

Saudi Arabia

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1. Abstract

This paper describes the production of a 31-sector input-output table for the Kingdom of Saudi Arabia for 2005.

The I-O table was developed by combining disaggregated national accounts and trade data for Saudi Arabia with a 44-sector I-O table for Kuwait. For major sectors, (e.g. oil and gas and refining) inputs were adjusted to reflect 2005 relative production and processing levels.

The completed I-O table is in thousand Saudi riyals (SAR), at producer prices.

2. Source Data

Three key sources of data were used to produce the input-output table:

- A 44-sector I-O table for 2005 for Kuwait, developed for use in GTAP in 2011.
- National Accounts Data 2005, Central Department of Statistics and Information, Saudi Ministry of Economy and Planning
- The National Accounts Statistics 2005, Kuwait Central Statistical Office
- UN trade data (Comtrade) for imports and exports.

In addition, various data on specific sectors was also used (e.g. refining capacity, crude oil production, etc.).

2.1 2005 I-O Table

The Kuwait 2005 44-sector I-O table was developed by the author for use in GTAP. The table was constructed from a detailed 54-sector I-O table for 2000, in combination with a 29-sector I-O table for 2005 and detailed national accounts.

The final table comprised a matrix of 44 input sectors (listed in Table 1) together with labour and capital inputs. Final demand was disaggregated by investment, private household consumption, government consumption, changes in stocks and exports.

Table 1

44 I/O Sectors	
No. Description	No. Description
1 Agriculture & livestock	23 Manufacture of other transport equipment N.E.C.
2 Fishing	24 Manufacture of furniture
3 Extraction of crude petroleum & natural gas	25 Manufacture, N.E.C.
4 Service activities incidental to oil & gas extraction excluding surveying	26 Recycling
5 Other mining & quarrying	27 Electricity & gas
6 Manufacture of food products & beverages	28 Water works & supply
7 Manufacture of textiles	29 Construction
8 Manufacture of wearing apparel, dressing & dyeing of fur	30 Wholesale & retail trade
9 Tanning & dressing of leather, manufacture of luggage, hand bags, saddlery & harness	31 Restaurants & hotels
10 Manufacture of wood & cork products, except furniture and articles of straw	32 Transport & storage
11 Manufacture of paper & paper products	33 Communication
12 Publishing, printing & reproduction of recording media	34 Financial institutions
13 Manufacture of coke, refined petroleum products & nuclear fuel	35 Insurance
14 Manufacture of chemical & chemical products	36 Real estate
15 Manufacture of rubber & plastic products	37 Business services
16 Manufacture of other non-metallic mineral products	38 Sanitary services
17 Manufacture of basic metals	39 Educational services
18 Manufacture of fabricated metal products, except machinery & equipment	40 Medical & health services
19 Manufacture of machinery & equipment	41 Social & community services
20 Manufacture of electric machinery & apparatus	42 Recreational & cultural services
21 Manufacture of medical, precision & optical instruments, watches & clocks	43 Personal & household services
22 Manufacture of motor vehicles, trailers & semitrailers	44 Public administration & defense

2.2 *National Accounts Data 2005*

The Saudi Central Department of Statistics and Information (part of the Ministry of Economy and Planning) provide national accounts data disaggregated into the following eleven sectors:

- Agriculture
- Petroleum and mining
- Manufacturing
- Electricity, gas and water
- Construction
- Wholesale and retail trade, hotels and restaurants
- Transport, Communication and Storage

- Finance and Insurance services
- Real estate services
- Government services
- Other services.

The national accounts data also includes aggregate statistics on:

- Gross fixed capital formation
- Total private consumption
- Total public consumption
- Total operating surplus
- Compensation of employees by sector.

3. *Process*

The 2005 I-O table for Kuwait was used as a template for the Saudi I-O table. This table was then developed as follows:

- Saudi GDP sector ratios were applied
- Saudi trade data was added
- Some elements were set to zero
- The table was balanced
- The table was mapped to GTAP sectors.

3.1 *Applying GDP Sector Ratios*

As a first step each of the 44 I-O sectors was matched against one of the eleven GDP sectors (see Table 2). The inputs into each of the 44 sectors are then multiplied by the ratio of Saudi to Kuwaiti GDP for the associated sector, taking into account differences in the exchange rate.

These multipliers were subject to an initial reality check as they were applied. For example, the contribution of the construction sector to Saudi GDP is 9.8 times greater than that for Kuwait. While the Saudi population is around 24.6 times greater than that of Kuwait, household sizes are larger and per capita GDP is much lower (Saudi per capita GDP was around 41% of the Kuwaiti level in 2005). A multiplier of 9.8 then seems plausible. Inputs into the construction sector, (as given in the Kuwaiti I-O table) were then multiplied by 9.8 to provide an initial estimate of inputs into the Saudi construction sector.

The relative sectoral breakdown was also applied to final demand for investment, private consumption and public consumption, as well as inputs of labour and capital into each sector.

Table 2

Concordance: 11 GDP Sectors TO 44-Sector I/O			
11 GDP Sectors		44 I/O Sectors	
No.	Description	No.	Description
1	Agriculture	1	Agriculture & livestock
		2	Fishing
2	Petroleum and mining	3	Extraction of crude petroleum & natural gas
		4	Service activities incidental to oil & gas extraction excluding surveying
		5	Other mining & quarrying
3	Manufacturing	6	Manufacture of food products & beverages
		7	Manufacture of textiles
		8	Manufacture of wearing apparel, dressing & dyeing of fur
		9	Tanning & dressing of leather, manufacture of luggage, hand bags, saddlery & harness
		10	Manufacture of wood & woodwork products, except furniture manufacture of article of straw
		11	Manufacture of paper & paper products
		12	Publishing, printing & reproduction of recording media
		13	Manufacture of coke, refined petroleum products & nuclear fuel
		14	Manufacture of chemical & chemical products
		15	Manufacture of rubber & plastic products
		16	Manufacture of other non-metallic mineral products
		17	Manufacture of basic metals
		18	Manufacture of fabricated metal products, except machinery & equipment
		19	Manufacture of machinery & equipment
		20	Manufacture of electric machinery & apparatus
		21	Manufacture of medical, precision & optical instruments, watches & clocks
		22	Manufacture of motor vehicles, trailers & semitrailers
		23	Manufacture of other transport equipment N.E.C.
		24	Manufacture of furniture
		25	Manufacture, N.E.C.
		26	Recycling
4	Electricity, gas and water	27	Electricity & gas
		28	Water works & supply
5	Construction	29	Construction
6	Wholesale and retail trade, hotels and restaurants	30	Wholesale & retail trade
		31	Restaurants & hotels
7	Transport, communication and storage	32	Transport & storage
		33	Communication
8	Finance and insurance services	34	Financial institutions
		35	Insurance
9	Real estate services	36	Real estate
11	Other services	37	Business services
		38	Sanitary services
		39	Educational services
		40	Medical & health services
		41	Social & community services
		42	Recreational & cultural services
		43	Personal & household services
10	Government services	44	Public administration & defense

3.2 Applying Trade Data

Detailed Saudi trade data for 2005 was taken from Comtrade. The trade data was reported in HS-2002 nomenclature and mapping between HS-2002 and the 44 sectors in the I-O table followed the “HS2002-CPC 1.1-ISC, Rev3-GTAP Concordance” by Thomas Hutcheson¹.

The trade data was then mapped into the 44 I-O sectors using the concordance detailed in Table 3. While most of the GTAP sectors mapped discreetly into the 44 I-O sectors, the following splits had to be made:

- GTAP sectors 15 “coal,” 16 “oil” and 17 “gas” were matched against sectors 3 “extraction of crude petroleum and natural gas” and 4 “service activities incidental to oil and gas extraction excluding surveying.” The split between the two sectors was according to relative shares of total intermediate inputs (from the Kuwait I-O table).
- GTAP sector 31 “paper products, publishing” was split between sector 11 “manufacture of paper and paper products” and sector 12 “publishing, printing and reproduction of recording media” according to relative shares of total intermediate inputs.
- GTAP sector 42 “manufactures, nec” was split between sectors 21 “manufacture of medical, precision and optical instruments, watches and clocks,” 24 “manufacture of furniture,” 25 “manufacture, nec” and 26 “recycling” according to relative shares of total intermediate inputs.
- GTAP sector 47 “trade” was split between sectors 30 “wholesale and retail trade” and 31 “restaurants and hotels” according to relative shares of total intermediate inputs.
- GTAP sector 55 “recreational and other services” was split between sectors 42 “recreational and cultural services” and 43 “personal and household services” according to relative shares of total intermediate inputs.
- GTAP sector 56 “public administration, defence, education, health” was split between sectors 38 “sanitary services,” 39 “educational services,” 40 “medical and health services,” 41 “social and community services” and 44 “public administration and defence” according to relative shares of total intermediate inputs.

3.3 Zero Settings

The other components of final demand, notably import taxes, import tariffs and consumption taxes were left blank, as no data was available for either Kuwait or Saudi Arabia.

Other factors inputs (e.g. land) and changes in stock were also set to zero.

¹ https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=1916

Table 3

Concordance: 57 GTAP Sectors to 44 I/O Sectors			
57 GTAP Sectors		44 I/O Sectors	
No. Code	Description	No.	Description
1 PDR	Paddy rice	1	Agriculture and livestock
2 WHT	Wheat		
3 GRO	Cereal grains nec		
4 V F	Vegetables, fruit, nuts		
5 OSD	Oil seeds		
6 C B	Sugar cane, sugar beet		
7 PFB	Plant-based fibers		
8 OCR	Crops nec		
9 CTL	Bovine cattle, sheep and goats, horses		
10 OAP	Animal products nec		
11 RMK	Raw milk		
12 WOL	Wool, silk-worm cocoons		
13 FRS	Forestry		
14 FSH	Fishing	2	Fishing
15 COA	Coal	3	Extraction of crude petroleum and natural gas
16 OIL	Oil		
17 GAS	Gas	4	Service activities incidental to oil and gas extraction excluding surveying
18 OMN	Minerals nec	5	Other mining & quarrying
19 CMT	Bovine meat products	6	Manufacture of food products and beverages
20 OMT	Meat products nec		
21 VOL	Vegetable oils and fats		
22 MIL	Dairy products		
23 PCR	Processed rice		
24 SGR	Sugar		
25 OFD	Food products nec		
26 B T	Beverages and tobacco products		
27 TEX	Textiles	7	Manufacture of textiles
28 WAP	Wearing apparel	8	Manufacture of wearing apparel, dressing and dyeing of fur
29 LEA	Leather products	9	Tanning and dressing of leather, manufacture of luggage, hand bags, saddlery and harness
30 LUM	Wood products	10	Manufacture of wood & of products of wood crok, except furniture manufacture of article of straw
31 PPP	Paper products, publishing	11	Manufacture of paper and paper products
32 P_C	Petroleum, coal products	12	Publishing, printing and reproduction of recording media
		13	Manufacture of coke, refined petroleum products and nuclear fuel
33 CRP	Chemical, rubber, plastic products	14	Manufacture of chemical and chemical products
34 NMM	Mineral products nec	15	Manufacture of rubber and plastic products
		16	Manufacture of other non-metallic mineral products
35 I S	Ferrous metals	17	Manufacture of basic metals
36 NFM	Metals nec	18	Manufacture of fabricated metal products, except machinery and equipment
37 FMP	Metal products		

Continued....			
57 GTAP Sectors		44 I/O Sectors	
No. Code	Description	No.	Description
38 MVH	Motor vehicles and parts	22	Manufacture of motor vehicles, trailers and semitrailers
39 OTN	Transport equipment nec	23	Manufacture of other transport equipment, n.e.c.
40 ELE	Electronic equipment	20	Manufacture of electric machinery and apparatus
41 OME	Machinery and equipment nec	19	Manufacture of machinery and equipment
42 OMF	Manufactures nec	21	Manufacture of medical, precision and optical instruments, watches and clocks
		24	Manufacture of furniture
		25	Manufacture, n.e.c.
		26	Recycling
43 ELY	Electricity	27	Electricity and gas
44 GDT	Gas manufacture, distribution		
45 WTR	Water	28	Water works and supply
46 CNS	Construction	29	Construction
47 TRD	Trade	30	Wholesale and retail trade
		31	Restaurants and hotels
48 OTP	Transport nec	32	Transport and storage
49 WTP	Water transport		
50 ATP	Air transport		
51 CMN	Communication	33	Communication
52 OFI	Financial services nec	34	Financial institutions
53 ISR	Insurance	35	Insurance
54 OBS	Business services nec	37	Business services
57 DWE	Dwellings	36	Real estate
55 ROS	Recreational and other services	42	Recreational & cultural services
		43	Personal and household services
56 OSG	Public Administration, Defense, Education, Health	44	Public administration and defence
		38	Sanitary services
		39	Educational services
		40	Medical and health services
		41	Social and community services

3.4 *Balancing the Table*

Each of the input sectors was then balanced in turn (by row), from sector 1 through 44. Though as the sectors are connected, some sectors had to be adjusted several times.

The adjustments focussed on ensuring that the following balancing criteria were met:

- Imports do not exceed domestic demand
- Exports do not exceed domestic production
- Sum of rows = sum of columns

To meet the criteria and balance the table, adjustments were made to:

- The multiplier for inputs into the sector (e.g. the 9.8 given for construction in the example above)
- The multiplier the components of final demand
- The level of labour and capital inputs.

The adjustments made took into account a number of factors including differences in the resource base and industrialisation in the Kuwait and Saudi Arabia. Also, where relevant, levels of final consumption (per capita) were checked to see if they remained in line with relative per capita GDP.

The final detailed balancing of the table rows and columns was achieved through micro adjustments to the multiples used for the components of final demand.

The key adjustments made in balancing the I-O table were as follows:

- Extraction of crude petroleum: raised overall input/output in the sector to ensure that export requirements were met, and set inputs into the refining sector in relation to Saudi and Kuwait's relative refining throughputs.
- Service activities incidental to oil and gas extraction: adjusted (downwards) the split in oil and gas trade between services and products to reflect limited actual exports of services and high dependence on imports of services.
- Other mining and quarrying: raised overall inputs as the sector is more developed in Saudi Arabia, with a wide range of natural resources.
- Raised the multiple for final household demand to bring final consumption per capita to 85% of Kuwaiti levels (reflecting lower per capita GDP).
- Manufacture of chemicals: raised inputs into the sector by 100% to reflect higher level of development in Saudi Arabia.
- Manufacture of rubber and plastics: raised inputs into the sector by 200% to reflect much higher level of development in Saudi Arabia.
- Manufacture of machinery and equipment: increased inputs into the oil and gas sector to reflect high level of development.
- Manufacture of electrical machinery and equipment: increased all inputs by 150% to reflect substantially high development of the sector
- Manufacture of motor vehicles: increased all inputs into the sector to reflect higher level of development (e.g. truck assembly plant in Jeddah).
- Manufacture of other transport equipment: increased all inputs into the sector by 200% to reflect higher levels of development, specifically with vehicle superstructures.

3.5 Mapping to GTAP

As a final step, the 44 I-O sectors were then mapped to a final set of 32 GTAP sectors, as detailed in Table 4.

With reference to the GTAP sectors, it should be noted that the following sectors are either non-existent in Saudi Arabia or where they do exist they are insignificant economically:

5	OSD	Oil seeds
6	CB	Sugar cane
7	PFB	Plant-based fibres
12	WOL	Wool, silkworm cocoons
13	FRS	Forestry
15	COA	Coal

Table 4

Concordance: Kuwait 44 I/O Sectors to Saudi 31 I/O Sectors		
Kuwait 44 I/O Sectors		Saudi 31 I/O Sectors
No.	Description	No. Code Description
1	Agriculture & livestock	1 A L Agriculture & livestock
2	Fishing	2 FSH Fishing
3	Extraction of crude petroleum & natural gas	3 O_G Extraction of crude petroleum & natural gas
4	Service activities incidental to oil & gas extraction excluding surveying	
5	Other mining & quarrying	4 OMN Other mining & quarrying
6	Manufacture of food products & beverages	5 F B Manufacture of food products & beverages
7	Manufacture of textiles	6 TEX Manufacture of textiles
8	Manufacture of wearing apparel, dressing & dyeing of fur	7 WAP Manufacture of wearing apparel, dressing & dyeing of fur
9	Tanning & dressing of leather, manufacture of luggage, h& bags, saddlery & harness	8 LEA Tanning & dressing of leather, manufacture of luggage, h& bags, saddlery & harness
10	Manufacture of wood, wood & cork products, except furniture manufacture of article of straw	9 LUM Manufacture of wood, wood & cork products, except furniture manufacture of article of straw
11	Manufacture of paper & paper products	10 PPP Manufacture of paper & paper products, publishing
12	Publishing, printing & reproduction of recording media	
13	Manufacture of coke, refined petroleum products & nuclear fuel	11 P_C Manufacture of coke, refined petroleum products & nuclear fuel
14	Manufacture of chemical & chemical products	12 CRP Manufacture of chemicals, rubber & plastic products
15	Manufacture of rubber & plastic products	
16	Manufacture of other non-metallic mineral products	13 NMM Manufacture of other non-metallic mineral products
17	Manufacture of basic metals	14 I S Manufacture of basic metals
18	Manufacture of fabricated metal products, except machinery & equipment	15 NFM Manufacture of fabricated metal products, except machinery & equip.
22	Manufacture of motor vehicles, trailers & semitrailers	19 MVH Manufacture of motor vehicles, trailers & semitrailers
23	Manufacture of other transport equipment, n.e.c.	20 OTN Manufacture of other transport equipment, n.e.c.
20	Manufacture of electric machinery & apparatus	17 ELE Manufacture of electric machinery & apparatus
19	Manufacture of machinery & equipment	16 OME Manufacture of machinery & equipment
21	Manufacture of medical, precision & optical instruments, watches & clocks	18 OMF Manufactures nec
24	Manufacture of furniture	
25	Manufacture, n.e.c.	
26	Recycling	
27	Electricity & gas	21 E_G Electricity & gas
28	Water works & supply	22 WTR Water works & supply
29	Construction	23 CNS Construction
30	Wholesale & retail trade	24 TRD Wholesale & retail trade, restaurants & hotels
31	Restaurants & hotels	
32	Transport & storage	25 T S Transport & storage
33	Communication	26 CMN Communication
34	Financial institutions	27 OFI Financial institutions
35	Insurance	28 ISR Insurance
37	Business services	29 OBS Real estate & other business services
36	Real estate	
42	Recreational & cultural services	31 ROS Recreational & cultural services
43	Personal & household services	
44	Public administration & defence	30 OSG Public administration, defence, education, health
38	Sanitary services	
39	Educational services	
40	Medical & health services	
41	Social & community services	