Effect of Gas Subsidies In Indonesia

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Effect of gas subsidies in Indonesia

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Abstract

Countries that export energy or minerals often feel that they would be richer if the commodities could be processed onshore rather than overseas. In this way, it is thought, 'value-adding' could occur locally, raising local GDP. Such countries may subsidize local use of the exportable commodity.

The strategy, which involves 'picking winners', is not obviously sensible. Why not sell at the higher, export, price? If a subsidy to local industry were needed, why not offer an explicit subsidy, rather than a hidden subsidy in the form of cheaper inputs. A more orthodox economic approach would stress that prosperity is based on:

- human capital (a skilled and well-educated workforce);
- good infrastructure (eg, good roads and reliable electricity);
- good governance (not too much red tape or corruption);
- and, with luck, valuable natural resources!

The focus of this study is Indonesia's effort to use more natural gas locally rather exporting it. To further this aim, domestic users are offered natural gas at a price below the export (world) price. There is in effect a subsidy to local use of natural gas. Using INDORANI, a computable general equilibrium (CGE) model of Indonesia, we simulate the effect of removing this subsidy.

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1. Introduction

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2. Model structure and interpretation of results

In the late 1990's CoPS worked with Professor Anggito Abimanyu and others at Gadjah Madah University, Yogyakarta, to construct INDORANI. The model was used for policy analysis (with a special focus on regional and income disparity) and to analyse the effects of the Asian crisis. Since then various versions of the model have been used, with updated databases and different features. All of the versions descend from the ORANI-G template CGE model, created at CoPS. The model is specified and solved using GEMPACK (Horridge et al, 2018).

INDORANI has a theoretical structure that is typical of a static CGE model. It consists of equations describing, for some time period:[1]

- producers' demands for produced inputs and primary factors;
- producers' supplies of commodities;
- demands for inputs to capital formation: each industry has a different Leontief recipe for new capital;
- household demands, which follow the Linear Expenditure System;
- export demands, which are inversely related to foreign-currency prices;
- government demands (exogenous, or all moving together);
- the relationship of basic values to production costs and to purchasers' prices;
- market-clearing conditions for commodities and primary factors; and
- numerous macroeconomic variables and price indices.

Demand and supply equations for private-sector agents are derived from the solutions to the optimisation problems (cost minimisation, utility maximisation, etc.) which are assumed to underlie the behaviour of the agents in conventional neoclassical microeconomics. In particular, all users can substitute between imported and locally-produced versions of a given commodity. The agents are assumed to be price-takers, with producers operating in competitive markets that prevent the earning of pure profits. The Appendix contains a more detailed description of the model.

[1] In describing INDORANI, we draw freely on published documentation of ORANI-G, in particular Horridge (2000).

2.1. A comparative-static interpretation of model results

Like many CGE models, INDORANI is designed for comparative-static simulations. Its equations and variables all refer implicitly to the economy at some future time period.

This interpretation is illustrated by Figure 1, which graphs the values of some variable, say employment, against time. A is the level of employment in the base period (period 0) and B is the level which it would attain in T years time if some policy—say a tax change—were *not* implemented. With the tax change, employment would reach C, all other things being equal. In a comparative-static simulation, INDORANI might generate the percentage change in employment 100(C-B)/B, showing how employment *in period T* would be affected by the tax change alone.

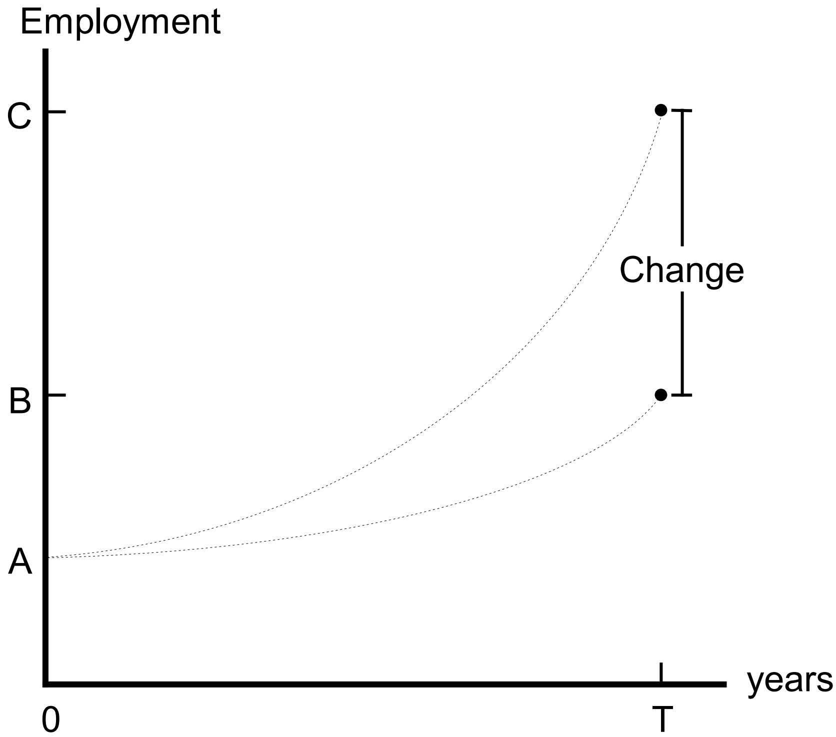


Figure 1. Comparative-static interpretation of results

Some comparative-static INDORANI simulations analyse the shortrun effects of policy changes. For these simulations, individual industry capital stocks are held at their pre-shock levels. Econometric evidence suggests that a shortrun equilibrium will be reached in about two years, ie., T=2 (Cooper, McLaren and Powell, 1985). Other simulations have adopted the longrun assumption that capital stocks are mobile between sectors—this might take 10 or 20 years, ie., T=10 or 20. In either case, only the choice of closure and the interpretation of results bear on the timing of changes: the model itself is atemporal. Consequently it tells us nothing of adjustment paths, shown as dotted lines in Figure 1.

3. Data used for the simulations

The bulk of the model's database is drawn from the 2010 Input-Output tables from BPS (Badan Pusat Statistik aka Statistics Indonesia). Currently, this is the latest available; 2016 tables may be available late 2021. Various behavioural elasticities were drawn from the GTAP database.

The IO tables distinguished 186 sectors, but unfortunately combined oil and gas processing sectors into one. We split that sector into two. In addition, we

- updated the database to match 2015 macro-economic aggregates.
- selectively updated the data to account for known gas usage changes (in particular, a lower export share).

A variety of sources were used. Unfortunately some of the sources were in physical rather than value units. We assumed that domestic users of natural gas paid 25% less than the export price of gas (no explicit estimates were found).

To ease presentation of results, the 187 original sectors were aggregated to 42. The aggregation scheme is shown in Table 1 below. Commodities and industries are not quite the same. Our industries include:

- an oil-refining industry making gasoline/diesel and LPG commodities
- an gas-processing industry making LNG and LPG commodities

Further details of the data processing are described in the Appendix.

3.1. Explicit and implicit subsidies

Our Indonesian data shows large explicit subsidies to local use of gasoline, electricity and fertilizer. However, subsidies to natural gas use did not appear in the BPS IO tables. The government-owned gas industry is free to offer lower prices to some users – one effect would be a reduction in gas profits that accrue to the government. No explicit subsidy is needed.

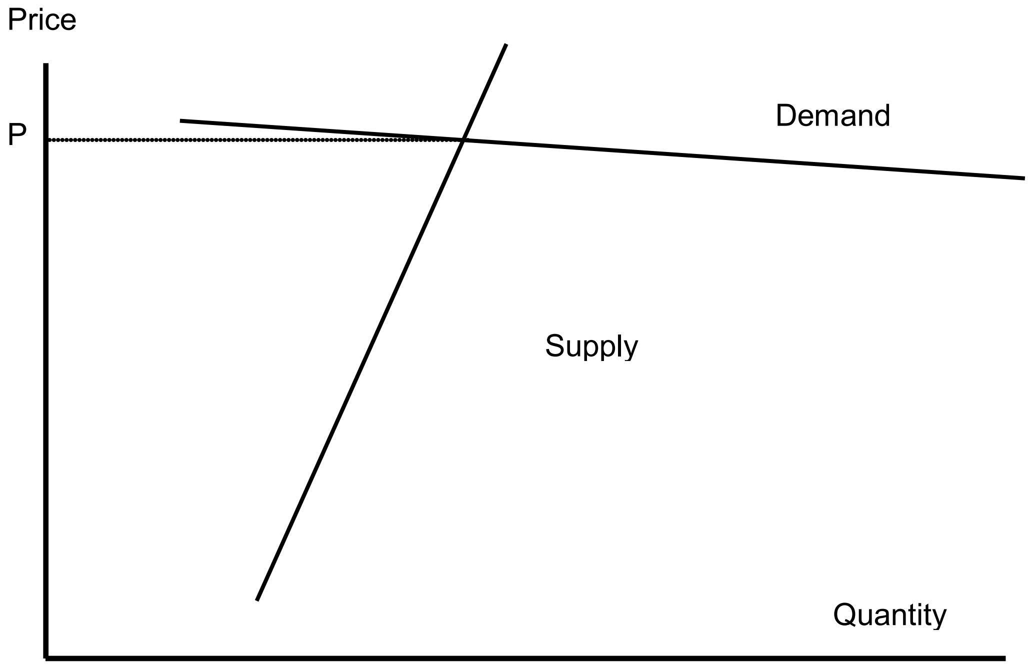


Figure 2. The market-clearing price

Some people suppose that a subsidy could be measured by comparing the user price with the cost of production. The 'cost of production' should truly consist of 3 components:

1. the short-run marginal cost comprising labour and materials needed to produce more gas. This could be quite low.
2. the capital rental that would be required to offset depreciation and maintain investment in the sector.
3. the resource rent arising from the scarcity of a natural input.

The 3 components add up to the market-clearing price P, shown in Figure 2 above. Since gas is a commodity traded on the world market, the demand curve is rather flat, and P may be thought of as the world or export price. In this report, we measure an implicit subsidy as the difference between P and the price charged to a particular user.[2]

[2] To be precise, we consider the subsidy to be the difference between the price paid by the LNG industry and the price charged to a particular user. Nearly all exports of gas are exported as LNG. Therefore we take into account the cost of liquefaction.

Table 1. How 187 original commodities are grouped into 42 model commodities

No.	Description	Code	Comprising
1	Agriculture, forestry and fishing	AgricForFish	Rice Corn SweetPotato Cassava OthTubers Peanuts Soy OthNuts OthGrains Vegetables DecorPlants Cane Tobacco PlantFiber OthPlantaton Fruits PlantBiophrm Rubber Coconut PalmOil Coffee Tea Cocoa Clove Cashew Livestock FreshMilk PoultryEggs OthAnimalPrd AgricSvc Wood OthForestPrd Fish Shrimps OthAquatic Seaweed
2	Coal	CoalLignite	CoalLignite
3	Crude oil	CrudeOil	CrudeOil
4	Natural gas	NaturalGas	NaturalGas
5	Services to oil/gas	Svcs2OilGas	PetrolNatGas
6	Non-metallic minerals	NonMetlMinrl	NonMetlMinrl CoarseSalt OthMiningQry
7	Other mining	OthMining	IronOre TinOre BauxiteOre CopperOre NickelOre OthMetalMine GoldOre SilverOre GalianPrd
8	Food processing	FoodProc	Abattoir MeatProcessg DriedFish FishProcess VegFruitProc EdibleOils Copra DairyPrd OthFlour WheatFlour RiceMilling BreadBiscuit Sugar Confectionry PastaNoodle CoffeeProc TeaProc SoyProcessed OthFood
9	Animal feed	AnimalFeed	AnimalFeed
10	Drinks and tobacco	BevTobac	AlcoBeverage NonAlcoBev Cigarettes TobaccoPrd
11	Textiles, clothing and footwear	TCF	Yarn Textile RopesCarpets OthTextilPrd KnittedPrd Apparel Tanning LeatherPrd Footwear
12	Wood and paper	WoodPaper	SawMill Plywood WoodBuildMat OthWoodPrdn PaperPulp Paper PaperPrd PrintedPrd
13	Petroleum Refining	PetrolRefine	PetrolRefine
14	LPG	LPG	LPG
15	LNG	LNG	LNG
16	Basic chemicals	BasChemicals	BasChemicals
17	Fertilizer	Fertilizer	Fertilizer
18	Plastics	Plastics	Plastics
19	Other Chemicals	OthChemPrd	Pesticide Paints Varnish Soaps Cosmetics OthChemPrd
20	Pharmaceutical	Pharmaceutcl	Pharmaceutcl TradMedicine
21	Rubber products	RubberPrd	Tire SmokedRubber OthRubberPrd
22	Plastic products	PlasticPrd	PlasticPrd
23	Glass	Glass	Glass
24	Clay and ceramics	ClayCermcPrd	ClayCermcPrd
25	Cement	Cement	Cement
26	Other non-metallic mineral products	OthNMmetlPrd	OthNMmetlPrd
27	Basic iron and steel	BasIronSteel	BasIronSteel
28	Non-ferrous metals	NonFerrMetal	NonFerrMetal
29	Other metal products	OthMetalPrd	FoundryPrd FabMetalPrd DomMetalPrd OthMetalPrd
30	Electronic products	ElectroncPrd	ElectroncPrd Instruments
31	Electrical equipment	ElecEquip	ElecMotorGen ElectEqp Batteries OthElecEqp DomElectEqp
32	Transport equipment	TranspEquip	MotorVehicle Ships RailwayEqp Aircraft OthTrnsEqp Motorcycle
33	Other equipment	OthEquip	PrimaryMover OfficeMachin OthMachinEqp
34	Other manufacturing	OthManufact	WeaponsAmmo Furniture Jewelry MusicInstrum SportsEquip GamesAndToys MedicalDvces OthIndustPrd ManMtlRepair
35	Electricity	Electricity	Electricity
36	Gas distribution	GasDist	GasDist
37	Water and sewers	WaterWaste	WaterSupply WasteManage
38	Construction	Construction	ResidBuildng EleGasInfstr AgricInfstrc RoadsBridges OthBuildings
39	Trade	Trade	CarTrading CarRepair OthTrade
40	Transport	Transprt	RailTransprt LandTransprt SeaTransport RiverTrnsprt AirTransport TransportSvc
41	Government services	GovSvc	Postal GenGovernmet GovEducation GovHealth OthGovSvc
42	Other services	OthSvc	Hotels Restaurants Publishing Broadcasting Telecommunic InformatTech FinancialSvc InsuranceSvc PensionSvc OthFinancSvc RealEstatSvc ProfSciTech RentalSvc PrvEducation PrvHealth ArtsEntrtain HholdRepairs OthSvc

4. Closure

We used both shortrun and longrun closures. However, most assumptions were common to both:

- Labour is mobile between industries, and fixed in aggregate.
- Capital is fixed in aggregate.
- Industry use of land, or other natural resources, is fixed.
- Real household consumption and real government demands adjust together to allow the trade balance (as a share of GDP) to remain constant.
- Aggregate real investment is fixed.

These assumptions are typical of CGE policy analysis. The balance of trade constraint means that policy changes must be be funded by Indonesians rather than by foreigners.

Input-output models, still popular in some circles, assume instead that primary factor inputs are freely available at a fixed price. Exports are usually fixed, and there is no balance of trade constraint. Under these assumptions, increases in government demand boost output and labour and capital earnings, so in turn boosting household consumption. Imports increase, so the GDP increase is partly foreign-funded.

4.1. Revenue neutrality

We enforce government budget balance by imposing a measure of revenue neutrality. The revenue target, which we hold fixed, is composed of:

(a) the sum of all indirect tax revenue; and

(b) the gross operating surplus of the Natural Gas sector (since it belongs in effect to the government).

To hit this target we uniformly adjust all indirect tax rates on commodities used in Indonesia. The effect is that if gas subsidies are removed (saving government money), other indirect taxes are slightly reduced (reducing cost for all sectors).

4.2. Differences between shortrun and longrun closure

- In the short run, industry capital stocks are fixed.
- In the long run, capital is mobile between industries, and fixed in aggregate.

5. Results

8 simulations are reported (see Table 2 below), reflecting 3 binary choices:

1. whether the gas subsidy is removed for all users (except Fertilizer), or for the steel industry only
2. whether the closure is shortrun (sr) or longrun (lr)
3. whether the removal of subsidy is accompanied by an efficiency improvement (A)

Table 2. Description of simulations

Code	Description
srsteel	Shortrun closure, remove gas subsidy from steel industry, no efficiency change.
srall	Shortrun closure, remove gas subsidy from all industries*, no efficiency change.
lrsteel	Longrun closure, remove gas subsidy from steel industry, no efficiency change.
lrall	Longrun closure, remove gas subsidy from all industries*, no efficiency change.
srsteelA	Shortrun closure, remove gas subsidy from steel industry, efficiency improvement.
srallA	Shortrun closure, remove gas subsidy from all industries*, efficiency improvement.
lrsteelA	Longrun closure, remove gas subsidy from steel industry, efficiency improvement.
lrallA	Longrun closure, remove gas subsidy from all industries*, efficiency improvement.

* *Gas subsidy to Fertilizer industry is retained since Fertilizer output is price controlled.*

Table 3 shows some economy-wide (macro) results. The real GDP results (row 6) are positive but small, especially if only the subsidies to the steel industry are removed. In the first 4 columns (no efficiency change), our fixed government revenue target implies that increased costs for gas users are balanced by reduced taxation for other sectors, so we would expect the overall result to be small.

Table 3. Macro results (% change from control)

	Description	Code	1 srsteel	2 srall	3 lrsteel	4 lrall	5 srsteelA	6 srallA	7 lrsteelA	8 lrallA
1	Real Household Consumption	RealHou	-0.00064	0.01286	-0.00164	0.01303	0.00391	0.08618	0.00320	0.09442
2	Real Investment	RealInv	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
3	Real Government Demand	RealGov	-0.00064	0.01286	-0.00164	0.01303	0.00391	0.08618	0.00320	0.09442
4	Real Exports	ExpVol	0.00555	-0.01099	0.02083	-0.06927	0.00208	0.01762	0.01189	-0.00150
5	Real Imports	ImpVolUsed	0.00334	-0.01996	0.01527	-0.09759	0.00087	0.01571	0.00844	-0.01945
6	Real GDP	RealGDP	0.00000	0.01157	0.00000	0.01553	0.00322	0.06570	0.00319	0.07522
7	Real GNE	RealGNE	-0.00048	0.00977	-0.00124	0.00990	0.00297	0.06548	0.00243	0.07174
8	Employment	AggEmploy	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9	Real Wage	realwage_io	0.00116	-0.00579	0.00391	0.01574	0.00497	0.08224	0.00600	0.08464
10	Aggregate Capital Stock	AggCapStock	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
11	GDP Price Index	GDPPI	-0.00917	-0.13020	-0.01353	-0.19642	-0.00331	-0.07339	-0.00837	-0.13140
12	GNE Price Index	GNEPI	-0.00869	-0.12840	-0.01228	-0.19080	-0.00306	-0.07317	-0.00761	-0.12792
13	Consumer Price Index	CPI	-0.00824	-0.11181	-0.01482	-0.19041	-0.00195	-0.05779	-0.00850	-0.12278
14	Export Price Index	ExportPI	-0.00243	-0.01069	-0.00606	-0.02980	-0.00122	-0.00231	-0.00369	-0.01860
15	Natural Gas Output	GasOutput	0.00014	0.00009	0.00385	-0.00715	-0.00007	-0.00364	0.00154	-0.03348

Note: the exchange rate is held fixed (numeraire assumption).

Larger GDP gains arise if we assume (columns 5-8) that the removal of subsidy is accompanied by an efficiency improvement. This is examined in Section 7 below.

All of the above results seem small. To put this in context, the gas subsidies that are being removed amount to only 0.17% of GDP. Compared to this, the largest GDP gain (pink in column 8) is surprisingly good.

Table 4. Commodity output results (% change from control)

	x0com		1	2	3	4	5	6	7	8
	Description	Code	srsteel	srall	lrsteel	lrall	srsteelA	srallA	lrsteelA	lrallA
1	Agriculture, forestry and fishing	AgricForFish	0.0023	0.0410	0.0118	0.1721	0.0003	0.0173	0.0060	0.1124
2	Coal	CoalLignite	0.0005	0.0058	0.0105	0.1232	0.0000	-0.0010	0.0046	0.0406
3	Crude oil	CrudeOil	0.0002	0.0037	0.0048	0.0561	0.0000	0.0000	0.0021	0.0227
4	Natural gas	NaturalGas	0.0001	0.0001	0.0039	-0.0071	-0.0001	-0.0036	0.0015	-0.0335
5	Services to oil/gas	Svcs2OilGas	0.0001	0.0023	0.0021	0.0465	0.0000	0.0005	0.0005	0.0752
6	Non-metallic minerals	NonMetlMinrl	-0.0073	-0.0154	-0.0311	-0.0562	-0.0053	-0.0094	-0.0231	-0.0104
7	Other mining	OthMining	-0.0042	-0.0174	-0.0667	-0.4843	-0.0035	-0.0161	-0.0473	-0.3108
8	Food processing	FoodProc	0.0053	0.0912	0.0166	0.2481	0.0006	0.0335	0.0087	0.1383
9	Animal feed	AnimalFeed	0.0029	0.0512	0.0130	0.1895	0.0003	0.0188	0.0066	0.1200
10	Drinks and tobacco	BevTobac	0.0011	0.0290	0.0018	0.0418	0.0017	0.0430	0.0029	0.0657
11	Textiles, clothing and footwear	TCF	0.0077	0.0874	0.0704	0.6924	0.0000	0.0355	0.0340	0.3680
12	Wood and paper	WoodPaper	0.0071	0.0859	0.0335	0.3420	0.0000	0.0300	0.0167	0.1702
13	Petroleum Refining	PetrolRefine	0.0029	-0.0050	0.0114	-0.2191	0.0007	-0.0209	0.0065	-0.1792
14	LPG	LPG	0.0007	-0.1981	0.0066	-0.5400	0.0002	-0.1581	0.0033	-0.4042
15	LNG	LNG	0.0066	0.1696	0.0367	0.7144	0.0010	0.1085	0.0193	0.5086
16	Basic chemicals	BasChemicals	0.0086	-3.1977	0.0356	-9.3004	0.0005	-0.7824	0.0139	-4.6634
17	Fertilizer	Fertilizer	0.0178	0.3279	0.1345	2.3448	0.0138	0.4457	0.0996	2.4227
18	Plastics	Plastics	0.0105	0.0226	0.0711	0.0907	0.0022	0.0368	0.0380	0.0700
19	Other Chemicals	OthChemPrd	0.0097	0.0872	0.0399	0.2771	0.0020	0.0416	0.0215	0.1480
20	Pharmaceutical	Pharmaceutcl	0.0033	0.0479	0.0122	0.1060	0.0018	0.0493	0.0092	0.1275
21	Rubber products	RubberPrd	0.0092	0.0895	0.0744	0.6467	-0.0002	0.0303	0.0330	0.2509
22	Plastic products	PlasticPrd	0.0057	-0.0806	0.0210	-0.1134	0.0025	0.0319	0.0132	-0.0118
23	Glass	Glass	0.0081	-0.0033	0.0165	0.0210	0.0029	0.0471	0.0106	0.0037
24	Clay and ceramics	ClayCermcPrd	0.0032	-0.2535	-0.0041	-0.2907	0.0045	-0.0403	0.0014	-0.1264
25	Cement	Cement	0.0009	-0.0102	-0.0011	-0.0581	0.0018	0.0281	0.0013	-0.0649
26	Other non-metallic mineral products	OthNMmetlPrd	-0.0010	-0.0257	-0.0077	-0.0952	-0.0001	0.0062	-0.0039	-0.0908
27	Basic iron and steel	BasIronSteel	-0.4207	-0.3834	-1.5444	-1.4475	0.0089	0.0534	-0.7966	-0.7422
28	Non-ferrous metals	NonFerrMetal	0.0121	-0.9850	0.0692	-5.6989	0.0110	0.0678	0.0692	-2.6251
29	Other metal products	OthMetalPrd	-0.0044	-0.3391	-0.0648	-0.7686	0.0041	0.0029	-0.0280	-0.3831
30	Electronic products	ElectroncPrd	0.0116	0.1145	0.0563	0.4968	0.0019	0.0872	0.0296	0.3444
31	Electrical equipment	ElecEquip	0.0061	0.0360	0.0433	0.3527	0.0008	0.0487	0.0227	0.2511
32	Transport equipment	TranspEquip	0.0035	0.0658	0.0168	0.3149	0.0004	0.0288	0.0099	0.2373
33	Other equipment	OthEquip	0.0092	0.1114	0.0331	0.3940	0.0019	0.0738	0.0169	0.3079
34	Other manufacturing	OthManufact	0.0075	0.0396	0.0270	0.1847	0.0007	0.0419	0.0140	0.1503
35	Electricity	Electricity	0.0003	-0.9786	-0.0024	-1.5508	0.0028	0.2161	0.0024	-0.6787
36	Gas distribution	GasDist	-0.0111	-0.3082	-0.0387	-0.6204	-0.0084	-0.3120	-0.0277	-0.6517
37	Water and sewers	WaterWaste	-0.0036	-0.0070	-0.0959	-0.5242	-0.0032	-0.0039	-0.0671	-0.2767
38	Construction	Construction	-0.0002	0.0067	-0.0029	-0.0497	0.0016	0.0358	0.0004	-0.0585
39	Trade	Trade	0.0009	0.0178	0.0056	0.0518	0.0017	0.0420	0.0045	0.0761
40	Transport	Transprt	0.0014	0.0563	0.0008	0.0599	0.0034	0.0890	0.0037	0.1087
41	Government services	GovSvc	-0.0003	0.0159	-0.0011	0.0178	0.0038	0.0848	0.0033	0.0945
42	Other services	OthSvc	0.0017	0.0445	0.0046	0.1308	0.0018	0.0485	0.0061	0.1539

6. Analysis of LRSteel simulation

In this section we analyse the results of one simulation, the 'lrsteel', previously described as 'Longrun closure, remove gas subsidy from steel industry, no efficiency change'.

As seen in Table 3, real GDP is scarcely affected. In a CGE model, a change in real GDP may be written as:

A Change in Real GDP = F(Changes in primary factor endowments)

+ Allocative efficiency changes + Technogical efficiency changes

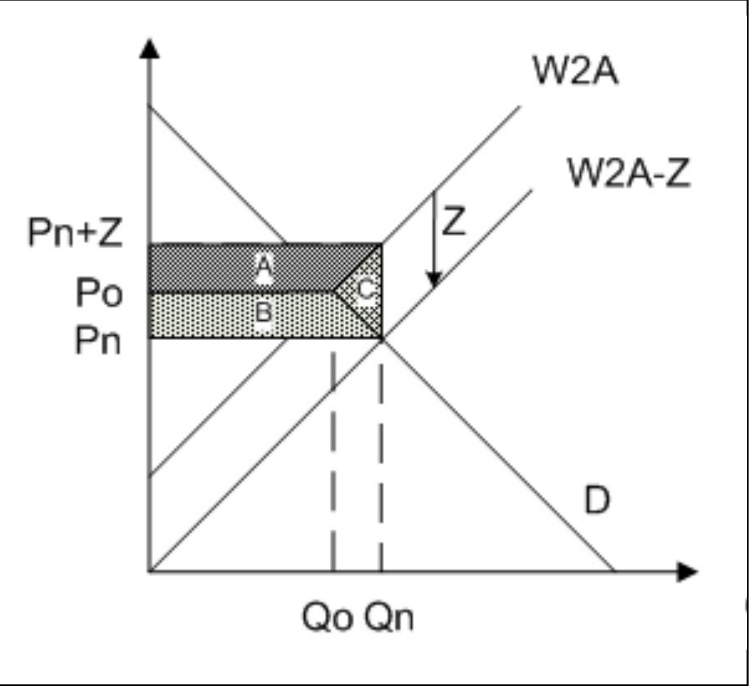
In this simulation, there are no changes in primary factor endowments or in technogical efficiency, so any real GDP changes must be due to changes in allocative efficiency.

The textbook explanation of the allocative efficiency loss due to a subsidy is shown in Figure 3 below. This loss (area of triangle C) is also known as the 'deadweight loss', the 'excess burden', or 'Harberger's triangle'.

The diagram suggests that if we started from an economy with no distortionary taxes or subsidies, the imposition of a subsidy would result in a real GDP loss. Note however that the area of triangle C is fairly small.

A similar diagram can be used to show that if we started from an economy with no distortionary taxes, the imposition of a tax would also result in a real GDP loss.

Such results underly the intuition that any taxes or subsidies that alter behaviour tend to reduce allocative efficiency.



W2A is the pre-subsidy supply curve, with initial price Po and quantity Qo. W2A-Z is the post-subsidy supply curve. The effect of the subsidy is that sellers can now charge less because the government is going to make up the difference. The buyer's price falls to Pn and the quantity rises to Qn. Sellers get to keep Pn+Z.

The sellers gain area A in new producer surplus. The buyers, who now pay a lower price, gain area B in consumer surplus. However, the total cost of the subsidy to the government is Z*Qn, which is equal to areas A+B+C. The subsidy thus costs C dollars more than the benefits it delivers. It is Pareto inefficient, and area C is deadweight loss.

Diagram and explanation from lecture notes by Professor P J Wilcoxen, Syracuse University, NY https://wilcoxen.maxwell.insightworks.com/pages/1896.html

Figure 3. Deadweight loss from a subsidy

However, the diagram depicts one sector only and assumes a starting point with no tax or subsidy. In reality we usually face a starting point with many taxes or subsidies, applied to range of interacting sectors. This greatly complicates the analysis.

For example, suppose there already was a 10% subsidy on textile production, leading to a deadweight loss. If we then imposed a 10% tax on the use of textiles (so neutralizing the subsidy) we could raise GDP. A tax on clothing might achieve a similar effect. These are examples of the *Theory of Second Best* (Lipsey and Lancaster, 1956).

The theory suggests that taxes or subsidies are bad insofar as they affect relative prices and so change behaviour. Hence, a uniform tax rate on consumer purchases, which does not affect relative prices, is likely to be far less harmful than a regime with wildy varying rates of tax or subsidy on different commodities. Unfortunately Indonesia falls into the second category! Table 5 below shows some of the largest taxes and subsidies among the 4324 distinguished by the model. Heavy taxes on cars, electronic equipment, alcohol and tobacco coexist with large subsidies to electricity, gasoline, gas, and fertilizer.

Table 5. Largest taxes and subsidies (billion rupiah)

Taxes				Subsidies			
Input	**Source**	**User**	**Value**	**Input**	**Source**	**User**	**Value**
BevTobac	dom	HouseH	142862	PetrolRefine	imp	WoodPaper	-364
PrdTax	dom	OthSvc	42526	PetrolRefine	dom	OthSvc	-370
FoodProc	dom	HouseH	39218	LNG	dom	HouseH	-390
OthEquip	imp	Invest	35799	LPG	dom	Construction	-394
Construction	dom	Invest	31233	Electricity	dom	OthManufact	-408
OthSvc	dom	HouseH	25205	Electricity	dom	OthSvc	-429
Construction	dom	GovGE	23681	LPG	imp	Construction	-430
PrdTax	dom	AgricForFish	19310	Electricity	dom	TCF	-440
TranspEquip	dom	HouseH	19007	PetrolRefine	dom	AgricForFish	-491
PrdTax	dom	Construction	17084	PetrolRefine	imp	AgricForFish	-627
ElectroncPrd	imp	HouseH	15304	LPG	dom	Trade	-688
PrdTax	dom	Trade	14695	LPG	dom	HouseH	-700
FoodProc	dom	Export	12513	NaturalGas	dom	BasIronSteel	-735
OthEquip	dom	Invest	12426	NaturalGas	dom	OthMetalPrd	-846
TranspEquip	imp	Invest	12297	LPG	imp	HouseH	-1164
TranspEquip	dom	Invest	11422	NaturalGas	dom	GasDist	-1534
FoodProc	imp	HouseH	11099	NaturalGas	dom	NonFerrMetal	-1755
TCF	dom	HouseH	8984	AgricForFish	dom	AgricForFish	-1805
PrdTax	dom	FoodProc	7126	PetrolRefine	imp	Construction	-1807
ElectroncPrd	imp	Invest	6582	Transprt	dom	HouseH	-1858
TCF	imp	HouseH	6150	NaturalGas	dom	BasChemicals	-2628
ElectroncPrd	dom	HouseH	5396	PetrolRefine	dom	Construction	-3441
OthEquip	imp	OthEquip	5362	LNG	dom	Export	-3899
PrdTax	dom	Transprt	4755	NaturalGas	dom	Fertilizer	-4353
ElectroncPrd	dom	Invest	4725	Electricity	dom	Trade	-4670
BevTobac	dom	BevTobac	4398	PetrolRefine	dom	Trade	-5509
BevTobac	imp	HouseH	4323	PetrolRefine	dom	Export	-5710
PrdTax	dom	PetrolRefine	3748	PetrolRefine	dom	Transprt	-6578
PrdTax	dom	CoalLignite	3698	NaturalGas	dom	Electricity	-6584
OthSvc	imp	HouseH	3660	Fertilizer	imp	AgricForFish	-6612
Trade	dom	HouseH	3648	PetrolRefine	imp	Transprt	-9146
Pharmaceutcl	dom	HouseH	3617	Fertilizer	dom	AgricForFish	-17914
PrdTax	dom	TranspEquip	3617	PetrolRefine	imp	HouseH	-20541
PrdTax	dom	OthMining	3615	PetrolRefine	dom	HouseH	-26007
BasIronSteel	imp	Construction	3611	Electricity	dom	HouseH	-108917

In the CGE model, the 'Allocative efficiency changes' in equation A above take the form (at first order):

$(1/GDP)*TAX_{c,s,u}*x_{c,s,u}$ where c=commodity, s=source (dom,imp) and u=user (sectors + final users)

Above, TAX is the tax revenue (negative for a subsidy) and x is the % change in use of c,s by user u. There are 4324 such contributions to GDP change: some of the largest negatives and positives are shown in Table 6 below. The important point is that GDP rises if:

- usage of a heavily taxed commodity increases, or
- usage of a heavily subsidized commodity declines.

Conversely GDP falls if:

- usage of a heavily taxed commodity declines, or
- usage of a heavily subsidized commodity increases.

Perhaps paradoxically, the more a subsidy to some sector increases output in that sector, the greater is the GDP loss!

Table 6. Allocative efficiency contributions to %change in real GDP

Input	Source	User	Value	Input	Source	User	Value
Fertilizer	dom	AgricForFish	-0.000270	NonFerrMetal	dom	Exp	0.000009
BasIronSteel	dom	Construction	-0.000193	TranspEquip	dom	Exp	0.000009
BasIronSteel	dom	Exp	-0.000141	FoodProc	dom	Hou	0.000010
PrdTax	dom	BasIronSteel	-0.000089	ElecEquip	dom	Exp	0.000010
BasIronSteel	dom	BasIronSteel	-0.000057	OthMetalPrd	imp	Construction	0.000010
BasIronSteel	dom	NonFerrMetal	-0.000052	PrdTax	dom	FoodProc	0.000010
NaturalGas	dom	Fertilizer	-0.000052	ElectroncPrd	dom	Hou	0.000011
BasChemicals	imp	BasIronSteel	-0.000037	TCF	dom	Hou	0.000011
BasIronSteel	dom	OthMetalPrd	-0.000032	Electricity	dom	Hou	0.000012
OthEquip	imp	Inv	-0.000028	OthEquip	imp	OthEquip	0.000013
BasChemicals	dom	BasIronSteel	-0.000024	ElectroncPrd	imp	ElectroncPrd	0.000014
FoodProc	imp	Hou	-0.000024	BasChemicals	dom	Exp	0.000014
PetrolRefine	dom	Exp	-0.000024	PrdTax	dom	OthSvc	0.000017
PrdTax	dom	OthMining	-0.000021	PrdTax	dom	TCF	0.000017
OthMining	imp	BasIronSteel	-0.000020	PrdTax	dom	AgricForFish	0.000020
ElectroncPrd	imp	Hou	-0.000018	OthEquip	dom	Inv	0.000024
TCF	imp	Hou	-0.000017	ElectroncPrd	dom	Exp	0.000024
LNG	dom	Exp	-0.000015	TranspEquip	dom	Inv	0.000025
PetrolRefine	dom	Hou	-0.000014	PetrolRefine	imp	Hou	0.000030
OthEquip	imp	BasIronSteel	-0.000014	TCF	dom	Exp	0.000034
NaturalGas	dom	NonFerrMetal	-0.000011	NaturalGas	dom	BasIronSteel	0.000050
ElectroncPrd	imp	Inv	-0.000010	BasIronSteel	imp	NonFerrMetal	0.000062
Construction	dom	Inv	-0.000009	BasIronSteel	imp	OthMetalPrd	0.000070
OthMetalPrd	dom	Exp	-0.000008	FoodProc	dom	Exp	0.000082
OthMetalPrd	dom	Construction	-0.000008	Fertilizer	imp	AgricForFish	0.000160
TranspEquip	imp	Inv	-0.000008	BasIronSteel	imp	Construction	0.000293

Table 7 below shows some more detailed results from the LRSTEEL simulation. Columns 1-5 show the % change effect on:

1 Output
2 Imports
3 LocDom: non-export demand for locally-produced
4 LocDem: non-export demand for combined (imports plus locally-produced)
5 Exports (which are all locally-produced)

Tables 5 and 7 enable us to explain Table 6. First, the steel industry contracts when it has to pay more for gas (row 27, Table 5). This releases capital and labour to other sectors, which mostly expand. As well, money saved by eliminating the gas subsidy to steel is used to evenly reduce taxes on other industries, so aiding their growth. Less gas is used by the steel industry, giving rise to the positive (NaturalGas, dom, BasIronSteel) contribution to GDP highlighted near bottom right of Table 6.

On the other hand Fertilizer output rises (row 17, Table 7), and because Fertilizer use is heavily subsidized, we see a negative GDP contribution from (Fertilizer, dom, AgricForFish) at top left of Table 6.

Again, less Gas use by Steel means gas is diverted to other sectors (which still enjoy subsidized Gas). This results in 2 negative contributions by Gas (blue in left colum, Table 6). [Columns 2 and 4 of Table 3 show that GDP does rise noticeably when gas subsidies to other users are also removed. This is because we no longer see gas being diverted to other still-subsidized users.]

At bottom left of Table 5 we see that (BasIronSteel, imp, Construction) is quite heavily taxed. As local prices for BasIronSteel steel rise, demand switches to imports. This leads (more high-taxed good used) to the largest positive GDP contribution at bottom right of Table 6.

These examples show that reducing a subsidy to only one gas user (BasIronSteel), while directly increasing GDP, has all sorts of side effects, both positive and negative, with absolute values that sometimes exceed the direct effect. The total of the allocative efficiency changes is near to zero.

Conventional economic wisdom, in cases where rates of tax or subsidy on different commodities vary greatly, is that the greatest initial benefit will accrue if, at the start of a reform process, the highest taxes and subsidies are the first to be reduced. With this achieved, reduction of other taxes and subsidies is more likely to lead to gains. In our simulation, the other distortions outweigh those due to gas subsidies, and so reducing only gas subsidies leads to little GDP gain.

Table 7. More detailed results from LRSTEEL simulation (%change)

Description	Code	1 Output	2 Imports	3 LocDom	4 LocDem	5 Exports
1 Agriculture, forestry, fishing	AgricForFish	0.012	0.007	0.011	0.011	0.025
2 Coal	CoalLignite	0.010	0.003	-0.026	-0.026	0.015
3 Crude oil	CrudeOil	0.005	0.011	0.011	0.011	0.000
4 Natural gas	NaturalGas	0.004	78.949	-0.004	-0.004	0.069
5 Services to oil and gas	Svcs2OilGas	0.002	0.000	0.002	0.002	0.038
6 Non-metallic minerals	NonMetlMinrl	-0.031	0.002	-0.031	-0.030	0.038
7 Other mining	OthMining	-0.067	-0.345	-0.206	-0.211	0.186
8 Food processing	FoodProc	0.017	-0.024	0.005	0.002	0.075
9 Animal feed	AnimalFeed	0.013	-0.010	0.013	0.011	0.038
10 Beverages and tobacco	BevTobac	0.002	-0.012	0.001	0.000	0.033
11 Textiles, clothing, footwear	TCF	0.070	-0.017	0.036	0.018	0.109
12 Wood and paper	WoodPaper	0.033	-0.013	0.011	0.009	0.087
13 Petroleum Refining	PetrolRefine	0.011	-0.013	0.004	-0.002	0.047
14 LPG	LPG	0.007	-0.012	0.007	-0.001	0.000
15 LNG	LNG	0.037	0.000	-0.003	-0.003	0.043
16 Basic chemicals	BasChemicals	0.036	-0.044	-0.040	-0.043	0.096
17 Fertilizer	Fertilizer	0.134	-0.252	0.166	0.049	0.081
18 Plastics	Plastics	0.071	0.004	0.056	0.037	0.108
19 Other Chem products	OthChemPrd	0.040	-0.021	0.012	0.001	0.112
20 Pharmaceutcl	Pharmaceutcl	0.012	-0.033	0.007	0.002	0.100
21 Rubber products	RubberPrd	0.074	-0.011	0.045	0.025	0.081
22 Plastic products	PlasticPrd	0.021	-0.031	0.011	0.004	0.096
23 Glass	Glass	0.016	-0.033	0.003	-0.002	0.108
24 Clay and ceramic products	ClayCermcPrd	-0.004	0.001	-0.005	-0.004	0.005
25 Cement	Cement	-0.001	-0.058	-0.002	-0.003	0.038
26 Other non-metallic mineral products	OthNMmetlPrd	-0.008	-0.019	-0.009	-0.009	0.038
27 Basic iron and steel	BasIronSteel	-1.544	0.875	-0.957	-0.132	-3.487
28 Non-ferrous metals	NonFerrMetal	0.069	-0.072	-0.012	-0.039	0.100
29 Other metal products	OthMetalPrd	-0.065	0.087	-0.034	-0.003	-0.290
30 Electronic products	ElectroncPrd	0.056	-0.002	0.026	0.006	0.093
31 Electrical equipment	ElecEquip	0.043	-0.001	0.023	0.010	0.071
32 Transport equipment	TranspEquip	0.017	-0.010	0.008	0.001	0.078
33 Other equipment	OthEquip	0.033	-0.010	0.025	0.000	0.075
34 Other manufacturing	OthManufact	0.027	-0.022	0.005	0.000	0.077
35 Electricity	Electricity	-0.002	-0.097	-0.002	-0.002	0.038
36 Gas distribution	GasDist	-0.039	-0.036	-0.039	-0.039	0.038
37 Water and sewers	WaterWaste	-0.096	-0.025	-0.102	-0.079	0.075
38 Construction	Construction	-0.003	0.003	-0.003	-0.003	0.038
39 Trade	Trade	0.006	0.000	0.006	0.006	0.038
40 Transport	Transprt	0.001	-0.024	0.000	-0.002	0.051
41 Government services	GovSvc	-0.001	-0.006	-0.001	-0.002	0.038
42 Other services	OthSvc	0.005	-0.022	0.002	0.000	0.051

7. Efficiency gains from reduction of X-Inefficiency

A subsidy to an input used by an industry could result in either

(a) cheaper output, reflecting the reduced input cost; or

(b) the subsidy might allow the industry to make super-normal profits; or

(c) the industry might operate less efficiently, failing to minimize production costs. Alternatively, the industry might divert resources into maintaining or increasing the subsidy (rent-seeking).

Effect (c) is sometimes called X-Inefficiency (Leibenstein, 1966). For some of the simulations reported, we incorporate X-Inefficiency effects. That is, if a subsidy makes an industry less efficient, removal of the subsidy should force the industry to be *more* efficient. The size of the (Hicks-neutral) efficiency gain is one half of the initial subsidy value as a percentage of industry costs – see Table 8 below.

Table 8. Gas subsidy as ranked percentage of total industry costs

Industry	%
16 Fertilizer	8.13
35 GasDist	2.79
34 Electricity	1.65
15 BasChemicals	1.21
27 NonFerrMetal	0.59
26 BasIronSteel	0.31
28 OthMetalPrd	0.25
23 ClayCermcPrd	0.22
24 Cement	0.19
25 OthNMmetlPrd	0.15
21 PlasticPrd	0.09
22 Glass	0.02

A possible cause of effect (c) above arises when only *some* firms within an industry get an input subsidy (or get a higher subsidy). This might occur if firms are more likely to get the subsidy if they are in trouble, through poor management or bad luck. The consequence would be that poorly performing firms come to form a higher share of the industry, dragging industry efficiency down.

The final columns of Table 3 shows that reducing X-Inefficiency greatly magnifies the GDP gains, especially when all gas subsidies are removed (srallA and lrallA columns). The longrun benefit is greater than the shortrun.

Repeating equation A above:

A Change in Real GDP = F(Changes in primary factor endowments)

+ Allocative efficiency changes + Technogical efficiency changes

we see that the contribution to GDP of technogical efficiency gains dwarfs that of allocative efficiency changes. We saw previously that allocative efficiency changes were small, and of mixed sign, summing in total to tiny GDP gains. In contrast, the technogical efficiency changes have a larger and more uniformly positive effect.

The final lrallA column of Table 4 shows that sectors losing gas subsidies still contract (Chemicals, Steel, Non-ferrous), but the contraction is about half that seen in column 4 (lrall). This is because they have received an efficiency gain with value half that of the lost subsidy.

With investment and the trade balance fixed, the increase in GDP appears as increases in household and government consumption. Hence, service and consumer-goods sector appear amongst the biggest winners.

8. Conclusions

Using a large CGE model, we have examined the question, whether subsidizing the local use of natural gas might boost the Indonesian economy. Or, conversely, would removing such subsidies increase GDP?

Our results give little comfort to supporters of subsidies. Removing the subsidies increases GDP.

On the other hand, using standard text-book assumptions, the benefits of removing subsidies are extremely small. Arguing from first principles, economists might expect that removing any tax or subsidy should result in an allocative gain. But our detailed model shows that, in an economy with many interacting distortions in different sectors, the removal of one subsidy only is not necessarily very beneficial.

The picture changes if we suppose that subsidies lead to X-inefficiency. Now, removing subsidies leads to efficiency gains which unambiguously raise GDP. The longrun GDP gain is nearly half the value of the subsidies removed.

The gas subsidies are small compared to some other distortions in the Indonesian economy – such as subsidies to Fertilizer, Electricity and Gasoline use, and taxes on some imports. More immediate benefits might result from first tackling these larger distortions.

Appendix: Description of INDORANI and how the database was prepared

The model requires a database with separate matrices for basic, tax and margin flows for both domestic and imported sources of commodities sold to domestic and foreign users, as well as matrices for the factors of production. The structure of the IO database is illustrated in Figure A1. The first three rows form the absorption matrix, while rows 4 to 7 contain primary factor costs and production taxes.

			Absorption Matrix					
			1	2	3	4	5	6
			Producers	Investors	Household	Export	Government	Change in Inventories
		Size	← I →	← I →	← 1 →	← 1 →	← 1 →	← 1 →
1	Basic Flows	↑ C×S ↓	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS
2	Margins	↑ C×S×M ↓	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	n/a
3	Taxes	↑ C×S ↓	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	n/a
4	Labour	↑ O ↓	V1LAB					
5	Capital	↑ 1 ↓	V1CAP					
6	Land	↑ 1 ↓	V1LND					
7	Production Tax	↑ 1 ↓	V1PTX					

C = Number of Commodities
I = Number of Industries

S = 2: Domestic, Imported,
O = Number of Occupation Types

M = Number of Commodities used as Margins

	Joint Production Matrix
Size	← I →
↑ C ↓	MAKE

Figure A1. The INDORANI Flows Database

In the absorption matrix, users are identified in the column headings and denoted by a number:

1. domestic producers divided into *i* industries;
2. investors divided into *i* industries;
3. a single representative household;
4. an aggregate foreign purchaser of exports;
5. government demand; and
6. changes in inventories.

The matrices in the first row, that is, V1BAS to V6BAS, represent direct flows of commodities from all sources to users valued at basic prices. The first matrix, V1BAS, can be interpreted as the direct flow of commodity *c*, from source *s*, used by industry *i* as an input into current production. V2BAS shows the direct flow of commodity *c*, from source *s*, used by industry *i* as an input to capital formation. V3BAS shows the flow of commodity *c* from source *s* that is consumed by a representative household. V4BAS is a column vector and shows the flow of commodity *c* to exports. V5BAS and V6BAS show the flow of commodity *c* from source *s* to the government and change in inventories respectively. In the IO database, no imported commodity is exported without being processed in a domestic industry. Hence, V4BAS has no import dimension.

The matrices in row 1 of Figure A1 contain only direct flows valued at basic prices. The basic price of a domestic commodity is the price the producer receives, and excludes margin costs and sales taxes. The basic price of an imported commodity is the CIF price, that is, the price at the port of entry. It is assumed that the basic price is the same for all users. The row sums are the total direct usage of a commodity. It should be noted that all the values, with the exception of V6BAS, are positive. V6BAS records the *change in inventories,* and thus can be positive or negative.

A special feature of CoPS-style models is the detailed treatment of margins (Dixon et al., 1982:3). The second row, V1MAR to V5MAR, represents the value of commodities used as margins to facilitate the basic flows in row 1. The model includes 7 margin commodities, trade and transport services. V1MAR and V2MAR are four-dimensional matrices and show the cost of margin service *m* used to facilitate the flow of commodity *c*, from source *s* to industry *i*. V3MAR and V5MAR are three dimensional and show the cost of margin service *m* that facilitates the flow of commodity *c* from source *s* to the representative household and the government respectively. V4MAR is a two-dimensional matrix and shows the cost of margin service *m* that facilitates commodities flows to exporters. There are flows that do not require any margins and therefore the values in these matrices are zero or the matrices are omitted. This is mainly for services and inventories (unsold commodities).

The third row in Figure A1 represents the tax matrices, V1TAX to V5TAX. These matrices show the taxes paid in the delivery of domestic and imported commodities to the different users. Positive values refer to taxes and negative values to subsidies. For example, a positive element in V1TAX and V2TAX can be interpreted as the tax associated with the delivery of commodity *c* from source *s* used by industry *i* as an input into current production and capital formation respectively. A negative value is interpreted as a subsidy paid on commodity *c*, from source *s*, used by industry *i*. V3TAX and V5TAX are interpreted as the taxes associated with the delivery of commodity *c* from source *s* used by households and government. V4TAX is associated with the taxes paid for the delivery of commodities to exporters. Taxes are not paid on inventories and therefore there is no V6TAX matrix. It should be noted that tax rates may differ between users and sources.

Rows 4 to 6 contain matrices that provide a breakdown of the primary factors used by industry in current production. These matrices include the inputs of three factors of production: occupation-specific labour (V1LAB), fixed capital (V1CAP) and natural resources (V1LND). For example, V1LAB shows the purchase of labour of skill *o* by industry *i* that is used as an input into current production. V1CAP contains the rental value of each industry's fixed capital and V1LND shows the rental value of natural resource use by each industry. Industry also pays production taxes such as business licences, payroll taxes and stamp duties (United Nations, 2009:147-148). These taxes are contained in V1PTX in row 7.

The database shows that labour, capital, natural resource and production costs are only used in current production and therefore these matrices are absent from entries in the capital formation, household consumption, exports, government and change in inventories columns.

The satellite matrix is the multi-production (MAKE) matrix. Each element in the MAKE matrix refers to the basic value of commodity *c* produced by industry *i*. In principle there are two different types of MAKE matrices. The first is where the entries in the matrix are diagonal, that is, an industry only produces one unique commodity and a commodity is only produced by one industry. All non-diagonal values are zero. The second type of MAKE matrix is a joint-production matrix where an industry can produce more than one commodity and a commodity can be produced by more than one industry. Therefore, a number of the off-diagonal values are non-zero. The national database includes the second type of MAKE matrix. The implication of a joint-production matrix is that a producer will choose to produce a combination of output commodities that will maximise their revenue. For example, as the market price of commodity 1 increases relative to commodity 2, producers will shift their resources to producing more of commodity 1 and away from commodity 2.

Structure of production

INDORANI allows each industry to produce several commodities, using as inputs domestic and imported commodities, labour of several types, land, and capital. The multi-input, multi-output production specification is kept manageable by a series of separability assumptions, illustrated by the nesting shown in Figure A2. For example, the assumption of *input-output separability* implies that the generalised production function for some industry:

F(inputs,outputs) = 0 may be written as: G(inputs) = X1TOT = H(outputs)

where X1TOT is an index of industry activity. Assumptions of this type reduce the number of estimated parameters required by the model. Figure A2 shows that the H function above is derived from a CET (constant elasticity of transformation) aggregation function, while the G function is broken into a sequence of nests. At the top level, commodity composites, a primary-factor composite and 'other costs' are combined using a Leontief production function. Consequently, they are all demanded in direct proportion to X1TOT. Each commodity composite is a CES (constant elasticity of substitution) function of a domestic good and the imported equivalent. The primary-factor composite is a CES aggregate of land, capital and composite labour. Composite labour is a CES aggregate of occupational labour types. Although all industries share this common production structure, input proportions and behavioural parameters may vary between industries.

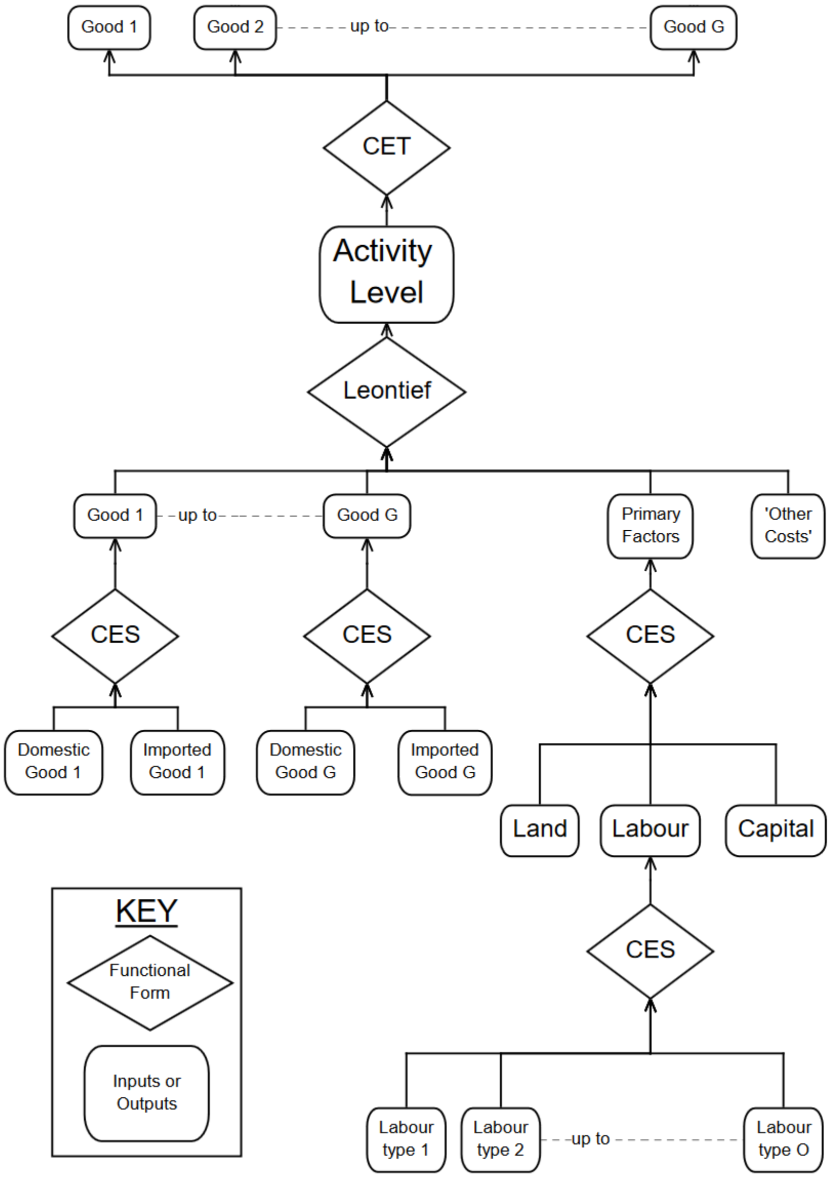


Figure A2. The structure of production

Data sources

Our starting point in creating the required CGE database is the 2010 Input Output (IO) tables. The data in the IO table is supplemented with other data such as detailed oil and gas data, Government Financial Statistics (GFS), International Monetary Fund (IMF) and World Bank Economic Indicators. The data sources are summarised in Table A1.

Table A1. Summary of data sources

	Data sources	Source	Reference
1.	Input Output Table (2010)	BPS	Catalogue 9401001
2.	Mining Statistics of Petroleum and Natural gas (2015)	BPS	Catalogue 6202001
3.	Handbook of Energy and Economic Statistics of Indonesia (2016)	Ministry of energy and Mineral Resources	ISSN 2528-3464
4.	National Income of Indonesia 2014-2018	BPS	Catalogue 9301001
5.	World Bank Economic Indicators		
6.	International Monetary Fund (IMF)	IMF	Online data facility
7.	GTAP database	GTAP	GTAP database

Note on the valuation of the tables

The 2008 System of National Accounts (SNA) recommends three ways in which production (output) of goods and services can be measured (United Nations, 2009: 104). The definitions of these measures are given below.

Basic price: “The basic price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output, minus any tax payable (ie. VAT and excise duties), plus any subsidy receivable, on that unit as a consequence of its production or sale. Basic prices exclude any transport charges involved separately by the producer” (United Nations, 2009: 104).

Producers’ price: “The producers’ price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output, minus VAT, or similar deductible tax, invoiced to the producer. It excludes any transport charges invoiced separately by the producer” (United Nations, 2009: 104).

Purchasers’ price: “The purchasers’ price is the amount paid by the user, excluding any deductible VAT or similar deductible tax, in order to take delivery of a unit of good and service at the time and place required by the purchaser. The purchasers’ price includes any transport charges paid separately by the purchaser to take delivery at the required time and place” (United Nations, 2009: 104).

The original input-output tables

The first step in creating a database is to develop a national input-output database. The latest Input-Output Table are for 2010 and is our primary source of data is in creating the national input-output database (BPS, 2015). The IO contains information on how much of each product is used as an intermediate input in the production of other products as well as used as a final commodity by the final demanders. The 2010 official IOTs are in million rupiah and presented in 3 tables. These tables are similar in row and column dimensions, but are valued at different prices. Figure A3 illustrates the first table.

Figure A3 is a simplified representation of the published input-output table valued at purchasers’ price and shows the use of commodity c[3], from all sources[4], used by user u[5]. In other words, Figure A3 shows the value of domestically sourced 185 commodities, valued at basic price, used:

[3] COM is a set including 185 commodities.

- by 185 industries;
- by 1 representative households which includes non-profit institution serving households ;
- by the government;
- by 1 aggregate investor;
- for inventory use, and
- for exports.

The data in columns 1 to 9 are valued at basic price, and are supplemented by data on commodity-specific imports (column 10), trade and transport margins (column 11) and net taxes including subsidies on commodities (column 12). In addition to the commodity-specific use of commodities, Figure A3 includes additional rows (rows 2-4) showing industry-specific gross value added (GVA) by income item.[6]

The second and third published IO tables have similar dimensions to the first IO table as illustrated in Figure 1, but they are valued at different prices. The second table shows the total use of commodity c, summed over source s, by user u valued at basic price. These data values do not include margins or indirect taxes.

The third table shows the use of domestically sourced commodity c used by user u valued at basic price. These data values do not include the use of imported commodities, margins or indirect taxes.

The published data is not in the format required of a national input-output database. Several steps are taken to transform the published data into the required national database.

[4] SRC is a set including 2 sources (dom, imp).

[5] USER is a set of 190 users including 185 industries and 5 final demanders (household consumption, investment, stocks, government and exports).

[6] These income items includes (1) compensation of employees (COE), (2) Gross operating surplus, and (3) Taxes less subsidies on production.

			Absorption Matrix											
			1	2	3	4	5	6	7	8 = 2 + … + 7	9 = 1 + 8	10	11	12
			Producers	Household	Non-Profit Institutions serving households	Government	Investors	Change in Inventories	Export	Total final demand	Total demand at purchasers' price	Imports c.i.f	Margins	Net tax on products
		Size	1,..,185	→ 1 ←	→ 1 ←	→ 1 ←	→ I ←	→ 1 ←	→ 1 ←	→ 1 ←	→ 1 ←	→ 1 ←	→ 1 ←	→ 1 ←
1	Flows by commodity	↓ C ↑	IO(c,i)	IO(c,"hou")	IO(c,"npish")	IO(c,"gov")	IO(c,"inv")	IO(c,"stk")	IO(c,"exp")	$\sum_{u=2-7} IO\_S(c,u)$	$\sum_{u=1-7} IO\_S(c,u)$	IO_U(c,"imp")	V0MAR_US(c)	V0TAX_SU(c)
2	Labour	1	V1LAB											
3	Capital	1	V1CAP											
4	Production taxes	1	V1PTX											

C = Number of commodities

I = Number of industries

M = Number of Margin type

IMP = Number of import categories

Figure A3. Total transactions by commodity valued at purchasers' price, 2010

Adjustments to the original input-output tables

To promote transparency and to assist trouble shooting, we have automated the process of generating the database by using GEMPACK (Horridge et al, 2018). Much of our initial input data were provided to us in Excel format. We converted these data into Header Array files using ViewHAR. For each step of the database creation process, we wrote a GEMPACK "TABLO" program to conduct the necessary calculations and manipulations. An important part of each TABLO program at each step is the inclusion of a series of checking statements to ensure that the data meet necessary balance and other conditions. Batch files automate the execution of the series of TABLO-generated programs.

Our approach has a number of advantages, particularly relative to the common alternative of doing large numbers of sequential data manipulations using a spreadsheet program such as Excel. First, it is transparent. TABLO input files are text files written in an easy-to-master language. As such, each TABLO program represents transparent documentation of the data manipulation processes that we have implemented at each stage of the database creation process. Second, automation enables a more timely generation of an updated database.

The next section describes the steps taken to improve the input-output representation of the Indonesian economy. These modifications are based on the expert knowledge of colleagues at Padjadjaran University (UNPAD). We also describe the modifications made to the input-output representation of the crude oil and natural gas sector. These modifications are based on the information from the Mining Statistics of Petroleum and Natural gas and expert knowledge of colleagues at Universitas Padjadjaran.

Processing and checking of the original IO data

In this step we perform the following tasks:

a. Read the 2010 IO data, presented in excel format (BPS, 2015), into header array files. The 2010 official IO tables are in million rupiah and includes:

    - The use of domestically sourced commodity c, used by user u valued at basic price.
    - The total use of commodity c, summed over source s, used by user u valued at basic price.
    - The use of commodity c, summed over source s, used by user u valued at purchasers' price.

b. Perform several checks, including tests to verify that the:

    - IOTs are balanced;
    - costs are equal to sales; and
    - GDP from the income side is equal to GDP from the expenditure side.

The data from the IOT are presented in the following matrices:

- IO(c,s,u,b) for all $c \in$ COM, $s \in$ SRC, $u \in$ USER and $b \in$ OTH[7]
- VA(v,i) for all $v \in$ FACTOR[8] and $i \in$ IND

For example, IO (c,"dom",u,"bas") is the use of commodity c, sourced domestically, used by user u, valued basic price. The matrix includes 185 commodities and 190 users (185 industries and 5 final demanders). This matrix is similar to the IOT illustrated in Figure A3.

[7] OTH is a set including the different components that make up values at purchasers prices. The elements in OTH are, "bas" (values in basic price), "tax" (indirect taxes) and the 8 margin commodities. Summing the values over these elements shows commodity-specific values at purchasers' price.

[8] FACTOR is a set containing elements of value added including compensation of employees (COE), gross operating surplus (GOS) and indirect taxes.

$\sum_{s \in SRC} \text{IO}(\text{c,s,u,"bas"})$ is the use of commodity c, summed over source s, by user u valued basic price.
The output of this step serves as the input to the next step.

Create government investment

The IOT shows that public and private investment is captured in the use of commodity c, from source s, by the final user investment. We want to show public investment separately from total investment. Therefore, in this step we allocate a portion of total investment expenditure on selected domestically sourced commodities, to government spending. This allows for government investment to be explicitly accounted for as part of government spending. We assume that government invests in the following areas:

- Residential building and non-residential buildings
- Building & Installing Electricity, Gas, Drinking Water and Communication
- Agricultural Infrastructure
- Roads, Bridges and Ports
- Other Buildings

We assume a government investment share (SHRGOV) of 10 per cent for the above-mentioned commodities except for roads, bridges and ports where we assume 90 per cent government investment and for agricultural infrastructure at 50 per cent. The value of public investment (GOVINV) is added to government consumption in (E.2) and subtracted from domestic investment via (E.3).

$$\text{GOVINV}(c) = \text{IO}(c,\text{"dom"},\text{"Invest"},\text{"bas"}) \times \text{SHRGOV}(c) \qquad \text{(E.1)}$$

$$\text{IO}(c,\text{"dom"},\text{"GovCon"},b) = \text{IO}(c,\text{"dom"},\text{"GovCon"},\text{"bas"}) + \text{GOVINV}(c) \qquad \text{(E.2)}$$

$$\text{IO}(c,\text{"dom"},\text{"Invest"},b) = \text{IO}(c,\text{"dom"},\text{"Invest"},\text{"bas"}) - \text{GOVINV}(c) \qquad \text{(E.3)}$$

Household spending

The IO table shows household consumption for 185 commodities sourced domestically or imported. The table suggests that 5.6 per cent of household spending was on housing, while the household survey shows 12 per cent. We increase imputed rent of housing by 50 per cent to better reflect the share of household spending on real estate as suggested in the household survey (see E.4 and E.5). To keep the IO table balanced (ie. costs equals sales), we add the same amount to the operating surplus in the real estate sector-see (E.6).

$$\text{HOUADD} = \sum_{s \in SRC} \sum_{b \in OTH} \text{IO}(\text{"RealEstatSvc"},s,\text{"HouCon"},b) / 2 \qquad \text{(E.4)}$$

$$\begin{aligned} &\text{IO}(\text{"RealestatSvc"},\text{"dom"},\text{"HouCon"},\text{"bas"}) = \\ &\quad \text{IO}(\text{"RealestatSvc"},\text{"dom"},\text{"HouCon"},\text{"bas"}) + \text{HOUADD} \end{aligned} \qquad \text{(E.5)}$$

$$\text{VA}(\text{"GOS"},\text{"RealEstatSvc"}) = \text{VA}(\text{"GOS"},\text{"RealEstatSvc"}) + \text{HOUADD} \qquad \text{(E.6)}$$

Create exports for air transport

The IO data shows that there are no data for the exports of air transport. However, we do believe that foreigners buy local air transport. To account for this export value, we move 10 per cent of domestically sourced household consumption of air transport to the export column. Equation (E.7) calculates the part of air transport in household consumption, which is then moved from domestically sourced household consumption (E.8) to the export column (E.9).

$$\text{TADD} = \text{IO}(\text{"AirTransport"},\text{"dom"},\text{"HouCon"},\text{"bas"}) * 0.1 \qquad \text{(E.7)}$$

$$\begin{aligned} &\text{IO}(\text{"AirTransport"},\text{"dom"},\text{"HouCon"},\text{"bas"}) = \\ &\quad \text{IO}(\text{"AirTransport"},\text{"dom"},\text{"HouCon"},\text{"bas"}) - \text{TADD} \end{aligned} \qquad \text{(E.8)}$$

$$IO(\text{"AirTransport","dom","Export","bas"}) = IO(\text{"AirTransport","dom","Export","bas"}) + TADD \quad (E.9)$$

Creating land rentals

The model required capital rental and land rental values by industry to be explicitly accounted for in the database. The IOTs do not provide any information on land rentals - only industry-specific capital rental values are shown in the VA matrix. To infer land rental values, we adopt the share of land rentals in total operating surplus from the GTAP database. The GTAP database shows land rental shares of 30 per cent for all agriculture and mining industries and 50 per cent for crude oil and natural gas industries. Equation (E.10) calculates land values for agricultural and mining industries. These values are then subtracted from the capital rental values by industry (E.11).

$$VA2(i,\text{"land"}) = VA(i,\text{"GOS"}) * LNDSHR(i) \quad \text{for all } i \in LANDIND \quad (E.10)$$

$$VA2(i,\text{"capital"}) = VA(i,\text{"GOS"}) - VA2(i,\text{"land"}) \quad (E.11)$$

Labour adjustments

The IOT includes industry-specific compensation of employees, which is included in the GVA. Compensation of employees is defined as the total remuneration payable by an enterprise to an employee in return for work done. Compensation of employees has two components: wages and salaries payable in cash and social insurance contributions payable by employers. The IOT shows compensation of employees for paid labour. Unpaid labour includes all productive activities outside the official labour market done by individuals for their own households or for others. As unpaid labour may account for a large part of inputs, it is important to make some estimate of its value using wage rates paid for similar kinds of work in the local labour market (SNA, 2008; 110). We want to include unpaid labour with the compensation of employees in the IOT. For Indonesia, we assume that most of the unpaid labour occurs in the agricultural sectors. The share of unpaid labour in total labour payments in the agricultural industries varies from 72 per cent or Paddy to 61 per cent in the Coconut industry. Thus we know that:

$$VA2(i,\text{"labour"}) = WAGE(i) * SHR(\text{"paid"}) \quad (E.12)$$

Rewriting E.12 yields

$$WAGE(i) = VA2(i,\text{"labour"}) / SHR(\text{"paid"}) \quad (E.13)$$

Assuming that unpaid labour receives the same wage, we calculate the value of unpaid labour via:

$$WAGE(i) * SHR(\text{"unpaid"}) = VA2(i,\text{"labour"}) * \frac{SHR(\text{"unpaid"})}{SHR(\text{"paid"})} \quad (E.14)$$

We will deduct the imputed wages of unpaid labour form mixed income and therefore need to ensure that the value of unpaid labour does not exceed GOS/mixed income. We do this by calculating the share of unpaid labour to GOS/mixed income as:

$$KSHR(i) = \frac{WAGE(i) * SHR(\text{"unpaid"})}{VA2(i,\text{"GOS})} \quad (E.15)$$

For industries where imputed wages of unpaid labour exceeds GOS (KSHR), we set the share to 75 per cent. We then recalculate the imputed value of unpaid labour as:

$$MORELAB(i) = KSHR(i) * VA2(i,\text{"labour"}) \quad (E.16)$$

We then recalculate compensation of employees and gross operating surplus as:

$$VA3(i,\text{"labour"}) = VA2(i,\text{"labour"}) + MORELAB(i) \quad (E.17)$$

$$VA3(i,\text{"capital"}) = VA2(i,\text{"capital"}) - MORELAB(i) \quad (E.18)$$

The model requires compensation of employees to distinguish between the types of labour employed (ie. occupations) in the productive process. It shows what kind of labour is demanded by the different industries.

$$\text{LABOUR}(i,o) = \text{VA3}(i,\text{"labour"}) * \text{OCCSHR}(i,o) \quad \text{(E.19)}$$

Creating investments by industry

The IO table shows investments by commodity. However, we require investments by commodity to be distributed over industries. To create the industry dimension, we calculate the share of industry-specific capital rental in total capital (E.20).

$$\text{RENTSHR}(i) = \text{VA3}(i,\text{"capital"}) \Big/ \sum_{j \in IND} \text{VA3}(j,\text{"capital"}) \quad \text{(E.20)}$$

To create a matrix showing investment by commodity and industry, we multiply this share with the total investment by commodity valued at purchasers' price.

$$\text{IOPUR}(c,i) = \text{IO\_S}(c,\text{"Invest"}) \times \text{RENTSHR}(i) \quad \text{(E.21)}$$

There are unique relationships between the uses of commodities by certain industries. For example, ships are used exclusively as an investment commodity by the water transport industry. No other industry would use ships as an investment commodity. Table A2 summarises the use of commodities exclusively by certain industries.

Table A2. The use of commodities by industries

	Commodities	Industries
1	Residential builidings	Real estate services
2	Aircraft	Air transport
3	Ships	Sea transport
4	Ships	River transport
5	Railway equipment	Rail transport
6	Electricity and gas infrastructure	Electricity
7	Electricity and gas infrastructure	Gas distribution
8	Electricity and gas infrastructure	Water supply
9	Motor vehicle	Land transport
10	Medical devices	Government health
11	Medical devices	Private health
12	Weapons and ammunition	General government

To preserve the commodity total, we scale this matrix to add to total investments by commodity valued at purchasers' price.

Creating the CGE database

After the adjustments, described above, are made to the original IO tables, we unpack the information in these tables into a format required by the model.

Update the 2010 database to 2015

The database shows the structure of the Indonesian economy in 2010. We use the Adjuster program to update the 2010 database to 2015 (CoPS, 2004). The Adjuster program can be used to rectify imbalances in a CGE database, or to update the database to a more recent year. We use the Adjuster program to update the 2010 database to 2015. The target values are presented in Table A3.

Table A3. Target values for macroeconomic variables, billion Rp

1	Private consumption	6,621,880
2	Investment	2,787,706
3	Government	2,118,056
4	Exports	2,438,993
5	Imports	2,394,879
6	GDP	11,526,333
7	Prodution tax	152,116
8	Commodity tax	363,127

Table A4 summarises the database in the format presented in Figure A1. For simplicity, we have aggregated the 185 commodities and industries to 33.

The rows in Table A4 list 33 commodities (rows 1-33) while the columns list the users of these commodities. Columns 1 to 33 list industries while columns 34 to 38 list final demand. Rows 34 – 37 list components of value added by industry. Note that the total value of private consumption, investment, government spending and exports as shown in Table A3 are consistent with the total value of these final demanders in Table A4, row 38 column 34 to 37.

Representation of natural gas and crude oil sector

Table A4 shows the cost and sales structure of industries and commodities. The cost structure of industries are represented in the column values for columns 1 – 33. The inputs used in each industry is shown in the row values for each industry (rows 1 – 37). The sales structure of commodities are represented in the row values. The users of commodities are industries (columns 1 – 33) or commodities are used as final demand (columns 34-38).

Of specific interest is the representation of Crude oil and Natural Gas in the IO tables. Table A4 show data for the commodities called Natural Gas (NaturalGas) and Refined oil and gas (OilandGasRef), used by various industries (columns 1 to 33) and final demanders (columns 34 – 38). The commodity called NaturalGas, is mainly used as an intermediate input by an industry called OilandGasRef followed by the Electricity, Crude oil and Natural gas industries. A large share of NaturalGas is also exported. The OilandGasRef commodity is mainly used by households or exported with the remainder used as an intermediate input by various industries including Electricity.

During production, industries (column 1 – 33) use a combination of inputs to produces outputs. The inputs include commodities (rows 1 -33) used as intermediate inputs and primary factors (rows 34 -36). Industries may also pay production tax. For example, the industry called OilandGasRef (column 7) shows that this industry uses mainly CrudeOil (row 2) as an intermediate input, followed up by NaturalGas (row 3). Rows 34 – 37 shows the value added of the CrudeOil industry. The total output of this industry is given in Row 38.

For this study, we adapt the database to better represent the users of Natural Gas and Crude Oil as well as disaggregate the commodity and industry called OilandGasRef into three unique commodities and industries namely, refined petroleum (PetrolRefine), LPG and LNG. We use information from the Mining Statistics of Petroleum and Natural gas and expert knowledge from our colleagues at the Universitas Padjadjaran, to inform on a better representation of the production and sales structure of Natural gas, Crude oil, Refined petroleum, LPG and LNG. This representation is presented in Table A5, rows 3, 4 and 12 to 14 and columns 3, 4, 12 and 13.

Table A5 row 3 shows that Crude oil is used as an intermediate input to the Refine petroleum industry (column 12) or exported (column 41). This is different from the initial IO tables where Crude oil is used as an intermediate input in a number of industries. Natural gas is used as an intermediate input to a number of industries-mainly the gas refining industry (column 13), basic chemicals (column 14), fertilizer (column 15) and electricity industry (column 30).

The PetrolRefine (column (13) and GasRefine (column 14) use a combination of intermediate inputs and primary factors to produce refined products, namely RefinePetrol, LPG and LNG. The PetrolRefine industry mainly produces refined petroleum with a small percentage output of LPG. The GasRefine industry mainly produces LNG with a small percentage of LPG.

Refined petroleum (which is an output of the GasRefine industry) is mainly used by industries, the household and exported (see row 12). LPG is mainly used as an intermediate input in the production of commodities and households, while 90% of LNG is exported.

After the production and sales structure of the newly created sectors are completed, the database is balanced. The balanced database is used as an input to run the simulations.

Table A4. CGE database valued at purchasers' price (2015), billion Rp

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		CoalLignite	CrudeOil	NaturalGas	NonMetlMinrl	AnimalFeed	OthNMmetlPrd	OilAndGasRef	BasChemicals	Fertilizer	Plastics	OthChemPrd	Pharmaceutcl	Tire	SmokedRubber	OthRubberPrd	PlasticPrd	Glass	ClayCermcPrd	Cement
1	CoalLignite	3,302	7	1	-	-	3,892	998	20	5	70	9	-	-	-	-	-	1,657	2,830	5,892
2	CrudeOil	-	13,732	10,034	-	-	3,403	137,925	19,702	3,490	761	4,538	2,182	-	1	264	2,987	-	-	-
3	NaturalGas	-	14,728	12,353	-	-	1,416	78,713	9,993	-	-	-	-	-	-	31	1,130	74	1,087	-
4	NonMetlMinrl	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1,220	-
5	AnimalFeed	-	-	-	-	711	-	-	2	-	-	-	59	-	-	-	-	-	-	-
6	OthNMmetlPrd	6	-	-	-	1	5,553	653	34	59	300	73	42	31	118	25	388	1,228	611	3,173
7	OilAndGasRef	4,404	1,738	117	105	6	3,166	7,457	1,538	482	1,757	690	1,334	143	597	58	750	806	1,762	1,545
8	BasChemicals	622	103	27	21	83	1,480	277	22,497	3,310	17,791	4,103	6,061	1,059	2,942	457	6,152	1,641	1,491	3,162
9	Fertilizer	-	-	-	-	-	5	-	3	64	-	89	-	6	40	1	34	6	4	11
10	Plastics	-	-	-	-	16	66	35	145	185	9,427	273	2,583	718	1,459	1,826	46,881	75	65	150
11	OthChemPrd	696	7	1	124	-	466	197	37	390	10	660	2	97	449	50	515	334	101	923
12	Pharmaceutcl	1	9	1	-	24	9	19	128	-	8	1	17,740	63	207	22	324	2	5	5
13	Tire	15	21	10	-	8	5	2	3	-	18	2	-	234	674	68	1,031	2	3	4
14	SmokedRubber	-	-	-	-	-	8	-	4	-	-	20	-	4,480	3,060	2,196	4,867	-	-	-
15	OthRubberPrd	-	-	-	-	-	90	-	-	-	14	-	1	10	534	72	892	4	40	7
16	PlasticPrd	8	7	-	1	1	11	44	346	-	250	2	136	-	-	36	7,274	13	132	24
17	Glass	-	-	-	-	-	166	-	-	-	-	-	35	-	-	-	239	244	237	406
18	ClayCermcPrd	-	-	-	-	-	302	-	-	-	-	-	-	-	-	-	1	373	864	734
19	Cement	-	-	-	-	-	429	1	2	-	8	-	-	-	-	3	-	532	609	1,058
20	BasIronSteel	-	-	-	-	-	3,060	-	-	75	-	92	-	-	-	12	-	-	1,847	-
21	NonFerrMetal	-	-	-	-	-	695	3	-	3	-	3	1	-	24	151	-	40	-	134
22	FabMetalPrd	-	-	-	-	-	1,194	-	-	-	8	-	-	2	27	23	24	-	1,182	-
23	OthMetalPrd	-	5	-	-	27	311	423	4	-	86	1	-	54	43	31	1	292	416	417
24	ElectroncPrd	2	304	19	8	-	244	30	1	-	-	6	482	-	-	4	-	4	86	8
25	Electricity	122	607	55	-	3	273	850	68	122	395	151	251	112	401	50	604	316	242	612
26	GasDist	-	-	-	-	2	528	184	115	213	683	263	185	133	486	55	721	595	520	1,155
27	RailTransprt	265	1	-	-	-	10	3	-	-	-	-	-	-	-	-	-	8	10	15
28	LandTransprt	1,417	159	58	53	1	641	271	10	12	104	15	258	23	82	15	122	200	505	387
29	SeaTransport	1,106	950	190	-	-	6	1,347	1	-	-	1	1	-	-	-	1	-	-	1
30	RiverTrnsprt	75	216	24	-	-	16	355	-	-	1	-	1	-	1	-	1	7	9	14
31	AirTransport	820	915	221	4	2	65	302	14	6	41	8	58	13	47	6	72	21	37	42
32	OthSvc	-	-	-	-	-	29	169	13	19	6	23	723	31	124	11	168	-	11	-
33	Other	39,016	28,945	6,085	318	26,685	15,228	14,209	6,885	2,216	9,953	3,023	9,872	8,126	48,213	872	21,858	7,276	12,691	14,517
34	Labour	39,970	26,693	17,831	2,643	10,085	45,162	96,105	16,929	4,532	16,409	6,954	13,616	4,635	15,108	1,733	20,309	11,794	19,510	11,329
35	Capital	142,047	108,796	83,761	1,977	11,701	24,781	258,761	24,824	6,970	25,315	10,132	30,997	8,189	26,581	2,935	35,757	8,313	10,768	19,527
36	Land	62,752	109,184	84,020	1,084	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
37	PrdTax	3,665	3,562	2,758	83	250	1,053	4,690	660	183	659	269	699	193	629	69	846	381	492	584
38	Total	300,311	310,689	217,568	6,423	49,607	113,765	604,022	103,982	22,337	84,075	31,403	87,319	28,352	101,849	11,078	153,951	36,240	59,387	65,837

Table A4 (continued)

		20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
		BasIronSteel	NonFerrMetal	FabMetalPrd	OthMetalPrd	ElectroncPrd	Electricity	GasDist	RailTransprt	LandTransprt	SeaTransport	RiverTrnsprt	AirTransport	OthSvc	Other	Invest	HouseH	Export	GovGE	Stocks	Total
1	CoalLignite	517	725	911	822	1	11,894	481	1	-	-	-	-	-	828	-	-	292,939	-	-97	327,703
2	CrudeOil	-	-	-	-	-	65	6	-	-	-	-	-	-	250	-	-	184,804	-	-944	383,200
3	NaturalGas	5,105	6,835	1,554	1,700	-	21,079	5,999	-	-	-	-	-	-	372	-	-	55,397	-	-1	217,568
4	NonMetlMinrl	-	-	-	-	-	-	-	-	-	-	-	-	-	6,932	-	-	29	-	0	8,183
5	AnimalFeed	-	-	-	-	-	-	-	-	-	-	-	-	-	59,145	-	2,815	264	-	-408	62,587
6	OthNMmetlPrd	640	786	216	90	161	13	-	-	-	-	-	-	100	118,763	-	6,032	2,354	-	-78	141,372
7	OilAndGasRef	1,765	1,857	642	653	396	37,595	1,402	815	65,752	17,455	3,892	34,516	337	198,746	-	187,980	225,967	-	-500	807,724
8	BasChemicals	6,978	8,649	2,695	3,031	1,375	80	2	-	12	3	-	1	657	61,679	-	4,221	62,192	-	0	224,855
9	Fertilizer	-	-	-	-	3	-	-	-	-	-	-	-	-	96	-	1,423	12,195	-	-10	13,972
10	Plastics	7	10	508	583	5,200	-	-	-	-	-	-	-	82	28,939	-	-	25,400	-	-682	123,953
11	OthChemPrd	166	143	822	136	637	218	3	8	47	30	10	1	684	29,069	-	13,323	15,467	-	-86	65,738
12	Pharmaceutcl	25	30	1	3	190	1	1	2	105	76	50	12	758	19,480	-	81,046	3,948	-	-632	123,663
13	Tire	4	5	-	5	2	5	1	-	5,736	1	15	1,724	2	6,214	-	3,875	21,560	-	-90	41,159
14	SmokedRubber	-	1	-	27	1	-	-	-	-	-	-	-	-	519	-	-	93,186	-	-800	107,571
15	OthRubberPrd	-	-	2	7	6	11	-	2	16	89	56	-	67	7,109	-	5,632	8,365	-	-71	22,955
16	PlasticPrd	1	-	122	202	3,761	6	-	6	242	73	41	17	635	92,105	3,493	91,308	19,987	-	-372	219,915
17	Glass	2	3	-	95	67	-	-	98	497	75	-	-	435	34,280	111	13,379	6,502	-	-38	56,833
18	ClayCermcPrd	1	2	-	2	110	-	-	-	-	-	-	-	174	41,592	174	25,793	5,706	-	-94	75,734
19	Cement	2	4	21	17	-	-	-	-	-	-	-	-	-	74,209	-	1,515	1,568	-	-169	79,810
20	BasIronSteel	12,685	19,716	13,096	13,865	313	1	-	-	-	-	-	-	-	126,224	-	-	27,240	-	-1,589	216,638
21	NonFerrMetal	1,831	2,710	4,205	3,756	573	-	-	-	-	-	-	-	-	69,783	-	-	109,355	-	-939	192,330
22	FabMetalPrd	-	492	43	279	8	-	-	-	-	-	-	-	-	108,310	-	-	5,131	-	-120	116,604
23	OthMetalPrd	73	511	106	1,703	182	21	-	41	580	88	55	-	815	96,733	1,230	557	12,010	-	-409	116,404
24	ElectroncPrd	3	127	1,105	1,086	44,075	1,342	-	49	679	-	-	1	370	64,393	92,573	296,277	93,566	-	-987	595,855
25	Electricity	554	743	535	514	1,025	122,923	13	369	190	61	123	40	553	28,823	-	44,735	-	-	-15	206,421
26	GasDist	951	1,297	870	829	1,038	5,315	73	-	590	-	-	-	4	10,689	-	495	-	-	0	27,992
27	RailTransprt	1	2	-	1	-	1	-	1	-	-	-	-	1	729	-	5,469	-	-	0	6,518
28	LandTransprt	392	330	234	210	272	862	89	10	934	173	10	-	4	48,782	-	197,092	-	-	-3	253,725
29	SeaTransport	22	1	-	-	-	1	-	1	32	2	1	-	4	3,988	-	22,184	-	-	-1	29,842
30	RiverTrnsprt	4	1	8	7	-	7	1	-	413	-	-	-	1	3,149	-	12,149	-	-	0	16,461
31	AirTransport	115	87	56	67	190	78	6	3	232	180	14	1,767	95	21,791	-	145,335	10,305	-	-1	183,016
32	OthSvc	-	-	1	1	-	-	-	-	168	-	-	5	25,165	2,134	-	105,350	768	-	-1	134,919
33	Other	36,714	48,518	13,856	9,492	48,345	10,976	916	1,771	35,107	18,706	4,391	39,180	9,517	2,815,299	2,690,125	5,353,894	1,142,790	2,118,056	-36,282	14,637,357
34	Labour	10,548	10,570	14,618	13,702	29,826	28,009	5,610	3,656	87,592	11,912	6,812	37,021	59,932	4,041,432	-	-	-	-	-	4,742,589
35	Capital	34,540	36,928	25,491	25,587	38,107	81,588	13,095	592	122,168	19,048	4,343	32,968	31,230	4,356,130	-	-	-	-	-	5,663,945
36	Land	-	-	-	-	-	-	-	-	-	-	-	-	-	347,515	-	-	-	-	-	604,555
37	PrdTax	619	651	537	529	1,205	1,461	267	55	2,650	399	149	910	916	120,041	-	-	-	-	-	152,116
38	Total	114,267	141,735	82,254	79,003	177,073	323,552	27,964	7,481	323,741	68,373	19,962	148,163	132,539	13,046,273	2,787,706	6,621,880	2,438,993	2,118,056	-45,423	31,001,785

Table A5. Modified CGE database valued at purchasers' price (2015), billion Rp

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		AgricForFish	CoalLignite	CrudeOil	NaturalGas	NonMetlMinrl	OthMining	FoodProc	AnimalFeed	BevTobac	TCF	WoodPaper	PetrolRefine	GasRefine	BasChemicals	Fertilizer	Plastics	OthChemPrd	Pharmaceutcl	RubberPrd
1	AgricForFish	56,197	50	-	-	3	14	554,819	17,940	14,302	13,092	38,093	80	21	186	-	1,360	8,538	3,417	51,610
2	CoalLignite	-	3,301	7	1	24	-	1	-	-	19	-	798	210	20	3	70	10	-	-
3	CrudeOil	-	-	-	-	-	-	-	-	-	-	-	207,110	-	-	-	-	-	-	-
4	NaturalGas	-	-	-	-	-	-	-	-	-	-	-	-	91,924	7,446	13,330	-	-	-	23
5	NonMetlMinrl	-	14,043	3,147	100	171	5,515	1,385	-	1	1	-	-	-	142	2	166	23	207	12
6	OthMining	3	5	-	-	309	2,514	5	-	73	38	32	39	10	2,634	786	3,095	5,865	248	5
7	FoodProc	843	194	323	116	2	263	182,833	8,503	15,779	3,779	795	394	104	735	149	1,295	1,584	998	76
8	AnimalFeed	58,451	-	-	-	-	-	-	711	-	-	-	-	-	2	-	-	-	59	-
9	BevTobac	20	1	-	-	-	1	699	11	28,678	5	1	5	1	31	3	17	14	95	4
10	TCF	944	220	142	16	9	67	218	-	115	84,685	527	2	-	14	8	141	82	431	399
11	WoodPaper	554	165	1,132	135	15	154	274	3	6,192	764	83,184	30	8	60	22	252	237	476	460
12	PetrolRefine	6,406	3,667	25,517	19,181	709	5,347	1,988	5	1,214	3,211	5,179	3,711	3,081	18,155	2,150	2,098	5,061	2,943	886
13	LPG	1,057	596	2,954	2,176	115	880	309	1	194	510	948	108	88	2,115	244	344	649	385	137
14	LNG	183	111	1,519	1,170	22	154	69	-	39	104	89	55	47	1,073	131	61	262	147	31
15	BasChemicals	1,660	619	103	28	165	4,353	2,878	83	1,974	9,065	8,936	221	58	22,912	2,130	17,762	12,682	6,047	4,450
16	Fertilizer	128	-	-	-	-	-	8	-	-	-	1	-	-	4	49	-	207	7	56
17	Plastics	-	-	-	-	-	-	36	16	5	13,639	2,569	28	7	148	120	9,430	483	2,583	4,004
18	OthChemPrd	5,542	698	8	1	706	2,555	262	53	264	977	7,014	162	43	122	270	360	1,774	406	698
19	Pharmaceutcl	923	1	9	1	2	20	801	24	71	114	4	15	4	131	-	8	111	17,908	293
20	RubberPrd	72	15	21	10	2	16	22	8	16	371	38	2	-	7	-	32	22	19	11,330
21	PlasticPrd	1,060	8	7	-	7	34	119	1	83	1,732	1,053	35	9	352	-	250	436	136	36
22	Glass	10	-	-	-	-	-	1	-	3	51	177	-	-	-	-	-	-	35	-
23	ClayCermcPrd	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	Cement	-	-	-	-	-	-	-	-	-	-	25	1	-	2	-	9	6	-	3
25	OthNMmetlPrd	-	6	-	-	1	327	316	1	5	1,264	1,831	522	137	35	38	299	270	42	173
26	BasIronSteel	-	-	-	-	-	-	-	-	-	6	81	-	-	-	48	-	91	-	12
27	NonFerrMetal	-	-	-	-	-	-	440	-	44	169	1,175	2	1	-	2	-	3	1	174
28	OthMetalPrd	1,143	1	5	-	35	99	548	27	6	776	841	339	89	4	-	94	68	1	180
29	ElectroncPrd	-	2	306	19	68	173	1	-	-	1	8	24	6	2	-	1	18	509	7
30	OthManufact	345	176	593	74	11	186	626	1	137	384	258	331	87	34	19	13	570	1	50
31	Electricity	298	121	605	56	2	85	1,400	3	355	1,976	2,224	673	177	68	78	391	238	248	558
32	GasDist	-	-	-	-	1	3	852	2	640	1,496	1,211	145	38	115	135	669	409	181	659
33	WaterWaste	69	25	335	11	1	33	403	1	175	388	396	19	5	3	1	117	19	223	95
34	Construction	10,466	2,559	3,220	530	679	3,981	92	-	742	125	134	603	158	34	-	-	1	3	2
35	Trade	1,919	586	122	38	282	1,242	359	-	118	97	195	3	1	15	-	13	3	31	19
36	Transprt	470	3,885	2,365	513	451	2,728	365	3	1,085	718	3,732	1,846	485	26	12	145	82	393	191
37	GovSvc	767	368	1,062	116	5	70	248	1	417	308	382	362	95	101	20	111	102	158	212
38	OthSvc	12,570	13,067	14,087	3,207	710	4,688	12,247	158	10,916	12,520	14,712	6,569	1,724	2,523	309	2,580	3,386	4,251	3,042
39	Other	4,460	7,337	4,842	1,816	574	9,373	2,944	6	1,287	3,543	5,120	3,041	798	431	104	457	953	554	1,280
40	Labour	749,837	39,990	26,893	18,115	19,934	76,157	258,834	10,087	66,673	77,454	74,650	76,957	20,200	17,256	2,925	16,425	18,743	13,986	21,485
41	Capital	367,496	142,116	109,613	85,096	16,645	118,645	360,566	11,703	94,459	125,520	122,280	207,204	54,388	25,303	4,498	25,339	27,279	31,853	37,720
42	Land	280,892	62,782	110,004	85,359	8,922	56,375	-	-	-	-	-	-	-	-	-	-	-	-	-
43	OCT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44	PrdTax	19,254	3,667	3,589	2,802	663	3,556	7,113	250	1,907	2,682	2,666	3,755	986	673	118	660	719	718	892
45	Total	1,583,784	300,380	312,531	220,687	51,247	299,608	1,394,083	49,605	247,971	361,585	380,563	515,188	174,989	102,916	27,706	84,062	91,002	89,702	141,263

Table A5. (continued)

		20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
		PlasticPrd	Glass	ClayCermcPrd	Cement	OthNMmetlPrd	BasIronSteel	NonFerrMetal	OthMetalPrd	ElectroncPrd	OthManufact	Electricity	GasDist	WaterWaste	Construction	Trade	Transprt	GovSvc	OthSvc	Other
1	AgricForFish	14,621	162	377	56	662	-	-	57	-	1,839	-	-	-	48,046	133	435	8,922	74,385	71
2	CoalLignite	-	1,658	2,839	5,848	3,902	523	732	1,798	1	60	12,138	500	-	-	-	3	-	156	508
3	CrudeOil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	NaturalGas	828	54	798	764	1,039	3,774	5,051	2,518	-	73	15,737	4,569	-	-	-	-	-	-	73
5	NonMetlMinrl	66	99	1,348	190	89	847	26	48	20	95	-	-	-	6,964	98	-	-	930	53
6	OthMining	1,340	4,528	6,232	8,707	2,124	27,707	40,054	12,402	99	787	-	-	-	100,067	-	-	-	42	477
7	FoodProc	33	38	41	73	62	146	150	107	208	268	111	52	34	905	853	5,262	14,453	108,959	534
8	AnimalFeed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52	-	-	630	-
9	BevTobac	3	1	1	2	2	-	-	2	4	6	-	-	-	23	57	228	40	8,044	2
10	TCF	372	2	42	51	96	22	32	659	50	2,701	154	3	2	3,717	2,983	138	3,634	2,643	384
11	WoodPaper	204	121	1,410	252	5,080	111	148	184	2,490	12,492	42	2	2	110,569	23,565	171	45,943	31,128	1,335
12	PetrolRefine	3,139	672	1,475	1,278	5,512	1,497	1,565	1,138	393	1,070	32,083	1,223	39	78,194	41,533	121,592	9,264	8,399	2,638
13	LPG	374	105	228	199	734	171	241	146	61	154	4,789	182	7	11,293	4,887	492	1,065	1,029	401
14	LNG	180	23	52	44	268	90	55	59	13	45	1,234	47	1	3,247	2,423	93	556	464	97
15	BasChemicals	6,145	1,638	1,493	3,130	1,477	7,032	8,711	5,999	1,657	2,182	81	2	888	9,243	249	17	4,616	4,808	2,012
16	Fertilizer	40	7	5	13	6	-	-	1	4	-	-	-	-	64	-	-	45	6	8
17	Plastics	46,958	75	66	149	66	7	10	1,126	6,241	1,775	-	-	-	217	82	-	1,832	1,030	6,552
18	OthChemPrd	600	342	408	1,052	1,113	183	168	1,420	969	2,763	223	3	5	31,568	3,392	248	4,913	7,845	2,518
19	Pharmaceutcl	325	2	5	5	9	25	30	5	232	10	1	1	-	251	48	249	9,885	8,571	96
20	RubberPrd	6,803	6	44	11	103	5	7	46	9	192	16	1	2	4,077	2,235	7,977	175	1,216	5,132
21	PlasticPrd	7,280	13	133	24	11	1	-	332	4,489	3,830	6	1	2	58,658	13,261	394	2,521	5,101	4,086
22	Glass	239	245	238	403	167	2	3	98	84	204	-	-	-	31,343	71	671	1,151	1,407	280
23	ClayCermcPrd	1	373	865	728	303	1	2	2	110	91	-	-	-	39,851	-	-	32	1,723	17
24	Cement	-	534	613	1,054	431	2	4	39	-	82	-	-	-	74,366	-	-	-	-	5
25	OthNMmetlPrd	389	1,227	613	3,145	5,559	645	792	320	161	546	13	-	5	111,488	30	-	1,293	998	405
26	BasIronSteel	-	-	1,842	-	3,063	12,735	19,884	27,826	371	1,705	1	-	-	117,021	-	-	-	-	6,233
27	NonFerrMetal	-	39	-	133	696	1,848	2,733	8,186	671	3,099	-	-	-	61,354	-	-	-	110	2,943
28	OthMetalPrd	526	291	1,598	422	2,141	225	1,231	3,166	634	3,510	213	-	15	186,871	8,489	827	970	6,027	3,236
29	ElectroncPrd	1	11	86	8	259	194	452	3,418	64,645	909	1,370	-	51	14,697	5,711	778	987	20,819	24,142
30	OthManufact	51	12	20	24	71	69	73	89	261	1,544	75	110	15	3,642	2,326	2,566	3,723	11,197	343
31	Electricity	599	313	241	601	271	554	743	1,082	1,216	922	1,241	13	349	2,126	5,778	1,277	3,110	7,099	2,510
32	GasDist	706	583	511	1,122	518	941	1,283	1,734	1,223	968	5,310	74	2	1,706	4	681	87	586	2,384
33	WaterWaste	103	95	84	183	86	2,198	2,911	306	124	94	155	1	618	416	1,463	236	138	1,670	309
34	Construction	2	506	428	973	429	502	239	60	4	48	21	189	42	6,264	11,979	4,148	9,019	18,343	137
35	Trade	21	16	47	32	86	108	93	56	24	153	226	23	10	2,868	6,547	8,759	6,004	5,037	329
36	Transprt	200	237	805	456	977	552	426	608	561	1,040	973	102	162	14,871	19,912	28,931	23,830	9,118	1,638
37	GovSvc	231	23	84	45	170	65	83	108	200	147	81	1	99	5,554	1,719	1,348	2,458	9,126	885
38	OthSvc	3,154	1,063	2,804	2,047	4,035	2,184	2,517	2,988	5,482	8,240	7,107	425	253	79,595	101,265	34,594	86,938	225,527	15,514
39	Other	1,274	604	510	1,637	772	2,628	1,898	4,951	36,881	4,332	3,036	146	292	46,516	16,856	31,147	5,441	19,469	188,704
40	Labour	20,352	11,810	19,590	11,252	45,313	10,667	10,685	29,641	37,565	32,659	28,605	5,845	3,617	569,663	613,537	173,348	721,039	667,374	127,247
41	Capital	35,833	8,323	10,812	19,395	24,864	34,929	37,327	53,648	45,518	38,344	83,325	13,644	24,518	698,040	585,975	202,459	77,026	1,478,958	232,351
42	Land	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,502
43	OCT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44	PrdTax	848	381	494	580	1,057	626	658	1,118	1,475	951	1,492	279	107	17,302	14,870	4,814	151	43,056	5,386
45	Total	153,843	36,235	59,279	66,089	113,621	113,817	141,017	167,492	214,154	129,934	199,860	27,438	31,136	2,552,660	1,492,383	633,885	1,051,261	2,793,031	644,477

Table A5 (continued)

		39	40	41	42	43	44
		Invest	HouseH	Export	GovGE	Stocks	Total
1	AgricForFish	310,479	653,648	55,999	-	- 10,776	1,918,839
2	CoalLignite	-	-	292,698	-	- 97	327,731
3	CrudeOil	-	-	182,345	-	- 944	388,511
4	NaturalGas	-	-	53,994	-	- 1	201,995
5	NonMetlMinrl	18,908	-	31	-	- 6	54,725
6	OthMining	-	-	108,610	-	- 517	328,322
7	FoodProc	-	1,238,030	257,643	29,936	- 9,575	1,867,087
8	AnimalFeed	-	2,814	264	-	- 408	62,574
9	BevTobac	-	431,613	9,318	-	- 2,223	476,713
10	TCF	5,177	256,630	186,366	-	- 3,152	550,726
11	WoodPaper	3	30,863	131,560	-	- 649	491,144
12	PetrolRefine	-	177,332	84,122	-	- 481	684,186
13	LPG	-	6,936	-	-	- 13	47,292
14	LNG	-	1,506	148,103	-	- 7	163,862
15	BasChemicals	-	4,217	61,642	-	-	223,366
16	Fertilizer	-	1,519	15,126	-	- 10	17,039
17	Plastics	-	-	25,379	-	- 682	123,952
18	OthChemPrd	-	54,369	30,755	-	- 113	166,660
19	Pharmaceutcl	-	83,014	5,173	-	- 635	127,742
20	RubberPrd	-	9,504	123,068	-	- 962	171,671
21	PlasticPrd	3,490	91,184	19,956	-	- 372	219,762
22	Glass	111	13,361	6,492	-	- 38	56,809
23	ClayCermcPrd	174	25,733	5,692	-	- 94	75,604
24	Cement	-	1,519	1,572	-	- 169	80,098
25	OthNMmetlPrd	-	6,019	2,348	-	- 78	141,185
26	BasIronSteel	-	-	27,041	-	- 1,589	216,369
27	NonFerrMetal	-	-	108,727	-	- 939	191,613
28	OthMetalPrd	11,049	5,575	21,602	-	- 530	262,344
29	ElectroncPrd	117,708	313,519	110,634	-	- 1,288	680,260
30	OthManufact	42,387	65,877	43,608	-	- 1,166	180,812
31	Electricity	-	44,240	-	-	- 15	83,825
32	GasDist	-	485	-	-	-	27,466
33	WaterWaste	-	32,166	1,029	639	- 17	47,326
34	Construction	1,483,992	-	4,808	1,067,358	- 6,222	2,626,599
35	Trade	-	153,415	-	-	- 13	188,889
36	Transprt	-	409,748	10,302	-	- 6	544,938
37	GovSvc	379	32,155	8,720	999,762	- 8	1,068,338
38	OthSvc	98,016	2,083,483	156,888	19,584	- 31	3,066,939
39	Other	697,028	386,986	140,400	-	- 1,596	1,638,833
40	Labour	-	-	-	-	-	4,746,410
41	Capital	-	-	-	-	-	5,673,011
42	Land	-	-	-	-	-	606,836
43	OCT	-	-	-	-	-	-
44	PrdTax	-	-	-	-	-	152,315
45	Total	2,788,900	6,617,463	2,442,015	2,117,279	- 45,423	30,970,718

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