ENERGY MODEL FOR TURKEY

1. **General characteristics**
2. **Industrial coverage**
3. **Required parameters**
4. **Behavioral specifics**

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1. General characteristics

TurEGEM is a computable general equilibrium model for Turkey which finds its roots in the ORANI model. ORANI is a computable general equilibrium model constructed under the IMPACT project in Australia[1]. In the TurEGEM producers, households, investors, public sector and exporters are explicitly modeled as the economic agents.

Database of the model is built in 1998 input-output table of Turkey. The relationship between supply and demand is provided by make and absorbtion tables. Since SIS's statistics are insufficient particularly for factor markets, Köse and Yeldan (1996) is used to form the data regarding labor usage. For capital and land (used only for agriculture and minniig) use GTAP (Global Trade Analysis Project) database is used.

Table 1: General characteristics

Model	*TurEGEM*
Modeling Approach	Computable general equilibrium, price equilibrium, allows for imperfect competition
Temporal Properties	Comparative static, medium to long term
Solution Type	Linearization by GEMPACK
Solution Algorithm	Gragg[2] multi stage solution algorithm
Base Year	1998
Parameters	Synthetic
Commodity Coverage	36
Country Coverage	Turkey

[1] For more information about IMPACT see Powell (1977) and Dixon et. al (1982). http://ideas.repec.org/p/cop/wpaper/op-93.html; http://ideas.repec.org/r/cop/wpaper/op-93.html .
[2] Harrison ve Pearson (2002).

Number of Equations	149
Number of Variables	210 variables of which 61 are exogenous

2. Coverage

In TurEGEM 52 goods and services are produced by 40 industries. Multi-output production is realized in rafinery industry. While rafinery industry is producing 13 outputs (with one input), electricity is produced by five industries (four in production and one in distribution). In each industry only one output is produced. Therefore, the theoretical structure is formed to allow production of one output from multi-input or of multi-output from one input.

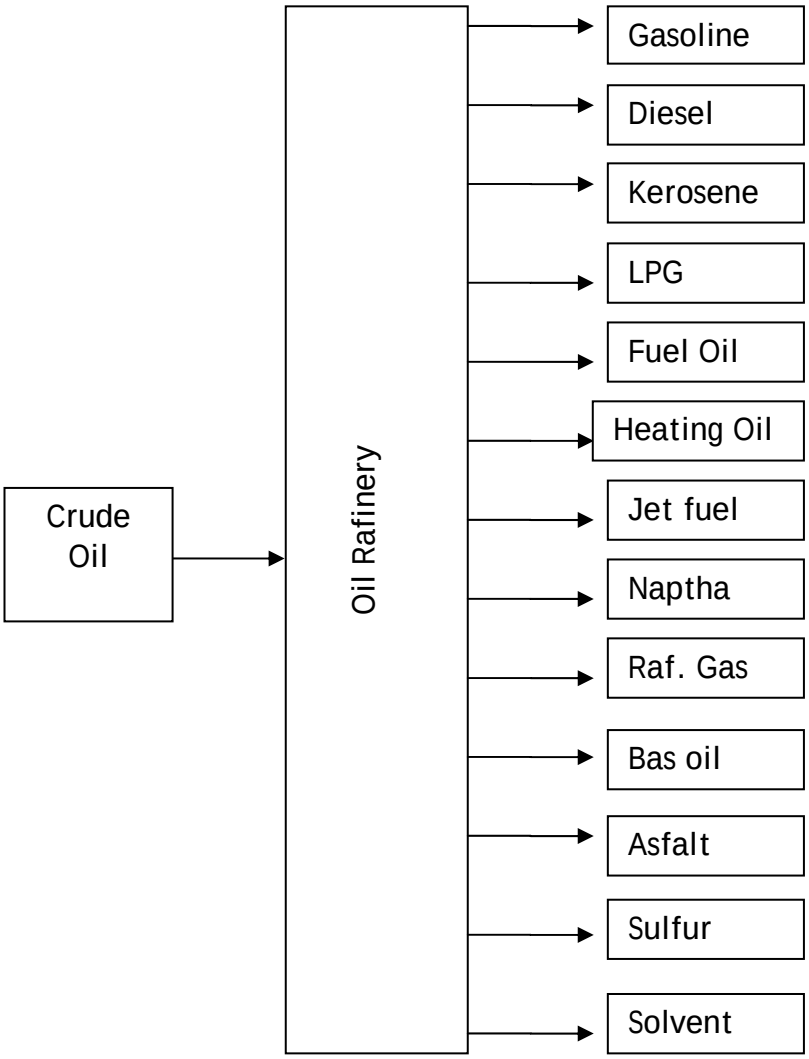
To link energy and economy, primary energy sources that are directly extracted from nature such as crude petroleum, natural gas, coal, and secondary energy sources (processeded after extraction) such as electricity and petroleum products are included explicitly at a disaggegated level whch becomes to be the most important feature of TurEGEM.

Table 2: Industry coverage

Industries	*Market Type*
1.Agriculture, forestry and livestock (6 sub-industries)	Perfect comp.
2.Fisheries	Perfect comp.
3.Mining of coal and lignite	Harris
4.Extraction of crude petroleum	Harris
5.Extraction of natural gas	Harris
6.Minerals (3 sub-industries)	Harris
7.Food products (13 sub-industries)	Perfect comp.
8.Textile products (7 sub-industries)	Perfect comp.
9.Forestry products (2 sub-industries)	Perfect comp.
10.Pinting (3 sub-industries)	Harris
11.Manufacture of coke	Lerner
12.Refined petroleum products	Perfect comp.
13.Chemicals, rubber and plastics (7 sub-industries)	Harris
14.Mineral products (4 sub-industries)	Perfect comp.
15.Iron-steel	Perfect comp.
16.Base metals (2 sub-industries)	Perfect comp.
17.Metallic products (2 sub-industries)	Perfect comp.
18.Machinary and equipment (7 sub-industries)	Harris
19.Transportation vehicles (5 sub-industries)	Harris
20.Other manufacturing	Perfect comp.
21.Generators using coal	Lerner
22.Generators using petroleum	Harris
23.Generators using natual gas	Harris

Industries	*Market Type*
24.Hydroelectricity	Lerner
25.Electricity (production and distribution)	Lerner
26.Gas (production and distribution)	Lerner
27.Collection, purification and distribution of water	Harris
28.Construction	Perfect comp.
29. Sale, maintenance and repair of motor vehicles, motorcycles; retail sale of fuel	Harris
30.Wholesale trade and commission trade	Harris
31.Perakende ticaret, kişisel ve ev eşy tamiri	Harris
32.Retail trade (2 sub-industries)	Perfect comp.
33.Land transport (3 sub-industries)	Harris
34.Water transport	Harris
35.Air transport	Harris
36.Communication	Harris
37.Finance (4 sub-industries)	Harris
38.Education and health (8 sub-industries)	Harris
39.Public services	Lerner
40.Ownership of dwelling	Lerner

Table 3: Multi-output structure of the rafinery industry



The secondary energy electricity is produced in four different types of generators depending on the energy used for production: petroleum, coal, natural gas, hidro power and there is one indutry that distributes electricity.

3. Required parameters

The parameters used in TurEGEM are exognously determined. In most cases Vincent (1986) and GTAP database is used as the main source of parameters. Parameters of the TurEGEM can be grouped under:

- substitution elasticity measures between primary factors of production

- substitution elasticity measures between imported and domestically produced goods (goods are not only differentiated with respect to types but to origin of production as well)
- Frisch parameter (marginal utility elasticity of income: LLuch (1977) and Derviş et. al (1982))
- export demand elasticity measures

4. Behavioral specifics

In TurEGEM producers are represented as either profit maximizers or cost minimizers and households are represented as utility maximizers. Households, investors and producers' demand for goods and services are derived from neoclasical constrianed optimization problem while public sector and exporters' demand for goods and services are derived from optimization problem. Public sector's consumption demand proportioanl to household demand and demand for export goods is specified as a function of foreign exchange. Changes in stocks are introduced exogenously.

Equation blocks in the TurEGEM are grouped under:

- demand for capital, labor and land
- intermediate input demand with respect to origin of production
- demand for composite goods and composite primary factors
- output of multi-product industries
- production structure of electricity
- demand for capital formation
- household demand
- exports and public sector expenditures
- trade and transportation margins
- puchaser prices
- indirect taxes
- market clearing in product markets
- trade balance and GDP by income and expenditure methods
- prices indices
- imperfect market conditions

Some industries are assumed to operate in perfectly competitive environemnt. Therefoe prices are equal to marginal cost in those industrie. Some others are assumed to operate in monopolistic market, hence prices are determined with mark-up pricing.

Production

Functional type: CES and Leontief; Multi-input Multi-output structure

Chart 1. Electricity producing industries

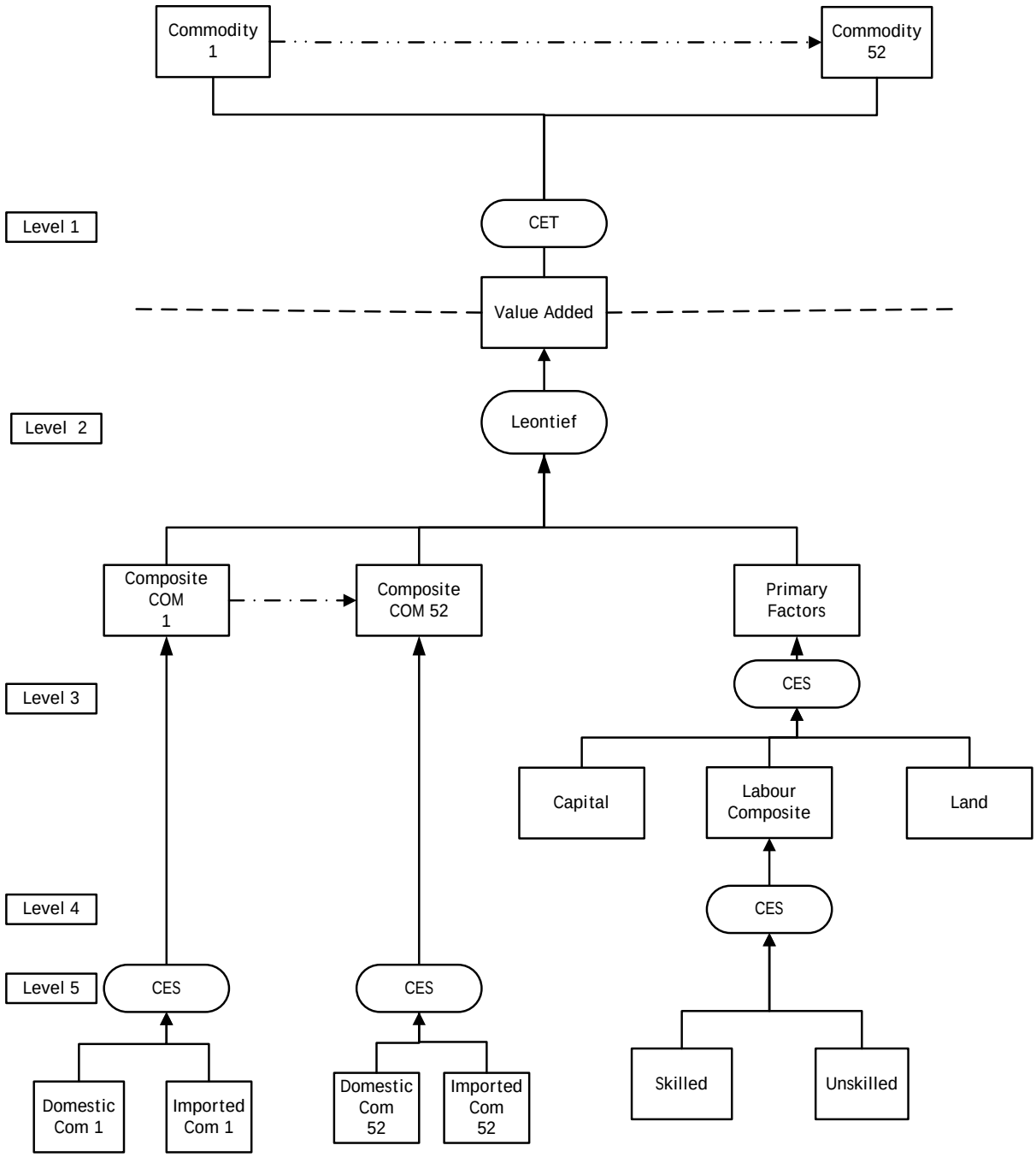


Chart 2. Electricity distributing industries

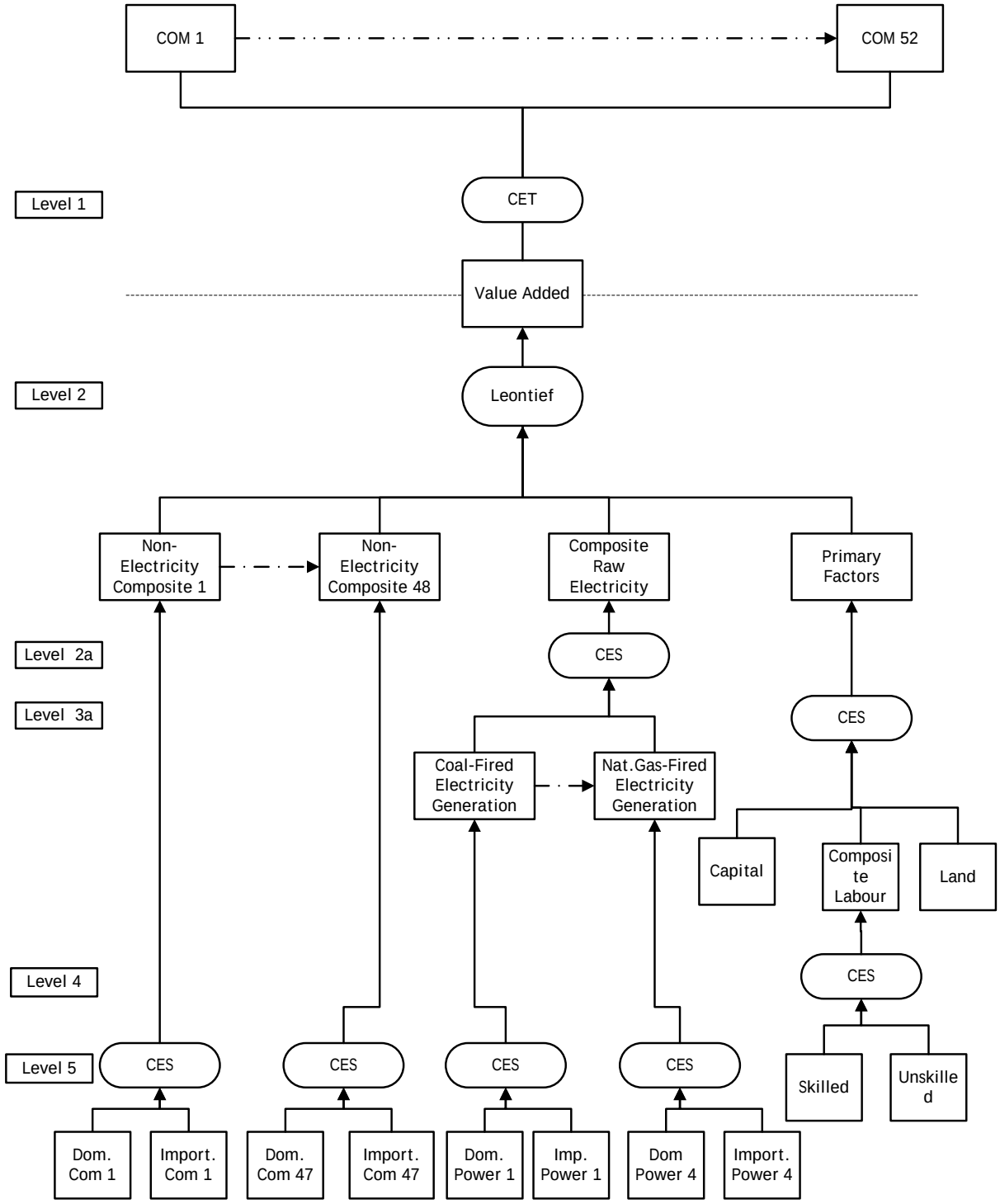
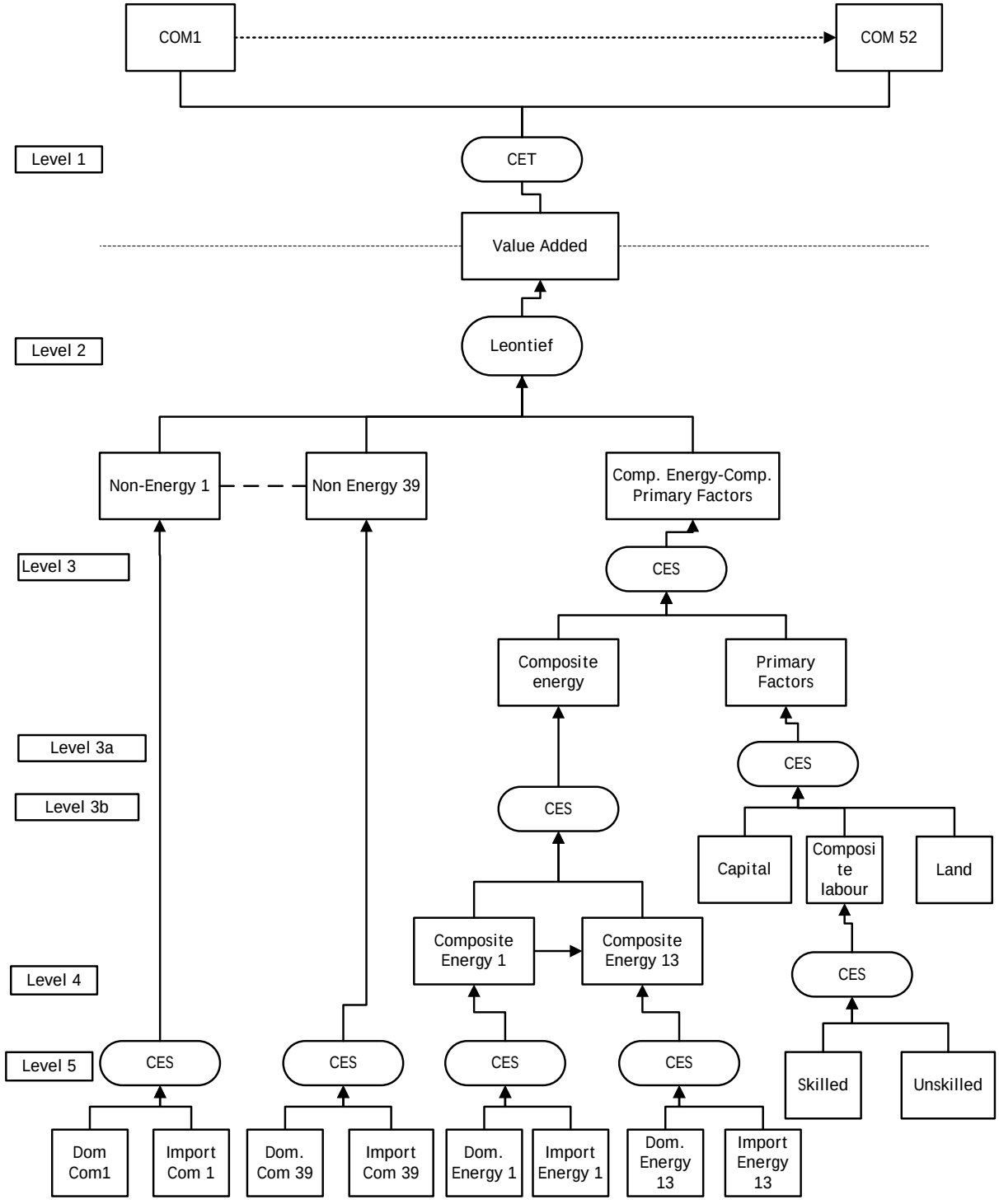


Chart 3. Production structure in the ordinary industries



Primary factor and intermediate input demand

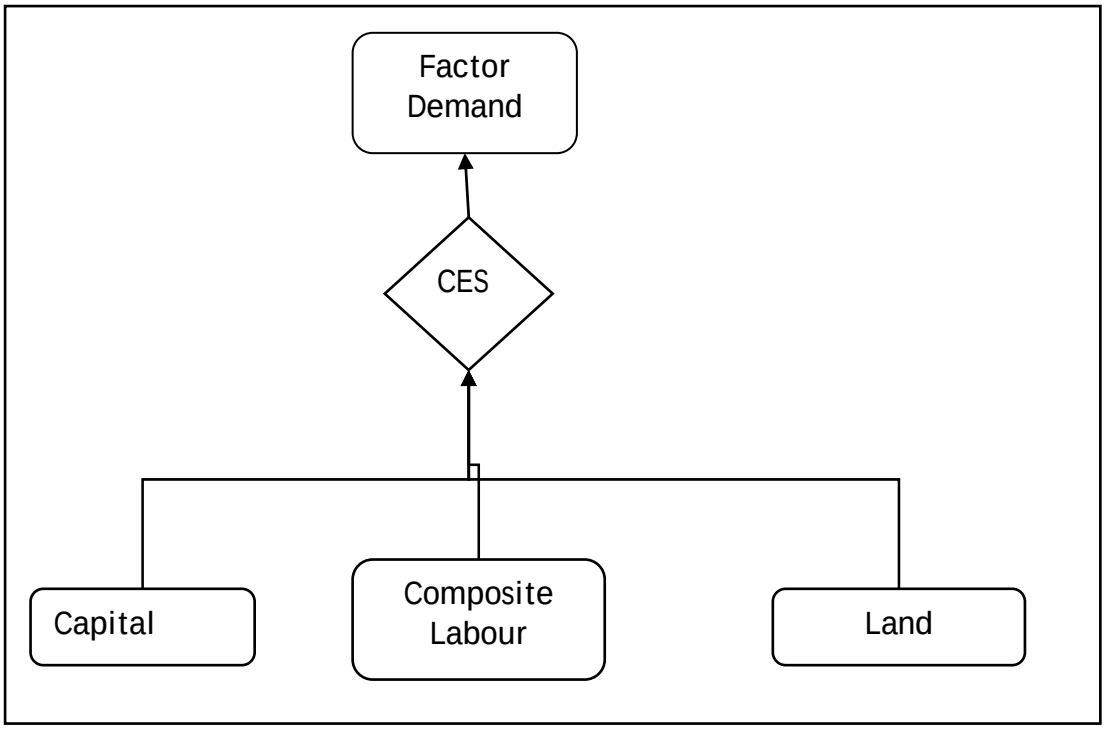
Labor demand

Two types of labor exist: qualified and unqualified.

Compsite labor, capital and land demand

Functional type: CES

Chart 4. Primary factor demand



Demand of electricity distribution sector from electricity production sector

Energy input demand in ordinary industries

Composite energy and composite primary factor demand in ordinary industries

Input demand in electricity producing industries

Input demand in electricity distributing industries

Input demand by ordinary industries

Supply of goods and services

Demand for composite imports and domestic intermediate goods

Armington (1969, 1970) specification: imports are imperfect substitutes for domestic poduction.

Public expenditures and export demand

Public expenditure is specified as a constant rate of household expenditures. There are two types of export goods:

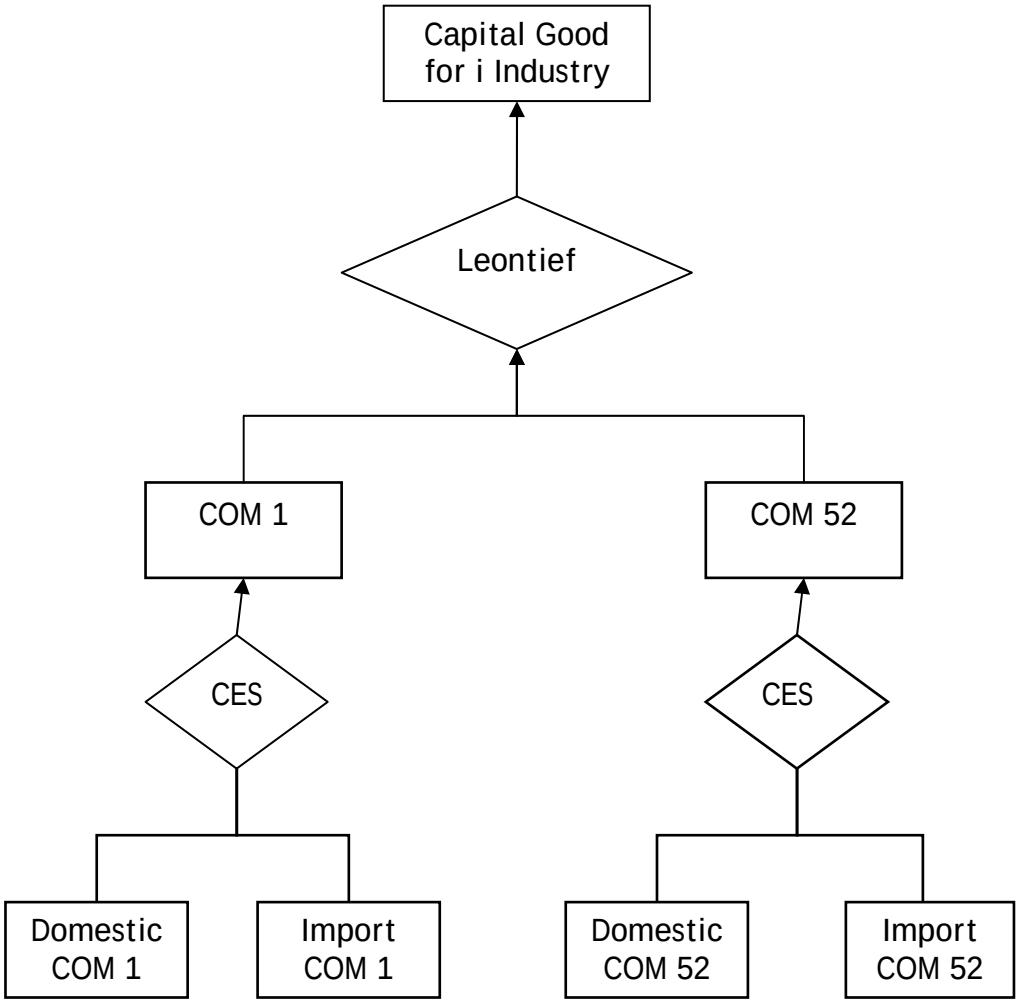
- traditional export goods (largest share in total)
- others

Trade and transpotation margins

Investment demand

Functional type: CES and Leontief

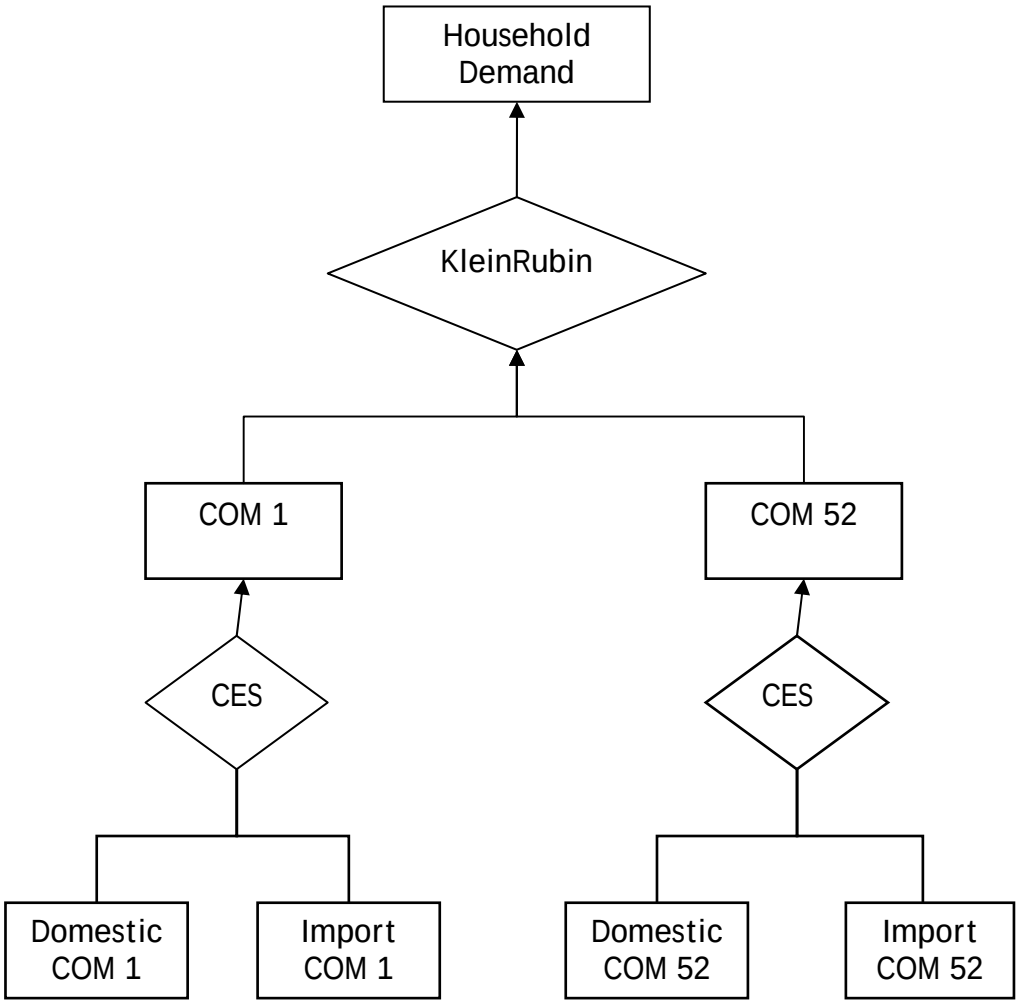
Chart 5. Investment demand



Household demand

Functional type: CES, LES

Chart 6. Household demand



Price system

Asumptions:

- zero profit
- total income is equal to total input cost
- purchaser price is equal to the sum of input price, taxes and margin
- import price is determined by importers and basing on customs tax
- demanders and suplliers are faced with the same price
- sales tax differs according to users
- margins are added to basic prices

- value of input capital is equal to total input cost
- household purchase price is equal to the sum of basic value of the good, sales tax and margin
- export price is defined to FOB (sum of basic value of the good, sales tax and margin)
- import price is defined to be CIF

Market clearing

- domestic supply and demand
- import supply and demand
- labour supply and demand

Trade balance

Indirect taxes

GDP by income and expenditure methods

Investment and rate of return

Labor market

Assumptions:
- labor supply is constant
- nominal wages are exogenous
- reel wages are endogenous
- employment isendogenous

Scale economies and imperfect competition

- firm level returns to increasing returns to scale technology
- monopolistic pricing

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