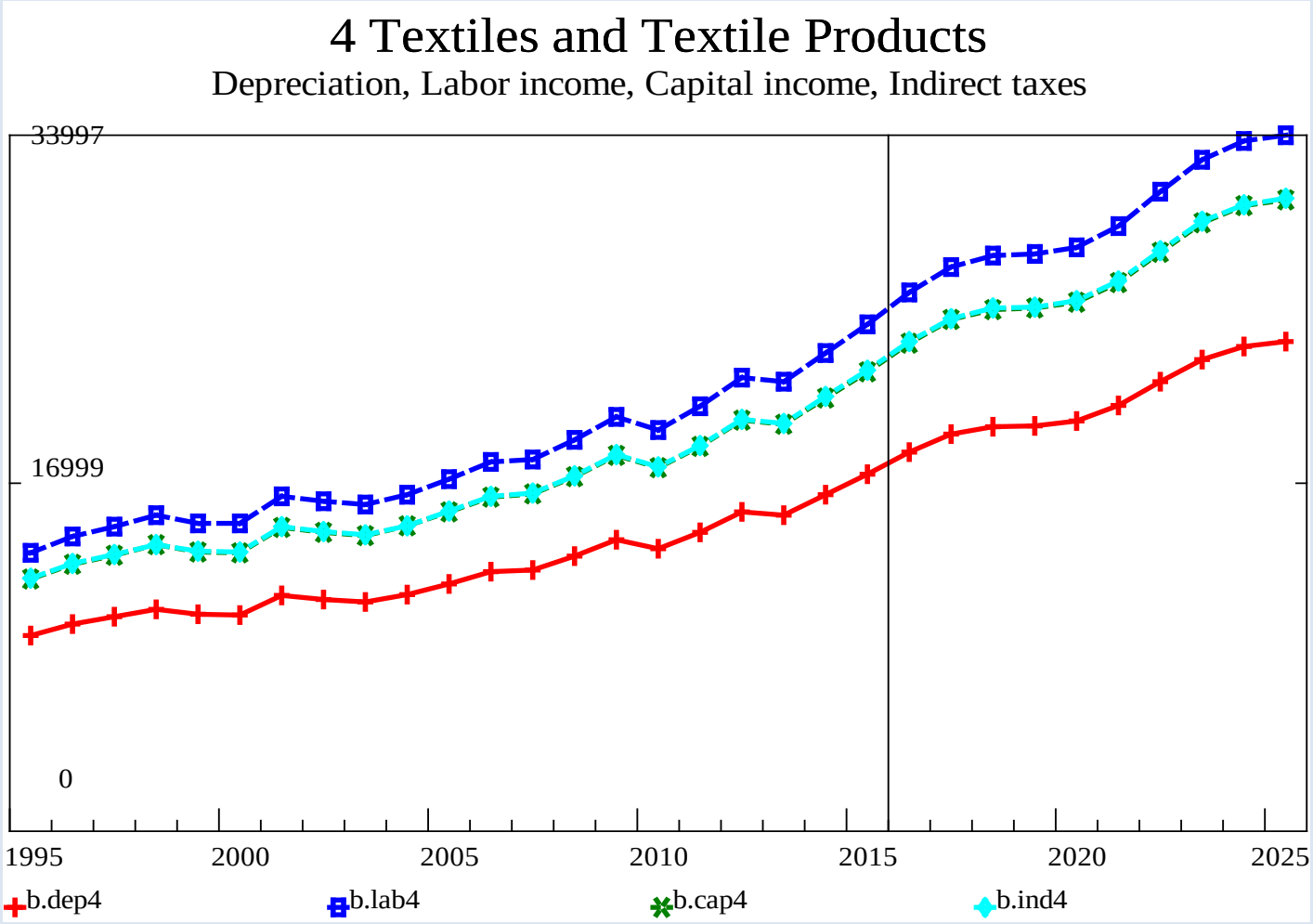

1 Agriculture, Hunting, Forestry and Fishing
Output and Final demand
263659
131829
0
1995
2000
2005
2010
2015
2020
2025
b.out1
b.fd1


1 Agriculture, Hunting, Forestry and Fishing
Depreciation, Labor income, Capital income, Indirect taxes
144006
72003
0
1995
2000
2005
2010
2015
2020
2025
b.dep1
b.lab1
b.cap1
b.ind1


18 Construction
Output and Final demand
221938
110969
0
1995
2000
2005


18 Construction
Depreciation, Labor income, Capital income, Indirect taxes
63891
31945
0
1995
2000
2005
2010
2015
2020
2025
b.dep18
b.lab18
b.cap18
b.ind18


4 Textiles and Textile Products
Output and Final demand
352110
176055
0
1995
2000
2005
2010
2015
2020
2025
b.out4
b.fd4


4 Textiles and Textile Products
Depreciation, Labor income, Capital income, Indirect taxes
33997
16999
0
1995
2000
2005
2010
2015
2020
2025
b.dep4
b.lab4
b.cap4
b.ind4

16. Results in the Form of Matrix Listing

The MATRIXLIST.CFG File for TINY

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

Table 10. Output, Top 10 sectors in 2011

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

Table 11. Personal Consumption Expenditures, Top 10 Sectors

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

Table 12. Investment by Top 10 Producing Sectors

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

Table 13. Matrix Listing

Matrix Listing

Seller: 1 Agriculture, Hunting, Forestry and Fishing

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

Table 13. Matrix Listing (Cont)

Seller: 18 Construction

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

Conclusions

- The model presented in this paper is a simple form of dynamic interindustry macroeconomic model for Turkey.
- The structure of the model is based on the framework of 35-sector IO table of Turkey for 2011.
- Calculations and presentations of the results are combined and centered in a single file called Gmodel.pre.
- With the help of additional files the model is run in the G7 command line or editor window.
- The dynamic property of the model is integrated not by a regression but with a special investment function.

Conclusions (Cont)

- The current version of the model demonstrates that one can predict or forecast the state of the economy up to 2025. This is an important property of any macroeconomic model.
- In this context the level of economic activities, final demand, and factor incomes are estimated in only one run.
- This run can be named as business as usual scenario (BAU).
- The model shows that the private final consumption expenditure (pce), which accounts for about two thirds of GDP, had grown at 4.6% year from 1995 to 2005, and at 3.1% from 2005 to 2015.
- And it will grow at 3.0% p.a. over the next 10 years from 2015 to 2025. This growth rate of pce as well as GDP is only possible if the gross fixed capital formation (inv) grows at about 4.2%.
- Regression equations, particularly for consumption and investment both at macro and sectoral level will be introduced into the model at a later stage.

Thank
You !