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On energy imports and short-term prospects of the Turkish economy: A CGE analysis*

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Abstract

This paper develops a multi-sectoral computable general equilibrium (CGE) model of the Turkish economy, calibrated to 2003 base-year data to scan 2003-2008. The model treats the energy sector independently as in Celasun (1986), who presented an influential, multi-sector computable general equilibrium (CGE) model of the Turkish economy. The data set used in this paper, captures the energy-sector items that are the most relevant in the energy-import bill of the Turkish economy. Utilizing the data set and the model constructed, the paper presents the results of two experiments. The first experiment simulates an environment where the recent increases in the energy price levels continue into the near future. The second experiment limits the amount of foreign capital inflows, while keeping the increase in the world energy prices. The results illustrate the importance of the energy sector in production activities of the model economy and the significance of the availability of foreign savings that soften the negative effects of the rising energy prices on the economy.

1. Introduction

This paper develops a multi-sectoral CGE model of the Turkish economy, calibrated to 2003 base-year data with the aim of exploring

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energy-related developments over 2003-2008. The CGE model is based on the 1996 input-output table of the Turkish economy published by the State Institute of Statistics (SIS), which is modified into seven production sectors as described in Telli (2005a). The model is built around agriculture, mining, industry, private services, public services, *and* a consolidated sector for energy products and services as the input-output core of the Turkish economy.

This study is thus enthused by the independent treatment of the crucial role of the energy sector in Celasun's (1986) SIMLOG-1 model, which will be described shortly. In SIMLOG-1, the energy sector was defined to cover all commercial production of primary and secondary energy inputs, including coal mining, crude-oil extraction, petroleum refining, and electricity, coke and gas generation. The everlasting strategic position of energy imports in Turkey's energy balances, foreign trade, and overall economic performance, encourages an analysis of the short-term energy prospects of the Turkish economy. This provides a concomitant motivation for the study.

In an energy resource poor country like Turkey, there is an ongoing debate on energy 'crises', the most recent one, in the context of rising oil prices in the world. A few years ago, another energy crisis debate ended up with Turkey committing to long-term fixed price and fixed quantity (amazingly, both) natural gas purchase agreement with Russia. Official energy demand projections done by the Ministry of Energy and Natural Resources (MENR), which constituted the excuse for the buy-or-pay commitment, were exceedingly high (see, for example, Ercan and Öz, 2004). This single event is justification in itself for the need of academically rigorous and honest energy modeling efforts in Turkey.

Turkey's buy-or-pay commitment is binding in many aspects. Since it was set as early as 1999, which primary fuel Turkey will be using to produce its electricity (natural gas) and at what import price (not to be disclosed by the officials), there are problems in forming and regulating a competitive electricity market. There is not much market that may be open to competition. Any medium to long-term energy demand forecast therefore ought to consider this buy-or-pay commitment of Turkey. This may create difficulties in using major energy modeling systems that are in use around the world. These are usually cost-minimizing systems with linear programming or CGE software at their cores that interact with outside modules (of macroeconomic models, for example). Since the Turkish solution

would not be cost minimizing, some intermediate steps need be overridden manually. These are good reasons for Turkish academics to get involved in energy modeling issues.

In his frequently cited paper, Celasun (1986) presented an influential, multi-sector computable general equilibrium (CGE) model of the Turkish economy, which distinguishes itself by structuring both its macroeconomic framework and public financial balances of the model around the system of national accounts actually published and used by the State Planning Organization (SPO) in Turkey's official planning process. Called SIMLOG-1 (Simulation with an Inter-industry Model Based on Log-change Variables), the model combined sectoral detail, which was provided by a four-sector (agriculture, energy, manufacturing and services) input-output (I-O) core, with a well-diversified labor market structure that differentiated between four types of labor: agricultural labor, non-agricultural wage labor, and non-agricultural non-wage labor and government employees. It provided a thorough analysis of adjustment in domestic product and factor markets as well as changes in balance of payments and other macroeconomic balances. The model was calibrated to 1978 data and was used as a basis for both historical and counter-factual simulations covering the 1978-1983 period of the Turkish economy.

The historical simulations with the SIMLOG-1 model demonstrated the importance of the relative price changes in the analysis of income distribution, employment, foreign trade and growth performance of the Turkish economy in the period under consideration. Counter-factual experiments focused on the role of exchange rate as a principal policy instrument in achieving various balance of payments targets by considering the interconnected nature of the key prices in an economy. Thus, the paper successfully highlighted the interactions of relative price movements with growth and structural change processes in the Turkish economy.

The present study differentiates itself with its treatment of the "energy" sector: the re-defined and re-constructed "energy" sector in the model exposes the strategic position of energy imports in the foreign trade balance of the Turkish economy. After fully describing the construction of the data set and the model, we present a conditional forward projection underlining the critical role of the energy sector as the provider of a key intermediate input to other sectors and its significance in the balance of payments accounts of the Turkish economy.

The plan of the paper is as follows: Section 2 explains the construction of the data set and lays out the structure of the model. Section 3 discusses the benchmark solution and the results from two simulation experiments. The first one of these experiments considers the effects of the continuation of the rising trend of world energy prices as recently observed, whereas the second one intends to capture the role of foreign savings as a means of avoiding the adverse effects of increasing energy prices. The concluding remarks and directions for further research are in Section 4.

2. Data structure and basic features of the model

"Viewed broadly, a CGE model for a given economy is a numerically-based framework which integrates structural connections among producing sectors with formally specified demand and supply conditions for all relevant markets under a precisely defined set of macroeconomic identities and adjustment mechanisms. The equation system of such a model is highly non-linear, unavoidably large, and strongly simultaneous, hindering the use of a general-purpose solution algorithm in its numerical implementation" (Celasun, 1986, p. 31). As such, these models require a large amount of sectoral and macroeconomic data that is tedious to collect and consolidate. A Social Accounting Matrix (SAM) provides a coherent format for merging sectoral data with data on macroeconomic balances to provide a snap shot of the economy at the base period. As such, a SAM serves as the typical data-input of a CGE model.[1]

The CGE model presented in this study is based on an aggregation of the 1996 input-output table of the Turkish economy published by the State Institute of Statistics (SIS) into seven production sectors as described in Telli (2005a). It distinguishes two types of labor and it incorporates households, a central government, and a foreign sector. The model utilizes a multi-sectoral SAM of the Turkish economy for the year 2003, constructed by Telli (2005a), to provide an interlocking and integrated framework to define, collect, classify and manipulate necessary data. It is then used as a basis for generating a series of yearly aggregated SAMs for the Turkish economy starting from 1996. The SAMs keep official figures on key

[1] The theoretical grounds that a computable general equilibrium framework stands can be found in Dervis *et al*. (1982), Bolnick (1989) and Lofgren *et al*. (2002). The multi-sectoral CGE models built for the Turkish economy following Celasun (1986), include Yeldan (1998), Mercenier and Yeldan (1997), Diao *et al*. (1999) and Bekmez (2002).

macroeconomic and fiscal variables such as public sector borrowing requirement (PSBR), public savings and national income unchanged.

This study introduces a number of improvements to the data generation process by i) incorporating the latest socio-economic dynamics when building the micro SAM for the Turkish economy, and ii) by enhancing the simulation and decomposition capabilities as well as potential accuracy and reliability of general equilibrium model(s) through the use of yearly updates of SAMs. Yet another notable feature of the data generation approach adopted here is the resulting comparability of the values of macroeconomic and sectoral variables with official figures (specifically those of SPO).[2]

2.1. The input-output Core and the construction of the multi-sectoral SAM

The model is built around a seven-sector (agriculture, mining, industry, private services, public services, and a consolidated sector for energy products and services) input-output core of the Turkish economy. While the coverage of agriculture, private services and public services conform to their conventional definitions of the national accounts, a distinguishing feature of the model is its treatment of the energy sector. A new sector covering energy products and services is defined in order for the model to capture the strategic position of the national energy balances within the sectoral, trade, and macroeconomic accounts, allowing for an analysis of the effects of various energy shocks. Note that, because of this grouping, mining and industry sectors do not conform to their conventional definitions in the national accounts. Their coverage is net of energy sectors.

As published by the SPO in Main Economic Indicators, the total value of imports of "mineral fuels, lubricants and related material",[3] in 2003 is 11,574.9 million dollars, of which 6,578.9 million dollars belonging to petroleum and related products and 3,966.6 million dollars accounts for the natural and manufactured gas. These two sub-categories constitute a share of more than 90% of the broad category. The value of total imports in this class represents more than 16% of total import bill of the Turkish economy for the year 2003. Therefore, it becomes important to arrange a specific scheme of aggregation to

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[2] The model structuring around the system of national accounts actually used by the SPO, and in this sense the database being directly comparable to the official accounts is another common property of this study and that of Celasun (1986).

[3] The sub-categories include coal, coke and briquettes; petroleum, petroleum products and related; gas (natural and manufactured) and electric current.

reveal the strategic position of energy-sector imports in foreign trade balances of the Turkish economy. [4]

To fulfill the necessities of our approach, the sub-sectors, "mining of coal", "extraction of crude petroleum and "natural gas" are taken out of the general "mining sector". Following a similar procedure, the sub-sectors, "manufacturing of coke" and "refined petroleum products" are dig out of the wide-ranging "industry" sector. Next, the conventional energy sector is re-defined to include these sub-sectors. Specifically, the "energy products and services" sector consists of the following categories:[5]

- Production, collection and distribution of electricity
- Manufacture of gas; distribution of gaseous fuels through mains
- Collection, purification and distribution of water
- Mining of coal and lignite
- Extraction of crude petroleum and natural gas
- Manufacture of coke, refined petroleum products

The disaggregation method followed uses the schematic macro-SAM presented at Telli (2005a) to get the micro version SAM through: i) the use of relevant input-output coefficients, ii) highly detailed and electronically linked data surface through an assembly line system and iii) the other up-to-date information available like census, surveys conducted by SIS and foreign trade compositions. Tables 1 and 2 display definitions and figures of such a schematic SAM of the Turkish economy for the year 2003.

2.1.1. Input output core

The latest official I-O Table belongs to the year 1998 but 1996 I-O is preferred for further use in the analysis for a number of reasons. First, the macro-SAM structure which we use as a basis in the disaggregation and aggregation procedure in constructing the database

[4] The crucial position of the energy imports for the Turkish economy can be traced from the data available by the SPO in Main Macroeconomic Indicators, Foreign Trade and Balance of Payments Section. The data on energy imports here is classified according to the Standard International Trade Classification (SITC, Rev.3). However, one needs to make the data available on both the import matrix and the input-output tables published, compatible with the definition here, since the sectoral aggregation is not readily available.

[5] The import value of the "energy products and services" sector as defined constitutes 15.70% of total imports in the SAM constructed for the model, which enables us to believe that the aggregation that is carried out in this study provides a satisfactory approximation of the sector.

Table 1

Schematic (Aggregated) Social Accounting Matrix

		Factors								Capital Account			
	Activities	Commodities	Formal Labor	Informal Labor	*Capital*	Households	Enterprises	Social Sec. Inst.	Government	*Private Investment*	*Public Investment*	ROW	TOTAL RECEIPTS
Activities		Domestic Supply										Exports	*Total Sales Revenue*
Commodities	Intermediate Inputs					Private Consumption			Government Consumption	Private Investment	Public Investment		*Domestic Absorption*
Formal Labor	Formal Wages												*Formal Labor Income*
Informal Labor	Informal Wages												*Informal Labor Income*
Capital	Operating Surplus + Depreciation												*Capital Income*
Households			F. Labor Income	Inf. Labor Income			Distributed Profits (Net)	Social Security Expenditures	Current Transfers to Households			Remittances	*Private Income*
Enterprises					Capital Income				Transfers to SEEs			Private For. Transfers	*Corporate Income*
Social Sec. Inst.	Soc. Security Taxes by Employers		Soc. Security Taxes by Workers						Current Transfers to Soc. Sec. Institutions				*Social Security Income*
Government	Net Indirect Taxes on Production	Sales Taxes (VAT) + Tariffs				HH Income Tax + NonTax Rev	Pub. Sector Factor Income + Corporate Taxes					Public For. Transfers	*Public Income*
Capital Account *Private Investment*						Private Investment							*Private Investment*
Capital Account *Public Investment*						Private Saving Surplus			Public Savings			Foreign Resources	*Public Investment*
Rest of the World		Imports					Profit Transfers Abroad		Foreign Interest Payments on Ext Pub. Debt				*For. Exch. Earnings*
Total Expenditures	*Production Costs*	*Aggregate Absorption*	*F. Labor Costs*	*Inf. Labor Costs*	*Capital Expenditures*	*Private HH Expenditures*	*Corporate Expenditures*	*Social Security Expenditures*	*Public Expenditures*	*Private Investment*	*Public Investment*	*For. Exch. Expenses*	

Table 2

Schematic (Aggregated) Social Accounting Matrix For Turkey,2003, Billion TL.

		Factors					Capital Account						
		Activities	Commodities	*Formal Labor*	*Informal Labor*	*Capital*	Households	Enterprises	Social Sec. Inst.	Government	*Private Investment*	*Public Investment*	ROW	TOTAL
	Activities		510.187.304										98.496.338	608.683.642
	Commodities	278.878.198					245.085.448			44.192.468	66.212.051	16.110.988		650.479.153
	Formal Labor	78.687.170												78.687.170
	Informal Labor	34.039.632												34.039.632
	Capital	169.553.793												169.553.793
	Households			70.385.523	34.039.632			197.871.230	37.566.120	19.305.641			1.090.079	360.258.224
	Enterprises					169.553.793				56.375.925			7.196.707	233.126.425
	Social Sec. Inst.	15.290.833		8.301.647						13.973.640				37.566.120
	Government	32.234.016	29.957.482				28.370.862	30.510.587						121.072.947
Capital Account	*Private Investment*						66.212.051							66.212.051
	Public Investment						20.589.863			-19.398.942			14.920.067	16.110.988
	Rest of the World		110.334.367					4.744.608		6.624.215				121.703.191
	Total Expenditures	608.683.642	650.479.153	78.687.170	34.039.632	169.553.793	360.258.224	233.126.425	37.566.120	121.072.947	66.212.051	16.110.988	121.703.191	

for our model, uses 1996 I-O data when constructing schematic recursive real SAMs for years 1996-2003. Secondly, authors observe that 1996 I-O structurally mirrors the fiscal parameters like some tax and subsidy figures much closer to the official public accounts than the fiscal definitions employed in 1998 I-O[6].

1996 I-O is re-arranged accordingly to give a structural portray of *intermediate inputs* at the intersection of commodities row and activities column in the 2003 macro-SAM. Tables 3 and 4 display the balanced I-O table for 1996 and import matrix for the same year according to disaggregation into the seven sectors defined, respectively. The factor incomes of the capital input as it appears in I-O table under the heading of *operating surplus*, is used for any necessary correction to avoid sectoral excess demand or supply conditions. Non-residents' final consumption at home is treated to be from private services sector in its origin while residents' final consumption abroad is added to the final imports of private services.

Intermediate demand and supply coefficients are then used to divide the 278,878,198 billion TL flow to the sectors defined in Table 2. Additionally, the structural composition of most tax figures in micro SAM are re-calculated in accordance with this aggregated version of 1996 I-O. Alternatively, factor incomes and foreign trade compositions by sector of origin are based on the most recent data following Telli (2005b) rather than simply reproduction of the 1996 I-O ratios.

The SAM constructed for the model is given in Table 5. As can be traced from the sectoral input-output relations module in the SAM, the energy sector is one key sector providing the intermediate inputs to other sectors' final production. The energy sector accounts for more than 14% of all intermediate input usage payments for 2003 (the two larger percentages are 38.5% for industry sector and 33% for services sector). Likewise, energy intermediate inputs constitute more than 5% of agriculture and construction, almost 10% of the industry, 20% of the services, more than 35% of the mining and more than 80% of energy sector's total intermediate input bills. Together with the weight of energy-imports in total import bill, we believe the model database as aggregated captures both the macroeconomic and the inter-sectoral impact of the energy sector for the Turkish economy.

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[6] Specifically, the 1998 I-O and that of 1996 are not identical in their treatment and definition of certain fiscal items like production taxes.

Table 3
I-O 1996, TL

		AGRI	MIN	IND	CONS	SERV	PSERV	ENE	
	CODE	*1*	*2*	*3*	*4*	*5*	*6*	*7*	INT CONS
AGRI	*1*	753 594 350	181 386	705 497 075	6 879 511	72 941 731	0	1 063 157	1 540 157 210
MIN	*2*	152 093	55 490	58 548 461	35 344 664	1 792 611	0	111 571	96 004 892
IND	*3*	275 059 229	4 620 046	2 824 767 903	660 519 267	742 160 948	0	19 760 190	4 526 887 582
CONS	*4*	0	0	0	0	36 686 796	0	0	36 686 796
SERV	*5*	326 936 787	11 133 174	1 219 507 991	327 411 130	1 905 284 635	0	84 098 036	3 874 371 753
PSERV	*6*	0	0	0	0	0	0	0	0
ENE	*7*	104 228 229	8 912 500	420 614 598	55 976 291	667 493 178	0	421 019 777	1 678 244 572
SUBTOTAL		*1 459 970 688*	*24 902 595*	*5 228 936 028*	*1 086 130 863*	*3 426 359 900*	*0*	*526 052 732*	*11 752 352 805*
Gross Value Added at Factor Cost		2 388 841 859	75 648 263	3 439 089 676	862 145 588	6 934 734 748	1 186 868 765	945 730 589	15 833 059 488
Prod Taxes and Tariffs		76 383 238	1 077 481	198 443 369	8 953 764	188 021 624	0	356 791 861	829 671 337
Less Subsidies		150 529 183	0	2 000 000	0	87 759 576	0	3 120 000	243 408 759
Depreciation		108 754 105	28 588 117	290 897 999	13478739	331 140 081	38 966 427	25 615 075	837 440 543
Wage Payments		281 359 232	11 171 310	547 106 630	95 308 346	1 050 079 111	1 147 902 338	101 640 412	3 234 567 379
Operating Surplus		2 072 874 467	34 811 355	2 404 641 679	744 404 739	5 453 253 509	0	464 803 241	11 174 788 989
GROSS PRODUCTION at FC		3 848 812 547	100 550 858	8 668 025 704	1 948 276 451	10 361 094 648	1 186 868 765	1 471 783 320	27 585 412 292

Table 3 (continued)

	CODE	PRIV C	PUB C	PRIV GFCF	PUB GFCF	STOCK CH	EXPORTS	Agg Demand	Tot Imports	Gross Prod
AGRI	*1*	1 751 814 356	46 718 973	5 569 724	336 068	508 220 446	165 480 208	4 018 296 985	169 484 438	3 848 812 547
MIN	*2*	0	395 559	0	0	2 596 237	22 977 631	121 974 319	21 423 461	100 550 858
IND	*3*	3 454 123 040	76 102 691	1 352 271 983	135 858 565	690 823 336	1 443 737 790	11 679 804 988	3 011 779 284	8 668 025 704
CONS	*4*	0	6 589 186	1 389 836 684	515 163 785	0	0	1 948 276 451	0	1 948 276 451
SERV	*5*	4 300 714 827	327 004 255	362 981 890	45 097 834	- 124 433 981	1 996 669 518	10 782 406 094	421 311 447	10 361 094 648
PSERV	*6*	0	1 186 868 765	0	0	0	0	1 186 868 765	0	1 186 868 765
ENE	*7*	332 970 622	67 607 265	0	0	- 125 514 347	24 371 132	1 977 679 243	505 895 923	1 471 783 320
SUBTOTAL		9 839 622 844	1 711 286 694	3 110 660 281	696 456 251	951 691 691	3 653 236 279	31 715 306 845	4 129 894 553	27 585 412 292
Gross Value Added at Factor Cost									Check	27 585 412 292
Prod Taxes and Tariffs										
Less Subsidies										
Depreciation										
Wage Payments										
Operating Surplus										
GROSS PRODUCTION at FC										

Table 4
Import Matrix 1996, TL

		AGRI	MIN	IND	CONS	SERV	PSERV	ENE	
	CODE	*1*	*2*	*3*	*4*	*5*	*6*	*7*	INT IMP
AGRI	*1*	68 761 242	0	62 995 786	0	1 431 702	0	91 126	133 279 857
MIN	*2*	955	101	18 933 468	2 488 065	0	0	871	21 423 461
IND	*3*	59 071 825	965 959	876 732 849	135 281 503	153 121 254	0	7 021 067	1 232 194 456
CONS	*4*	0	0	0	0	0	0	0	0
SERV	*5*	0	0	0	0	0	0	0	0
PSERV	*6*	0	0	0	0	0	0	0	0
ENE	*7*	8 890 725	691 804	45 528 073	3 642 652	60 591 227	0	337 793 332	457 137 812
TOTAL		136 724 746	1 657 864	1 004 190 177	141 412 220	215 144 183	0	344 906 396	1 844 035 585

Table 4 (continued)

	CODE	PRIV C	PUB C	PRIV GFCF	PUB GFCF	STOCK CH	FIN DEMAND FOR IMP	TOT IMPORTS
AGRI	*1*	27 564 095	3 191 739	5 138 011	310 019	717	36 204 581	169 484 438
MIN	*2*	0	0	0	0	0	0	21 423 461
IND	*3*	656 551 850	10 487 893	882 486 364	93 053 007	137 005 714	1 779 584 828	3 011 779 284
CONS	*4*	0	0	0	0	0	0	0
SERV	*5*	1 341 713	0	0	0	0	421 311 447	421 311 447
PSERV	*6*	0	0	0	0	0	0	0
ENE	*7*	44 450 457	4 307 654	0	0	0	48 758 111	505 895 923
TOTAL		729 908 115	17 987 287	887 624 375	93 363 026	137 006 431	2 285 858 968	4 129 894 553

Table 5

Social Accounting Matrix, Turkey, 2003, The Real Side

		ACTIVITIES							COMMODITIES						
		A	M	I	C	S	G	E	A	M	I	C	S	G	E
ACTIVITIES	A								67.056.766						
	M									1.818.467					
	I										112.584.954				
	C											48.501.948			
	S												193.449.593		
	G													43.635.078	
	E														43.140.499
COMMODITIES	A	17.882.465	4.304	16.741.137	163.248	1.730.875	0	25.228							
	M	3.609	1.317	1.389.329	838.713	42.538	0	2.648							
	I	6.527.035	109.632	67.030.508	15.673.834	17.611.155	0	468.901							
	C	0	0	0	0	870.562	0	0							
	S	7.758.067	264.185	28.938.392	7.769.323	45.211.572	0	1.995.610							
	G	0	0	0	0	0	0	0							
	E	2.473.290	211.49	9.981.001	1.328.293	15.839.322	0	9.990.615							
FACTORS	LF	3.510.595	1.148.799	16.694.736	6.661.522	24.666.479	22.690.103	3.314.937							
	LI	16.066.919	148.835	3.324.749	924.254	12.929.559	0	645.316							
	KP	12.891.778	279.848	23.522.903	13.443.684	89.578.753	0	6.830.506							
	KG	977.43	195.486	1.368.402	19.549	0	16.535.736	3.909.720							
HOUSEHOLDS	H														
ENTERPRISES															
SOCIAL SECURITY INST.		682.194	223.24	3.244.194	1.294.496	4.793.297	4.409.239	644.173							
GOVERNMENT		2.094.323	45.526	6.280.969	385.034	8.085.264	0	15.342.901	5.501.352	235	10.819.772	0	12.656.251	0	979.872
VAT									5.155.269	0	10.164.851	0	12.656.216	0	979.872
IMPTAX									346.084	235	654.921	0	36	0	0
PROTAX		2.094.323	45.526	6.280.969	385.034	8.085.264	0	15.342.901							
NONTAX															
DIRTAX															
FACINC															
ENTTAX															
PRIVATE CAPITAL Acc															
PUBLIC CAPITAL Acc															
REST OF THE WORLD									3.887.947	3.270.385	79.192.195	62.756	6.613.655	0	17.307.428
Total Expenditures		70.867.705	2.632.661	178.516.320	48.501.948	221.359.376	43.635.078	43.170.555	76.446.065	5.089.087	202.596.921	48.564.704	212.719.498	43.635.078	61.427.799

Table 5 (continued)

		FACTORS				HOUSEHOLDS	ENTERPRISES	SOCIAL SECURITY INST.
		UF	UI	KP	KG			
ACTIVITIES	A M I C S G E							
COMMODITIES	A M I C S G E					38.566.704 2.800.718 61.454.391 5.806.503 104.362.262 12.236.978 19.857.891		
FACTORS	LF LI KP KG							
HOUSEHOLDS	H	70.385.523	34.039.632				197.871.230	37.566.120
ENTERPRISES				146.547.471	23.006.322			
SOCIAL SECURITY INST.		8.301.647						
GOVERNMENT *VAT* *IMPTAX* *PROTAX* *NONTAX* *DIRTAX* *FACINC* *ENTTAX*		0	0	0		28.370.862 8.888.866 19.481.996	30.510.587 20.838.377 9.672.210	0
PRIVATE CAPITAL Acc						66.212.051		
PUBLIC CAPITAL Acc						20.589.863		
REST OF THE WORLD							4.744.608	
Total Expenditures		78.687.170	34.039.632	146.547.471	23.006.322	360.258.224	233.126.425	37.566.120

Table 5 (continued)

		GOVERNMENT	*PUBCONS*	*HHTRA*	*PROSUB*	*DOMINT*	*FORINT*	*SSITRA*	*PUBSAV*	PRIVATE CAPITAL	PUBLIC CAPITAL	REST OF THE WORLD
ACTIVITIES	A	0										3.810.939
	M	0										814.195
	I	0										65.931.366
	C	0										0
	S	0										27.909.783
	G	0										0
	E	0										30.056
COMMODITIES	A	1.206.476	1.206.476							117.853	7.774	
	M	10.215	10.215							0	0	
	I	1.965.285	1.965.285							28.613.390	3.142.790	
	C	170.16	170.16							29.800.295	11.917.184	
	S	7.696.334	7.696.334							7.680.513	1.043.239	
	G	31.398.100	31.398.100							0	0	
	E	1.745.898	1.745.898							0	0	
FACTORS	LF	0										
	LI	0										
	KP	0										
	KG											
HOUSEHOLDS	H	19.305.641		19.305.641								1.090.079
ENTERPRISES		56.375.925			1.579.403	54.796.522						7.196.707
SOCIAL SECURITY INST.		13.973.640						13.973.640				
GOVERNMENT		0								0	0	0
VAT												
IMPTAX												
PROTAX												
NONTAX												
DIRTAX												
FACINC												
ENTTAX												
PRIVATE CAPITAL Acc		0										
PUBLIC CAPITAL Acc		-19.398.942							-19.398.942			14.920.067
REST OF THE WORLD		6.624.215					6.624.215					
Total Expenditures		121.072.947	44.192.468	19.305.641	1.579.403	54.796.522	6.624.215	13.973.640	-19.398.942	66.212.051	16.110.988	121.703.191

2.2. General structure and dimensions of the model

2.2.1. Production, factor endowments and factor incomes

As primary factors of production, the model defines sectoral capital and labor aggregates. The gross output in each sector in turn, is produced by a representative firm employing intermediates and composites of primary inputs. Capital is featured around two categories: private and public. Public capital is assumed sector specific and the sectoral allocation of the public capital stocks over time is achieved by taking into account the depreciation factor and the new capacity creation effect of the fixed public investments. Private capital is assumed mobile across sectors and the movement is directed by the difference in the differentiated privet profit rates in each sector.

The initial estimation of the sectoral allocation of both private and public capital stocks are taken from Telli (2005b). The further disaggregation of the total capital stock into its public and private components is based on the estimated rates of return on both public and private capital.[7]

Labor input in the model is likewise, further decomposed into two categories: organized wage-labor and informal/marginalized labor. Labor demand decisions are derived from the marginal productivity condition of profit maximization. The nominal wage rate of the organized labor is given exogenously, and the organized labor market clears through quantity adjustments on employment. The unemployed "wage-labor" is then pooled with the informal labor category, where flexible movements of the informal wage rate clear the aggregate labor surplus.

Telli (2005b) gives a detailed estimation for sectorization of both formal and informal labor in four dimensions: first, labor endowment in the economy is shared between public and private sector employers. Second, a fine aggrageted level of sectoral decompositon is carried out. Formal and informal labor employments are then estimated bay making use of the SIS surveys, census and public accounts such as data from State Economic Enterprises (SEEs) and Social Security Institutions (SSIs). At the fourth stage, average wage rates for each labor type across major sectors of the economy are attributed.

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[7] Saygılı *et al*. (2002) also provide sectoral allocation of the capital stock for the Turkish economy. However, they do not make the distinction between public and private capital stocks.

Sectoral shares of total incomes of production factors are calculated accordingly; simply by multiplication of relevant matrices with the appropiate aggrageted SAM 2003 cell that is presented at Telli (2005a) (See Table 5).

Additional analysis of the supply-side properties of the CGE model requires the specification of the production functions at the sectoral level. Each representative firm is assumed a cost-minimizer making the input choices accordingly under the technical constraints of the specific production functions. In this model, a multi-level treatment of the production technology is employed.

The underlying production technology for the value-added varies across sectors, depending on the nature, but the intermediate input use in every sector is regarded as Leontieff. Treated in this manner, the gross-output supply in each sector is represented by:

$$X_i^S = \min\left[\frac{V_i}{b_{0i}}, \frac{a_{1i}X_i^S}{b_{1i}}, \frac{a_{2i}X_i^S}{b_{2i}}, \frac{a_{3i}X_i^S}{b_{3i}}, \ldots\right] \quad (1)$$

where V_i is the value-added and a_{ij}'s are the input-output coefficients measuring sales from sector i to sector j. We have *i=j=AGRI, MINE, INDS, CONS, PSRV, GSRV, ENGY.*

Except for the public services sector (GSRV) which is assumed to employ only formal labor and public capital in the production of the value-added, and the private services sector, of which the only type of capital employed is the private capital, the value-added in each sector is generated by combining both formal and informal labor, as well as public and private physical capital, through a multi-level constant elasticity (CES) of production structure: (i) at the lowest level of factor combination, formal labor and informal labor combine to forma composite labor aggregate:

$$C_i = \overline{A}_{Ci}[\beta_{Ci}LF_i^{-\rho_{Ci}} + (1-\beta_{Ci})LI_i^{-\rho_{Ci}}]^{-1/\rho_{Ci}} \quad (2)$$

$\overline{A}_{Ci}$, the index of technological change and β_{Ci}, the efficiency parameter of the formal labor input. (ii) private capital and labor aggregates are combined to form a composite primary input, with a relatively low level of substitution (as measured by $\sigma_{Ji} = \frac{1}{1+\rho_{Ji}}$):

$$J_i = \overline{A}_{Ji}[\beta_{Ji}C_i^{-\rho_{Ji}} + (1-\beta_{Ji})KP_i^{-\rho_{Ji}}]^{-1/\rho J_i} \quad (3)$$

(iii) Finally, sector-specific public capital combines with the composite input Ji, under a Cobb-Douglas technology:

$$V_i = A_{Vi} J_i^{\alpha_i} KG_i^{1-\alpha_i} \quad (4)$$

Value-added in the public services sector is assumed to be of Cobb-Douglas technology combining only formal labor and public capital.

2.2.2. Income Generation

For the households, the basic sources of income are returns to labor input, the wages, and returns to capital input, distributed profits. The enterprise profits amount to what is left over after paying or both types of wages and profits to the government:

$$RP_i = PVA_i.V_i^s - (1+ pyrltax)\overline{W}_F.LF_i^D - W_I.LI_i^D - RG_i \quad (5)$$

with (1+pyrltax)$\overline{W}_F$ and W_I representing the nominal unit cost of formal labor to the employers, the exogenous nominal wage rate plus the payroll tax of the formal labor and endogenous nominal wage rate of the informal labor, respectively. RG_i is the profit earnings of the government due to its production activities through SEEs.

However, the net transfer of the enterprise income to the households in terms of dividends is defined by:

$$EtrHH = (1 - t_K)\sum_i RP_i - rttrrow\sum_i (1 - tk)RP_i + GtrEE +$$

$$r^D DomDebt^G - r_E^F \varepsilon ForDebt^E + \varepsilon ForDebt^E + \varepsilon ForBOR^E \quad (6)$$

A constant portion, *rttrrow*, of the total profit income is distributed to rest of the world to represent net factor income of the foreigners in Turkey. *GtrEE* is the net transfers of the government to private enterprises; $r^D DomDebt^G$ is the interest payments of the enterprise sector out of government domestic debt and $r_E^F \varepsilon ForDebt^E$ is the interest payments of the private enterprises for their already accumulated foreign debt. As ε represents the exchange rate variable, $ForBOR^E$ is the new foreign borrowing in foreign exchange terms of the private sector.

Hence, totals private income composes of total labor income and all types of transfers to the private households:

$$totYHH = (1 - sstax).\overline{W}_F.\sum_i LF_i^D + W_I\sum_i LI_i^D +$$

$$EtrHH + GtrHH + SSItrHH + \varepsilon \cdot ROWtrHH \quad (7)$$

GtrHH and *SSItrHH* are government transfers to households and transfers from social security institutions respectively.[8] The *ROWtrHH* represents the remittances.

Public sector collects profit income from SEEs, direct taxes, and other budget revenue from the two income groups, and provides them in return current transfers at pre-determined proportions. The income flow of the public sector is further augmented by indirect taxes on domestic output and foreign trade (net of subsidies), less, public interest payments both to domestic and foreign markets, to yield public disposable income:

$$GREV = \sum_i tn_i.PX_i.XS_i + \sum_i tm_i \varepsilon P_i^w M_i + \sum_i te_i \varepsilon P_i^w E_i +$$
$$\sum_i tva_i.PQ_i CC_i + ty \cdot totYHH + t_K \sum_i RP_i + \sum_i RG_i \quad (8)$$

In equation (8), tn_i is the production tax rate, tm_i and te_i are tariff rate and subsidy rate on exports, tva_i is the sector-specific sales tax rate and *ty* is the direct income tax rate.

Private household save a constant fraction, s^p of their income. Private consumption aggregate is then obtained by subtracting total private savings from the private disposable income. Exogenous shares for sectoral allocation of total private consumption are calibrated and used throughout the analysis.

Likewise, the public consumption is allocated across sectors with pre-determined coefficients of consumption:

$$GD_i = gles_i.\frac{GOVCON}{PC_i} \quad (9)$$

Aggregate public consumption, on the other hand, is defined as a fixed proportion of the government revenues, net of interest payments on both domestic and foreign debt stocks:

$$GCON = gcr \cdot (\text{GREV} - r_p^F \varepsilon ForDebt^G - r^D \varepsilon DomDebt^G) \quad (10)$$

[8] The social security institutions in this model are treated separately with the revenue coming from contributions of employers and employees, and government transfers to close their income-expenditures gap. The collections of the institutions are transferred back to the households.

2.2.3. Product markets and final demand

The model classifies world prices of imported goods as exogenous data. The imports are treated as imperfectly competitive additional supplies in sectors For the base year, the model specifies the levels of defined imports for each sector. From the base-year onwards, the ratio pof derived imports to domestic output available fro the home market is allowed to change in response to movements in the relative prices of imported and domestic goods. This relationship is based on the first order conditions of a CES-type trade aggregation functions specified for each relevant sector. Similarly, on the export side, it is supposed that export volumes are sensitive to differences between Turkey's own export prices and the world price of exports.

In order to characterize rigorously the main instrument of the current public fiscal policy, the government's fiscal balances are centered on achieving the pre-determined levels of primary surpluses:

$$PRIMBAL = GREV - GOVCON - GINV - GtrHH - GtrEE - GtrSSI \quad (11)$$

where GREV represents (total) government revenues and primary balance (*PRIMBAL*) is defined to be the difference between government revenues and non-interest expenditures, namely government consumption (*GOVCON*), government investment (*GINV*) and all types of government transfers (*GtrHH + GtrEE + GtrSSI*).

If government transfer items to the households, to the enterprises and to the social security system are taken as fixed proportions of government revenues net of interest payments, then, under a pre-determined primary surplus/GDP ratio, public investment demand is settled as a residual variable out of the public fiscal accounts.[9]

The PSBR then, is defined by

$$PSBR = GREV - GCON - GINV - r_P^G \varepsilon\, ForDebt^G - r^D DomDebt^G - GtrHH - GtrEE - GtrSSI \quad (12)$$

and is financed by either domestic borrowing or borrowing from abroad.

[9] The fixed public investment, as a ratio to GDP has been decreasing steadily under the constraints of the current program. The ratio was 5.6% in 2001, which has gradually dropped down to 5.33% in 2002, 4.17% in 2003 and 3.63% in 2004.

The model uses exogenous shares from sector allocation of total private and total public fixed investments.

In the last stage of the macro-analysis, the model's closure rule for the savings-investment balance is to be defined:

$$PSAV + GSAV + \varepsilon\, CAdef = PINV + GINV \tag{13}$$

The *CAdef* in Equation 13 determines the current account balance in foreign exchange terms and equals to the export revenues, the remittances and private and public foreign borrowing on the revenue side and the import bill, profit transfers abroad and interest payments on the accumulated private and public debt stocks on the expenditures side:

$$\begin{aligned} CAdef &= \sum P_i^W E_i + ROWtrHH + ForBor^E + ForBor^G \\ &- \left[\sum P_i^W M_i + trrow \sum (1 - tk) RP_i + r_E^F ForDebt^E + r_P^F ForDebt^G\right] \end{aligned} \tag{14}$$

The private and public components of the external capital inflows, are fixed in their foreign exchange terms. The additional endogenous variable of the system to close is the private investments, PINV.

The circular flow of the incomes described in this section and the outline of the model is illustrated more precisely in Table 5, The 2003 SAM constructed for Turkey.

3. Model experiments

The model described in Section 2 embodies a large number of structural and behavioral relations, requiring parameter estimates that are not always readily available. Therefore, the first step to carry out any analysis employing such models is the calibration of the sectoral and macroeconomic structures of the model to the consistent base-year data set; with the ultimate aim of getting the base-year SAM as the benchmark solution to the model. The static model described, under a pseudo-dynamic structure with exogenously provided growth rates of the labor supply and factor productivity, under the assumption of constant coefficients for sectoral allocation of investments, allows us to scan 2003-2008. The exogenous variables are updated based on available actual figures for years 2004 and 2005. Since it is important for the benchmark model to utilize the already available projections on exogenous variables, 2008 seems to be the appropriate (last) year for one can acquire estimates of economic growth rate, critical fiscal

policy measures, real interest rates on public debt, etc. in official documents.

The current account balance *CAdef* variable (See equations 13 and 14) is one such key exogenous variable which is basically observed to increase by approximately by 55% in 2004 and 45% in the first eight months of 2005 (as compared to the same period of 2004). Because the model utilizes the standard savings-driven closure rule, the possibility of the continuation of the availability of foreign savings as in 2004 and 2005 creates an important relief on the demand for private investment as well as the balance of payments accounts; significantly affecting the potential growth performance of the economy. Therefore, the issue for the available foreign savings to continue growing with similar rates as in 2004 and 2005 is one point that we try to reflect in the forward projections we present in this study.[10]

One other crucial variable that is important for the model experiments to capture is the exogenously provided world energy prices. As we want to focus on the energy sector as a significant sector, both in sectoral production relations and in balance of payments accounts, the recent continuous rise in the world energy prices is also to be reproduced in the model's historical period. One indicator to approximate this increase is the world energy prices can be the dollar price of crude petroleum over 2003-2005 period, as provided in Figure 1.

The benchmark model, assuming constant average productivity and population growth rates for 2003-2008 period,[11] assumes no further increases in the world price of the energy sector, but maintains the supposition that the availability of foreign savings will continue to grow with a 20% rate on average.

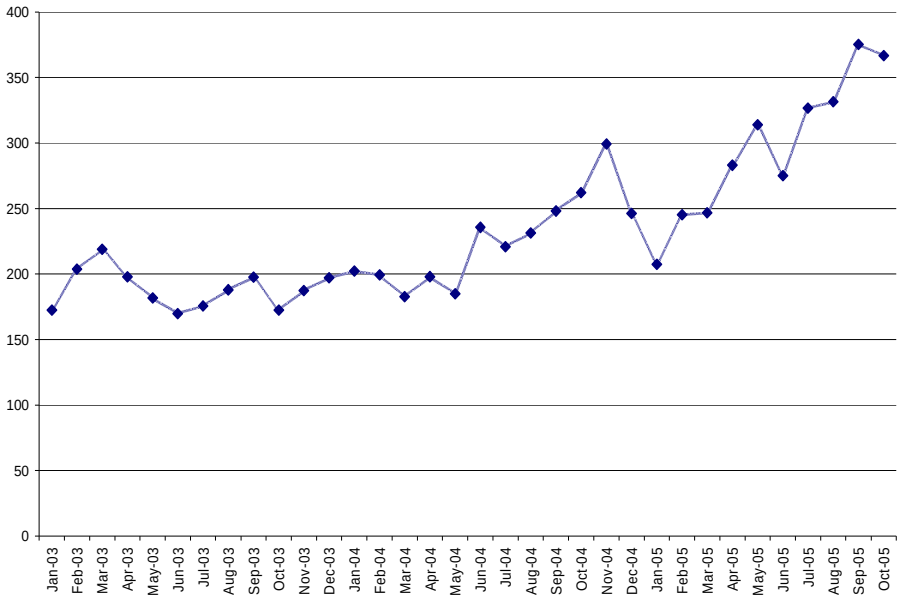
Our first experiment (Exp1), implements a "what if" question around the world price of the energy sector, which is exogenous to the model under the small open economy assumption. Here, we allow for an average annual increase of 25% in the world energy prices. This is to see whether the national economy could adjust to an increasing price of energy. In the second experiment (Exp2), in order to capture the significance of the foreign savings in moderating the severely

[10] The decrease in the real interest rates, especially in the public domestic debt stock is yet another observation to be reflected in 2003-2005 period of the model.

[11] We specify a 2% productivity growth rate for all sectors, except for agriculture, for which we take 1% average productivity growth. The population growth rate is assumed 0.15% for the whole modeling period.

constraining effects of the increase in energy prices in the macroeconomic performance of the economy (both historically for 2003-2005 period and for any possible future projection), while keeping the increase in world energy prices, we restrict the availability of foreign savings. Specifically, we allow for no further growth rate for the variable.

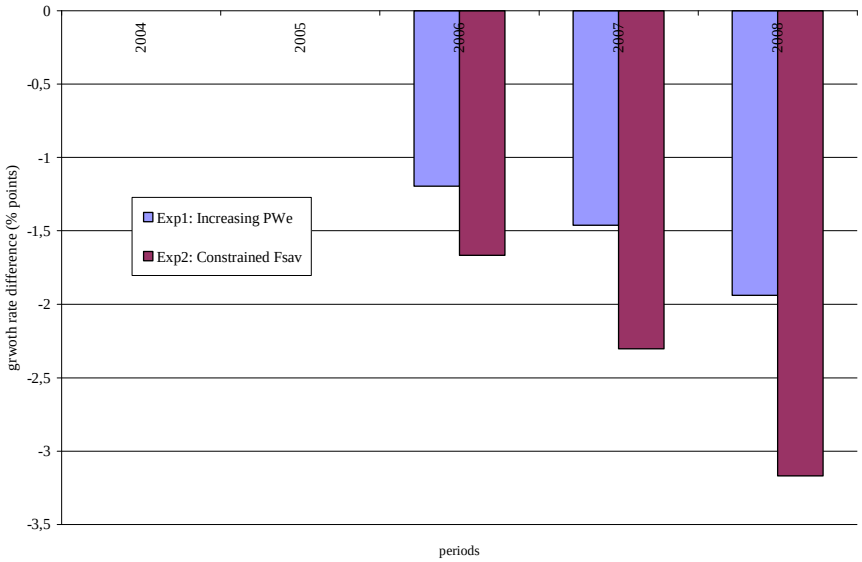
Figure 1
Dollar Price of Crude Petroleum ($/ton)



The real GDP growth paths under both experiments, in comparison to the benchmark case are portrayed in Figure 2. The general equilibrium results and sectoral results are provided in Table 6 and Table 7, respectively.

The increase in the world price of energy sector (Exp1) is observed to severely restrict the growth performance of the economy (with an average value of 1.96 percentage points lower with respect to benchmark for 2006-2008) as expected. On the other hand, the general price index is on average 3.47% lower than the base-run. The rise in the world price of one crucial intermediate input immediately raises the intermediate input costs in all sectors, especially those (services, mining and energy) that are heavily dependent on energy inputs. Yet, the rise in the intermediate costs of sectoral outputs is not fully

Figure 2
Differences in GDP Growth Rates w.r.t. Base-run



transformed into increases in producer prices (Table 7), since the flexibility of the input markets allows relative decreases in the cost of primary factors of production. Compared to base-run, formal wage rate and informal wage rate, on average are 1.26% and 1.75% lower for the last three periods of the model-scan. Accordingly, the demand for informal labor increases in every sector and formal labor unemployment is higher compared to base-run. Such adjustments bring about a lower price for value added in each sector, and this fall is reflected in the final producer prices (Tables 6 and 7).[12]

As such, the minor rises in some sectoral output levels is not reflected in the (relative) real GDP growth rates. Compared to the base-run, with no assumed change in the behavior of foreign savings, the public investment, which is determined by a (calibrated) fixed coefficient over public revenues decreases on average, by 17.59% over 2006-2008. With private saving levels slightly lower than the base-run, there is only a reduced amount of room for private investments, which is derived by the aggregate saving behavior in the model economy. Hence, sectoral levels of the capital stocks are comparatively lower under Exp 1.

[12] The exception is the energy sector, of which the demand for both formal and informal labor increases, along with the rise in world prices. The heavy rise in intermediate costs in this sector is reflected in producer prices. The producer prices, *PX*, in this sector are, on average, 35% higher, compared to base-run.

Table 6
General Equilibrium Results

	Benchmark Scenario					
	2003	2004	2005	2006	2007	2008
General Price Index	1,0000	1,0144	1,0249	1,0449	1,0671	1,0918
Real GDP	360,3805	367,0637	371,9154	383,5975	396,8524	412,2624
Real Private Disposable Income	331,8874	338,3796	343,0963	352,5306	366,5822	386,9154
Real Formal Wage Index	7,5669	7,4784	7,5079	7,5484	7,7230	8,0549
Real Informal Wage Index	2,5709	2,6017	2,6478	2,7881	3,0548	3,5243
Formal Unemployment	2,4930	2,2137	2,1054	1,6719	1,1218	0,3700
Private Consumption	245,0854	249,9937	253,9774	261,0627	271,6169	286,8838
Private Savings	86,8019	88,3860	89,1190	91,4679	94,9653	100,0316
Private Investment	66,2121	69,6565	71,8829	81,9838	95,1580	111,6830
Public Savings	-19,3989	-21,3442	-22,7628	-19,9784	-17,7057	-16,7143
Public Investment	16,1110	17,5651	17,9604	19,4564	20,2270	20,0768
Imports	109,7168	117,4939	124,3276	133,2447	144,6058	159,0819
Exports	98,4963	100,4741	103,9835	106,4360	109,2929	112,6252
	Exp 1. Increasing World Energy Prices					
	2003	2004	2005	2006	2007	2008
General Price Index	1,0000	1,0144	1,0249	1,0610	1,1032	1,1517
Real GDP	360,3805	367,0637	371,9154	379,1487	386,7064	394,2218
Real Private Disposable Income	331,8874	338,3796	343,0963	348,1116	361,2036	386,4176
Real Formal Wage Index	7,5669	7,4784	7,5079	7,4337	7,5857	8,0157
Real Informal Wage Index	2,5709	2,6017	2,6478	2,7313	2,9793	3,4997
Formal Unemployment	2,4930	2,2137	2,1054	1,7420	1,3189	0,7295
Private Consumption	245,0854	249,9937	253,9774	258,4834	269,4084	289,9585
Private Savings	86,8019	88,3860	89,1190	89,6283	91,7952	96,4592
Private Investment	66,2121	69,6565	71,8829	79,5500	88,3412	97,1967
Public Savings	-19,3989	-21,3442	-22,7628	-20,8721	-22,9446	-32,1064
Public Investment	16,1110	17,5651	17,9604	18,7019	17,3883	13,0784
Imports	109,7168	117,4939	124,3276	133,8162	146,4676	163,2601
Exports	98,4963	100,4741	103,9835	107,0077	111,0330	116,3884

Table 6 (continued)

	Exp 2. Constrained Foreign Savings					
	2003	2004	2005	2006	2007	2008
General Price Index	1,0000	1,0144	1,0249	1,0444	1,0673	1,0940
Real GDP	360,3805	367,0637	371,9154	377,4023	381,7470	384,4746
Real Private Disposable Income	331,8874	338,3796	343,0963	348,1024	357,1827	372,4848
Real Formal Wage Index	7,5669	7,4784	7,5079	7,5518	7,7184	8,0364
Real Informal Wage Index	2,5709	2,6017	2,6478	2,7156	2,8468	3,0699
Formal Unemployment	2,4930	2,2137	2,1054	1,9927	1,9345	1,9092
Private Consumption	245,0854	249,9937	253,9774	258,5003	266,4965	279,7461
Private Savings	86,8019	88,3860	89,1190	89,6021	90,6862	92,7387
Private Investment	66,2121	69,6565	71,8829	70,3289	67,7422	63,2800
Public Savings	-19,3989	-21,3442	-22,7628	-24,6418	-29,6440	-39,4900
Public Investment	16,1110	17,0701	17,0967	15,7061	13,0290	9,0274
Imports	109,7168	117,4939	124,3276	129,1641	134,9301	141,9306
Exports	98,4963	100,4741	103,9835	109,5834	115,9595	123,3748

By the effect of the increase in the world energy prices, both the import bill and the export revenues increase, because of weighty dependence on energy imports, and relatively lower domestic prices, respectively. Yet, the trade balance is almost unaffected. The last item in Table 7 compares the ratio of sectoral import prices to sectoral domestic prices.

Along with the increase in world price of energy, a restriction in foreign savings (Exp 2) leads to larger discrepancies between the paths of real growth rates under the benchmark scenario and Exp 2. On average, the difference between the real growth rates increases to 2.4 percentage points (Figure 2).

Still, the rising cost of intermediate inputs is compensated by further reductions in formal and informal wage rates, and producer costs, allowing for only slightest changes in the general price index w.r.t. benchmark. The (relative) reduction in the informal wage rate is higher, so the shift in the sectoral allocation of labor from formal to informal is higher. So, the formal unemployment is observed to stay at much elevated levels compared to both base-run and Exp1 (Table 7).

The most detrimental effect of bounded foreign savings availability for the domestic economy is observed in the investment

Table 7
Sectoral Results

		Benchmark scenario					Exp1. Increasing World Energy Prices					Exp2. Constrained Foreign Savings				
		2004	2005	2006	2007	2008	2004	2005	2006	2007	2008	2004	2005	2006	2007	2008
PX: Producer Price	Agriculture	1,0222	1,0185	1,0359	1,0534	1,0705	1,0222	1,0185	1,0318	1,0451	1,0582	1,0222	1,0185	1,0204	1,0213	1,0220
	Mining	0,9915	0,9796	0,9882	0,9978	1,0093	0,9915	0,9796	0,9871	0,9958	1,0069	0,9915	0,9796	0,9840	0,9882	0,9927
	Industry	0,9831	0,9630	0,9685	0,9757	0,9849	0,9831	0,9630	0,9668	0,9713	0,9759	0,9831	0,9630	0,9574	0,9513	0,9441
	Construction	1,0432	1,0512	1,1568	1,2725	1,3954	1,0432	1,0512	1,1378	1,2007	1,2150	1,0432	1,0512	1,0205	0,9591	0,8536
	Private Services	0,9970	0,9844	0,9993	1,0163	1,0360	0,9970	0,9844	0,9948	1,0069	1,0206	0,9970	0,9844	0,9781	0,9714	0,9641
	Government Services	1,0535	1,0956	1,1716	1,2557	1,3487	1,0535	1,0956	1,1631	1,2266	1,2617	1,0535	1,0956	1,1381	1,1684	1,1686
	Energy	1,1404	1,3466	1,3913	1,4412	1,4984	1,1404	1,3466	1,5981	1,9186	2,3363	1,1404	1,3466	1,5852	1,8825	2,2587
PM: Domestic Price of Imports	Energy	1,1760	1,4982	1,4982	1,4982	1,4982	1,1760	1,4982	1,8728	2,3410	2,9262	1,1760	1,4982	1,8728	2,3410	2,9262
PVA: Value-Added Price	Agriculture	0,4940	0,4863	0,4955	0,5041	0,5120	0,4940	0,4863	0,4845	0,4799	0,4714	0,4940	0,4863	0,4794	0,4697	0,4569
	Mining	0,7386	0,7100	0,7138	0,7182	0,7237	0,7386	0,7100	0,6934	0,6719	0,6445	0,7386	0,7100	0,6934	0,6715	0,6431
	Industry	0,2497	0,2271	0,2243	0,2221	0,2205	0,2497	0,2271	0,2106	0,1901	0,1638	0,2497	0,2271	0,2094	0,1879	0,1612
	Construction	0,5053	0,5155	0,6150	0,7235	0,8381	0,5053	0,5155	0,5906	0,6398	0,6376	0,5053	0,5155	0,4803	0,4132	0,3004
	Private Services	0,5838	0,5588	0,5664	0,5753	0,5857	0,5838	0,5588	0,5456	0,5285	0,5055	0,5838	0,5588	0,5352	0,5069	0,4722
	Government Services	1,0535	1,0956	1,1716	1,2557	1,3487	1,0535	1,0956	1,1631	1,2266	1,2617	1,0535	1,0956	1,1381	1,1684	1,1686

Table 7 (continued)

		Benchmark scenario					Exp1. Increasing World Energy Prices					Exp2. Constrained Foreign Savings				
		2004	2005	2006	2007	2008	2004	2005	2006	2007	2008	2004	2005	2006	2007	2008
	Energy	0,4114	0,4903	0,5105	0,5333	0,5595	0,4114	0,4903	0,5867	0,7105	0,8734	0,4114	0,4903	0,5817	0,6959	0,8411
Formal Labor Demand	Agriculture	1,2555	1,2934	1,4079	1,6009	1,9297	1,2555	1,2934	1,3974	1,5993	1,9816	1,2555	1,2934	1,3513	1,4386	1,5726
	Mining	0,1106	0,1118	0,1140	0,1178	0,1233	0,1106	0,1118	0,1140	0,1188	0,1267	0,1106	0,1118	0,1136	0,1166	0,1213
	Industry	2,1966	2,2221	2,2763	2,3652	2,4955	2,1966	2,2221	2,2748	2,3833	2,5644	2,1966	2,2221	2,2625	2,3287	2,4287
	Construction	0,6626	0,6695	0,6835	0,7067	0,7406	0,6626	0,6695	0,6832	0,7123	0,7608	0,6626	0,6695	0,6806	0,6992	0,7272
	Private Services	4,0007	4,0659	4,2271	4,4868	4,8803	4,0007	4,0659	4,2175	4,5129	5,0167	4,0007	4,0659	4,1663	4,3239	4,5611
	Government Services	2,3292	2,3635	2,5112	2,5508	2,4652	2,3292	2,3635	2,4632	2,3029	1,8191	2,3292	2,3635	2,3262	2,1115	1,6901
	Energy	0,1875	0,1896	0,1942	0,2017	0,2127	0,1875	0,1896	0,1941	0,2033	0,2186	0,1875	0,1896	0,1930	0,1987	0,2072
Informal Labor Demand	Agriculture	7,2882	7,3066	7,2511	7,1897	7,0828	7,2882	7,3066	7,2736	7,2850	7,3039	7,2882	7,3066	7,3425	7,4303	7,5725
	Mining	0,0588	0,0578	0,0538	0,0485	0,0415	0,0588	0,0578	0,0544	0,0496	0,0428	0,0588	0,0578	0,0565	0,0552	0,0535
	Industry	1,5006	1,4773	1,3796	1,2500	1,0779	1,5006	1,4773	1,3934	1,2775	1,1123	1,5006	1,4773	1,4468	1,4155	1,3762
	Construction	0,3658	0,3597	0,3348	0,3019	0,2585	0,3658	0,3597	0,3383	0,3086	0,2667	0,3658	0,3597	0,3518	0,3435	0,3331
	Private Services	3,7291	3,6880	3,4955	3,2355	2,8762	3,7291	3,6880	3,5247	3,3007	2,9690	3,7291	3,6880	3,6350	3,5859	3,5265
	Energy	0,0720	0,0709	0,0662	0,0599	0,0517	0,0720	0,0709	0,0668	0,0613	0,0533	0,0720	0,0709	0,0694	0,0679	0,0660
XS	Agriculture	72,3144	74,1157	76,3827	79,5196	83,8211	72,3144	74,1157	76,3889	79,9641	85,3838	72,3144	74,1157	76,2618	78,9437	82,3617
	Mining	2,6599	2,6982	2,7450	2,8136	2,9058	2,6599	2,6982	2,7465	2,8335	2,9661	2,6599	2,6982	2,7478	2,8178	2,9128
	Industry	186,0049	194,2760	202,9878	213,3826	225,7701	186,0049	194,2760	203,0843	214,3273	228,5184	186,0049	194,2760	203,2339	213,1818	224,3858
	Construction	49,8775	51,3476	52,9142	54,8709	57,2881	49,8775	51,3476	52,9371	55,0676	57,8447	49,8775	51,3476	52,9906	54,8356	56,9342
	Private Services	228,3205	235,4958	243,5132	253,6644	266,5479	228,3205	235,4958	243,5706	254,4142	268,9002	228,3205	235,4958	243,5508	252,4948	262,6200
	Government Services	44,9606	44,4968	45,3154	44,8766	43,0898	44,9606	44,4968	44,7746	42,1161	35,6776	44,9606	44,4968	43,2113	39,9058	34,0851

Table 7 (continued)

		Benchmark scenario					Exp1. Increasing World Energy Prices					Exp2. Constrained Foreign Savings				
		2004	2005	2006	2007	2008	2004	2005	2006	2007	2008	2004	2005	2006	2007	2008
	Energy	43,1337	43,6006	44,1205	44,8654	45,8658	43,1337	43,6006	44,1350	44,9908	46,2180	43,1337	43,6006	44,1628	44,8312	45,6322
INT	Agriculture	37,6737	38,9653	40,4226	42,2755	44,6322	37,6737	38,9653	40,4338	42,4829	45,3049	37,6737	38,9653	40,4158	42,1021	44,1021
	Mining	2,3616	2,4530	2,5496	2,6665	2,8075	2,3616	2,4530	2,5507	2,6774	2,8391	2,3616	2,4530	2,5528	2,6641	2,7898
	Industry	111,3652	115,6895	120,3211	125,9640	132,8324	111,3652	115,6895	120,3701	126,4851	134,3816	111,3652	115,6895	120,4307	125,7309	131,7491
	Construction	0,8979	0,9262	0,9577	0,9976	1,0483	0,8979	0,9262	0,9579	1,0006	1,0575	0,8979	0,9262	0,9578	0,9930	1,0328
	Private Services	94,9526	98,2171	101,7946	106,2512	111,8042	94,9526	98,2171	101,8271	106,6454	113,0127	94,9526	98,2171	101,8434	105,9098	110,5510
	Government Services															
	Energy	40,8226	42,0128	43,3196	44,9681	47,0378	40,8226	42,0128	43,3334	45,1261	47,5160	40,8226	42,0128	43,3440	44,8446	46,5653
KP	Agriculture	20,5005	21,1321	21,9759	23,1212	24,7298	20,5005	21,1321	21,9516	23,0805	24,7045	20,5005	21,1321	21,8474	22,5938	23,4061
	Mining	10,3727	10,6452	10,9198	11,2525	11,6587	10,3727	10,6452	10,9226	11,2469	11,6244	10,3727	10,6452	10,9392	11,2217	11,4903
	Industry	131,1500	134,6436	138,2299	142,6081	147,9986	131,1500	134,6436	138,2616	142,5497	147,6358	131,1500	134,6436	138,4222	142,0790	145,5964
	Construction	20,1620	20,6927	21,2288	21,8789	22,6733	20,1620	20,6927	21,2343	21,8685	22,6086	20,1620	20,6927	21,2654	21,8165	22,3411
	Private Services	651,7784	669,8905	689,9248	715,1716	747,5377	651,7784	669,8905	689,8927	714,7683	746,3081	651,7784	669,8905	689,7047	709,3128	728,9052
	Energy	67,1523	68,9396	70,7722	73,0083	75,7597	67,1523	68,9396	70,7886	72,9782	75,5722	67,1523	68,9396	70,8725	72,7423	74,5395
KG	Agriculture	23,5957	22,4243	21,3118	20,2557	19,2528	23,5957	22,4243	21,3118	20,2555	19,2516	23,5957	22,4243	21,3118	20,2550	19,2502
	Mining	3,0506	2,8980	2,7531	2,6155	2,4847	3,0506	2,8980	2,7531	2,6155	2,4847	3,0506	2,8980	2,7531	2,6155	2,4847
	Industry	10,3186	13,3389	16,4016	19,6792	23,0167	10,3186	13,3389	16,4016	19,5872	22,4641	10,3186	13,3389	16,4016	19,3430	21,8440
	Construction	12,2072	24,2318	35,9749	47,1787	57,3716	12,2072	24,2318	35,9749	47,0789	56,5457	12,2072	24,2318	35,9749	47,5621	58,2347
	Government Services	171,5238	162,9476	154,8002	147,0602	139,7072	171,5238	162,9476	154,8002	147,0602	139,7072	171,5238	162,9476	154,8002	147,0602	139,7072
	Energy	46,5082	44,1828	41,9737	39,8750	37,8813	46,5082	44,1828	41,9737	39,8750	37,8813	46,5082	44,1828	41,9737	39,8750	37,8813

Table 7 (continued)

		Benchmark scenario					Exp1. Increasing World Energy Prices					Exp2. Constrained Foreign Savings				
		2004	2005	2006	2007	2008	2004	2005	2006	2007	2008	2004	2005	2006	2007	2008
Priv Profits	Agriculture	12,7280	12,7308	13,1614	14,2160	16,1122	12,7280	12,7308	13,1541	14,7548	18,2156	12,7280	12,7308	13,0283	13,9777	15,8539
	Mining	0,2746	0,2735	0,2789	0,2950	0,3239	0,2746	0,2735	0,2791	0,3066	0,3655	0,2746	0,2735	0,2782	0,2961	0,3319
	Industry	23,1074	23,0191	23,4934	24,8828	27,3641	23,1074	23,0191	23,5118	25,8609	30,8920	23,1074	23,0191	23,4252	24,9440	27,9864
	Construction	13,2087	13,1542	13,4157	14,1947	15,5877	13,2087	13,1542	13,4265	14,7516	17,5903	13,2087	13,1542	13,3812	14,2418	15,9677
	Private Services	88,4695	88,2302	90,3351	96,1339	106,4798	88,4695	88,2302	90,3806	99,8970	120,3049	88,4695	88,2302	89,9188	95,9365	107,9387
	Energy	6,6323	6,6068	6,7426	7,1408	7,8520	6,6323	6,6068	6,7479	7,4215	8,8642	6,6323	6,6068	6,7232	7,1589	8,0316
PM/PD	Agriculture	0,9566	0,9401	0,9235	0,9076	0,8925	0,9566	0,9401	0,9274	0,9151	0,9033	0,9566	0,9401	0,9383	0,9373	0,9368
	Mining	0,9834	0,9721	0,9603	0,9474	0,9326	0,9834	0,9721	0,9618	0,9501	0,9357	0,9834	0,9721	0,9660	0,9602	0,9542
	Industry	0,9950	0,9957	0,9869	0,9756	0,9617	0,9950	0,9957	0,9895	0,9825	0,9753	0,9950	0,9957	1,0049	1,0154	1,0279
	Construction	0,9394	0,9136	0,8302	0,7547	0,6882	0,9394	0,9136	0,8441	0,7998	0,7904	0,9394	0,9136	0,9411	1,0013	1,1252
	Private Services	0,9805	0,9723	0,9560	0,9380	0,9182	0,9805	0,9723	0,9608	0,9478	0,9336	0,9805	0,9723	0,9794	0,9871	0,9957
	Government Services	0,9493	0,9127	0,8535	0,7964	0,7415	0,9493	0,9127	0,8598	0,8153	0,7926	0,9493	0,9127	0,8786	0,8559	0,8557
	Energy	1,0311	1,1124	1,0767	1,0394	0,9997	1,0311	1,1124	1,1717	1,2199	1,2522	1,0311	1,1124	1,1812	1,2433	1,2953
PVA	Agriculture	1,0257	1,0098	1,0288	1,0468	1,0631	1,0257	1,0098	1,0060	0,9964	0,9788	1,0257	1,0098	0,9954	0,9753	0,9488
	Mining	0,9741	0,9364	0,9414	0,9472	0,9544	0,9741	0,9364	0,9145	0,8861	0,8499	0,9741	0,9364	0,9145	0,8856	0,8481
	Industry	0,9257	0,8417	0,8314	0,8233	0,8176	0,9257	0,8417	0,7806	0,7047	0,6072	0,9257	0,8417	0,7761	0,6965	0,5976
	Construction	1,0969	1,1190	1,3350	1,5706	1,8194	1,0969	1,1190	1,2821	1,3888	1,3841	1,0969	1,1190	1,0426	0,8970	0,6521
	Private Services	0,9793	0,9372	0,9501	0,9650	0,9824	0,9793	0,9372	0,9152	0,8865	0,8479	0,9793	0,9372	0,8978	0,8502	0,7921
	Government Services	1,0535	1,0956	1,1716	1,2557	1,3487	1,0535	1,0956	1,1631	1,2266	1,2617	1,0535	1,0956	1,1381	1,1684	1,1686
	Energy	1,1573	1,3794	1,4363	1,5003	1,5741	1,1573	1,3794	1,6507	1,9989	2,4572	1,1573	1,3794	1,6365	1,9578	2,3664

values. Private investment reduces sharply, almost by 28.8% on average w.r.t benchmark and 23.3% on average w.r.t. Exp 1 throughout 2006-2008. Thus, the sectoral production activities, not only fall behind the case in which we analyze the effects of rising world energy prices, but also w.r.t the benchmark case where we observe no constraints on foreign savings and no (further) increases in the energy sector prices.

The availability of foreign savings, under the specified dynamics of the model, becomes crucial in governing the investment behavior, the sectoral input demands and output-supplies, and the overall production and absorption activities.

4. Concluding remarks

In this study, we have first constructed a data set that reflects the classification in the "Foreign Trade and Balance of Payments", which is based on the Standard International Trade Classification (SITC, Rev.3). The data set captures the energy-sector items that are the most relevant in the energy-import bill of the Turkish economy. Next, we developed a typical multi-sectoral model, calibrated to 2003 Turkish inter-sectoral and macroeconomic data to scan the years 2003-2008.

Utilizing the data set and the model constructed, we presented a conditional forward projection taking the energy sector as a critical sector in both its provision of intermediate input flows to other sectors and its significance in the balance of payments accounts of the Turkish economy. For this purpose, we designed two experiments. The first experiment, to analyze the effects of price increases in a sector that is critical in terms of providing inter-sectoral inputs, simulates a model environment where the recent increasing trend in the world energy price levels continue into the near future. The second experiment, with a focus on the effect of the availability of foreign savings – capital inflows - on the Turkish economy, limits the amount of foreign savings available, while keeping the increase in the world energy prices.

The results first illustrate the importance of the energy sector in the production activities of the model economy. Next, we observe the significance of the availability of foreign savings in aggregate economic activities. The results suggest that unconstrained foreign savings in the first experiment softens the negative effects of the rising energy prices on the economy. However, when we insert an upper bound on the foreign capital inflows, the damaging effects of the increase in energy prices are revealed. These experiments emphasize

the importance of the continuous availability of foreign savings, relative price movements, and their interactions with sectoral production and growth in the Turkish economy.

Future work will carry us into the domain of medium to long-term energy demand modeling. Such forecasting efforts will help in investigating strategic issues like whether Turkey can have a future without nuclear energy and how, or why not. Clearly, such modeling and forecasting will take the EU integration process and the Kyoto commitments into account in designing scenarios. Carbon emission scenarios (reduction costs based on scenarios that consider political, social, and technical feasibilities) are exactly the type of modeling output needed for Turkish general public and policy makers. This study was an appetizer in revealing how important energy imports are to the Turkish economy in a relevant (oil price increase) short-term context.

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Özet

Enerji ithalatı ve Türkiye ekonomisinin kısa-dönemli görünümü: Bir genel denge analizi

Bu makalede, Türkiye ekonomisi için çok sektörlü bir hesaplanabilir genel denge (HGD) modeli geliştirilmektedir. Model 2003 temel yılına kalibre edilmiş ve 2003-2008 dönemini taramaktadır. Celasun'da (1986) olduğu gibi, burada da enerji sektörü bağımsız olarak modellenmektedir. Bu makalede kullanılan veri seti, Türkiye'nin enerji ithalatında öne çıkan enerji sektörü kalemlerini yakalamakta, veriler ve oluşturulan model, iki deney için kullanılmaktadır. İlk deneyde, petrol fiyatlarında son dönemde gözlenen artış yakın geleceğe uzatılmaktadır. İkinci deneyde, bu durum korunmakta ve Türkiye'ye giren yabancı tasarruflarda bir azalma öngörülmektedir. Elde edilen sonuçlar, hem enerji sektörünün üretim faaliyetlerindeki baskın öneminin altını çizmekte, hem de yabancı sermaye girişlerinin, petroldeki fiyat artışlarının olumsuz etkilerini azaltan rolünü ortaya koymaktadır.