

Bahrain

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1. Abstract

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

The I-O table was developed by combining national accounts and trade data for Bahrain 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 Bahraini dinars (BHD), 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.
- General national accounts data for 2005, Central Informatics Organisation, Bahrain
- Detailed national accounts statistics 2006 and 2007, Central Informatics Organisation, Bahrain
- 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 IO 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 For 2005

The Bahraini Central Informatics Organisation publishes national accounts data that has been produced by the National Accounts Directorate. For all years up to 2007 (and including 2005), GDP data is disaggregated into the following eleven sectors and sub-sectors:

- Agriculture
- Petroleum and mining
- Manufacturing:
 - o Food industries
 - o Printing and paper industries
 - o Oil industry
 - o Other chemicals
 - o Aluminium industry
 - o Other metals

- o Building materials
 - o Other industries
- Electricity and water
- Construction
- Wholesale and retail trade, hotels and restaurants
- Transport, Communication and Storage
- Real estate services
- Finance and Insurance services
- Private education, health, personal and other services
- Government education, health, personal and other services.

In addition, the national accounts data also includes aggregate statistics on:

- Gross fixed capital formation
- Total depreciation
- Total private consumption
- Total public consumption
- Total operating surplus
- Total value of production
- Total value of inputs
- Total net indirect taxes
- Total wages and salaries.

2.3 National Accounts Data for 2006 and 2007

More detailed national accounts data is provided by the Central Informatics Organisation for 2006 and 2007. This data includes a matrix of the structure of GDP by sector. The sectors covered by the matrix are:

- Agriculture and fisheries
- Mining and quarrying, including petroleum
- Manufacturing
- Electricity and water
- Construction
- Wholesale and retail trade
- Hotels and restaurants
- Transport, Communication and Storage
- Social and personal services
- Real estate and business services
- Finance and Insurance services
- Not-for profit private sector activities

- Public administration
- Education services
- Health services.

For each of these sectors, GDP is disaggregated by:

- Value of production:
 - o Value of inputs
 - o Value added.
- Value added by income factors:
 - o Wages and salaries
 - o Depreciation
 - o Indirect tax
 - o Operating surplus.

3. *Process*

The 2005 I-O table for Kuwait was used as a template for the Bahrain I-O table.

This table was then developed as follows:

- Value added matrix for 2005 was estimated
- Initial estimation of I-O table
- Bahrain trade data was applied
- Some elements were set to zero
- The table was balanced
- The table was mapped to GTAP sectors.

3.1 *Estimation of 2005 Value Added Matrix*

A matrix of value added and inputs by sector was estimated for 2005, based on the 2006 matrix. For each sector, value added was reduced by the growth in GDP (2005 to 2006) reported for that sector.

In estimating 2005 from 2006 in this way it was assumed that the relative inputs of wages and salaries to operating surplus remained fixed.

The value added matrix estimates for 2005 then provided estimates of total intermediate inputs, wages and salaries, and capital inputs for the 15 sectors.

Table 2.

Concordance: Kuwait 44 I/O Sectors to Bahrain Value Added Sectors		
Kuwait 44 I/O Sectors		Bahrain VA Sectors
No.	Description	
1	Agriculture and livestock	Agriculture and fisheries
2	Fishing	
3	Extraction of crude petroleum and natural gas	Petroleum and mining
4	Service activities incidental to oil and gas extraction excluding surveying	
5	Other mining & quarrying	
6	Manufacture of food products and beverages	Manufacturing
7	Manufacture of textiles	
8	Manufacture of wearing apparel, dressing and dyeing of fur	
9	Tanning and dressing of leather, manufacture of luggage, hand bags, saddlery and harness	
10	Manufacture of wood & of products of wood crok, except furniture manufacture of article of straw	
11	Manufacture of paper and paper products	
12	Publishing, printing and reproduction of recording media	
13	Manufacture of coke, refined petroleum products and nuclear fuel	
14	Manufacture of chemical and chemical products	
15	Manufacture of rubber and plastic products	
16	Manufacture of other non-metallic mineral products	
17	Manufacture of basic metals	
18	Manufacture of fabricated metal products, except machinery & equipment	
22	Manufacture of motor vehicles, trailers and semitrailers	
23	Manufacture of other transport equipment, n.e.c.	
20	Manufacture of electric machinery and apparatus	
19	Manufacture of machinery and equipment	
21	Manufacture of medical, precision / optical instruments, watches & clocks	
24	Manufacture of furniture	
25	Manufacture, n.e.c.	
26	Recycling	
27	Electricity and gas	Electricity and water
28	Water works and supply	
29	Construction	Construction
30	Wholesale and retail trade	Wholesale and retail trade
31	Restaurants and hotels	Hotels and restaurants
32	Transport and storage	Transport, communication and storage
33	Communication	
34	Financial institutions	Finance and Insurance services
35	Insurance	
37	Business services	Real estate and business services
36	Real estate	
42	Recreational & cultural services	Social and personal services
43	Personal and household services	
44	Public administration and defence	Public administration
38	Sanitary services	Public administration
39	Educational services	Education services
40	Medical and health services	Health services
41	Social and community services	Social and personal services & not-for profit private sector

3.2 Initial Estimation of I-O Table

The 15-sector value added matrix was then used to provide the sub-totals for the 44-sector I-O table. To expand the matrix into the final 44-sector grid, the ratios from the Kuwait 44-sector table were used. These ratios were first applied to the missing sector totals for value added, and then to the disaggregation of inputs-outputs by sector.

The concordances between the 15 value added sectors and 44 sectors in the I-O table are given in Table 2.

3.3 Applying Trade Data

Detailed Bahraini 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-ISIC, Rev3-GTAP Concordance” by Thomas Hutcheson.¹

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.

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 Zero settings

The other components of final demand, notably import taxes, import tariffs and consumption taxes were left blank, as no detailed data was available for either Bahrain or Kuwait. While data on indirect taxes for 2006 was available for the 15 sectors for Bahrain, there was no corresponding breakdown for Kuwait that would support a sufficiently accurate disaggregation of indirect taxes across the final 44 sectors.

It should be noted that in general taxes are very low: income tax is between 1% and 3%, there is no sales tax or VAT, corporation tax is zero for most companies. In total, tax revenue amounts to less than 5% of GDP, which is one of the lowest levels worldwide.

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

3.5 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:

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

Regarding this last criterion, this was met in all sectors with the exception of the oil and gas extraction, and this issue is discussed further below.

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

- The multiplier for inputs into the sector
- The multiplier for the components of final demand
- Labour and capital input totals by sector

The adjustments made took into account a number of factors including differences in the resource base and industrialisation in the Kuwait and Bahrain (in general the Bahrain economy has a broader and more evenly developed industrial base than Kuwait, oil and gas production is relatively low and it has a well developed financial services sector). 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:

- Fisheries sector: raised overall input/output of this sector as it is much stronger proportionately than Kuwait's fisheries sector.
- Textiles: increased input/output of this sector as Bahrain has several significant manufacturing plants.
- Wood products: Bahrain has a strong woodworking sector, with significant exports to neighbouring states. To reflect this, the overall input/output was raised.
- Basic metals and metal products: Bahrain has a well developed metals sectors, based around the Alba aluminium smelter, which accounts for around 20% of merchandise exports. The Kuwaiti metals sector is relatively undeveloped and so the inputs/outputs of this sector for Bahrain were raised substantially.
- Labour inputs into oil and gas extraction and support services were raised to reflect the more fragmented nature of the Bahraini sector.
- Labour and capital inputs into the oil refining sector were reduced to reflect the differences in the Bahraini industry: there is only one, old and relatively simple refinery in Bahrain, while there are three, more complex facilities in Kuwait that have undergone significant expansion and development in recent years.

For the crude oil and natural gas extraction sector, imports exceed domestic demand. Bahrain has a large refinery that is that uses mainly imported crude oil imported from Saudi Arabia, and most of the output from the refinery is exported. The refinery dominates the Bahraini economy; crude oil supplies from Saudi Arabia account for just over 50% of total merchandise imports while refined product output accounts for two thirds of total exports.

3.6 Mapping to GTAP

As a final step, the 44 I-O sectors were then mapped to a final set of 31 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 Bahrain 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 Bahrain 31 I/O Sectors		
Kuwait 44 I/O Sectors		Bahrain 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	