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ASSESSING THE IMPACT OF TRADE LIBERALIZATION ON THE SUDANESE ECONOMY IN A GLOBAL MODELING FRAMEWORK

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ABSTRACT

Tariffs on imports are particularly important for developing countries as a source of revenue. Developing nations do not have the institutional capacity to levy income and sales taxes effectively. As Sudan is negotiating its accession to the WTO since 1994, it is essential to assess the impact of changes in the level of tariffs on the economy. These are policy reforms that are likely to take place in the future. In addition, production taxes in Sudan contributed 16% and 14% to the total government revenue in the years 2000 and 2004, respectively. As the WTO negotiations are unsuccessful due to several political obstacles among others, this paper tries to assess the implications of a situation in which the country liberalize its trade regime. In addition, a scenario that abolishes domestic taxes is also simulated to reduce the burden on the domestic producers and enhance their ability to participate in the domestic and external market. The computable general equilibrium model of the Global Trade Analysis Project and its Africa database are employed. Results indicate that full liberalization, although unlikely to take place with its simulated specifications, will be harmful for the Sudanese economy. The likely-to-happen stepwise liberalization, although not investigated in this paper, may have better consequences as it enable the economy to adapt transferring its trade to liberalization in a harmonized way.

I. INTRODUCTION

Tariffs on imports are of a particular importance for the developing countries as it represent major source of revenue. Developing nations do not have the institutional capacity to levy income and sales taxes effectively. In comparison with other forms of taxation, tariffs are relatively easy to collect. As Sudan is negotiating its accession to the WTO since 1994, it is essential to assess the impact of changes in the level tariffs on the Sudanese economy. These are policy reforms that are likely to take place in the future. In addition, production taxes in Sudan contributed 16% and 14% to the total government revenue in the years 2000 and 2004, respectively. It affects both producer and consumer prices, and hence domestic output and trade (Siddig, 2009).

Trade policy instruments such as tariffs and quotas have direct and indirect effects on the relative prices of commodities produced in a given country. Together with domestic tax

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policies, they directly affect the structure of] production in economies at the national and global levels. As the mix of goods and services produced change, the demands for factors of production also change. Consequently, in any given economy, it is difficult to conceive a situation where the change in trade policy would affect only one sector. Due to the forward and backward linkages and their related strengths existing in a particular economy, the result is always one in which the relative mix of sectoral outputs change. This by extension affects the relative mix of the different factors of production in the different sectors. Hence, changes the income of the different household groups and their welfare levels (Tekle, 2006).

Domestic tax instruments are also important components in the macroeconomic and trade policies. Their country-level effects on output mix and demands for factors of production can be extended to the global economy, particularly in the context of international trade. Changes in relative prices of outputs and inputs resulting in a given country's change in trade policy are transmitted to the industries and input markets of other economies that the country trades with. Therefore, for trade policy analysis to be meaningful and for robust results to be produced, the interactions that prevail among different sectors as a result of a change in trade policy instruments in a given country or group of countries must be taken into account (Karingi et al., 2006).

Trade issues by nature require an analytical framework that allows an overall view of the world economies. This is not only because of the inter-linkages between the various sectors in any given economy but also because of the relationships between sectors in one economy to the rest of the world economies. These national, regional and global linkages may occur either in the inputs or products markets or as are usually the case, in both. Therefore, in order to consider these linkages, a global general equilibrium model is the analytical instrument used in this study.

Sudan is one of the countries that are currently in the process of negotiating its accession to the World Trade Organization (WTO). The successful conclusion of negotiations and the accession of Nepal and Cambodia, both LDCs, at the fifth WTO Ministerial Conference in September 2003 provided a positive impetus and lessons for others such as Sudan that are in the process of accession. Sudan has extensive trade engagements with countries of eastern and southern Africa, as an active member in the Common Market for Eastern and Southern Africa (COMESA). Sudan has also very good trade relations with China, Australia, Korea, and the European Union in addition to the strategic relations with the Middle East and North Africa (MENA) countries.

Sudan has a great potential to increase its agricultural production and effectively contribute to the international agricultural market. It enjoys abundant natural resources in terms of arable land, water resources, petroleum, and other mineral resources. However, since the time of the political independence in 1956 the country excessively endangered itself into a bloody civil war that claimed the lives of many and the treasures of the country. In this regard, the situation in Darfur is also a case in point. Moreover, despite the fact that the nature offered it a lot, Sudan was also adversely affected by drought episodes, which hardly hit it five times since 1984 (Siddig, 2009).

In view of the country being negotiating its accession to WTO since 1994, the objective of this study is to analyze the situation using the model of the Global Trade Analysis Project (GTAP). The idea is to simulate a situation where the country completely liberalizes its trade with all the world's countries regardless to the persisting geopolitical situation, in addition to abolishing domestic taxation. The rationale is to assess the implications of this extreme situation on the economy as far as the WTO negotiations are unsuccessful due to several political obstacles among others. In addition, a less extreme and likely scenario that only abolishes domestic taxes is separately simulated to reduce the burden on the agricultural producers and to investigate their ability to participate in the domestic and external market. Accordingly, this paper simulates two scenarios including one extreme liberalization scenario, to which "scenario 1" is assigned throughout the paper, while the second is "scenario 2," where domestic taxes are abolished.

II. METHODOLOGY

This paper employs the Computable General Equilibrium (CGE) model of GTAP to simulate the above-mentioned scenarios on the Sudanese economy. The rationale of using the global CGE modeling framework of the GTAP is that it is one of the most popular models for analyzing the impact of trade policy. In addition, there are various particular advantages of employing the GTAP model in this study. Firstly, since it is a multi-regional model of world production and trade, it can take into account the overall trade implications of liberalization on Sudan taking into consideration all the countries and regions likely to be affected. Secondly, it contains a global database for 57 sectors and 40 regions covering all traded commodities and flexible possibilities of regional aggregation. Thus, trade implications for various sectors and regions of interest can be assessed.[2] Moreover, the representation of the trading sectors in the model allows the simulation of a situation where tariffs on trade across certain regions can be reduced or eliminated. This advantage is particularly relevant to our interest in liberalization policy; hence, it justifies the adoption of the GTAP model in this research. Furthermore, the model also incorporated all the relevant domestic tax instruments including taxes on producers and income taxes on households. Therefore, it allows the simulation of abolishing the domestic taxes as pointed out in the two scenarios of the paper.

Structure of the GTAP Model

The GTAP model is a comparative static, global Computable General Equilibrium (CGE) model based on neoclassical theories. It is a linearized model; assuming perfect competition in all markets, constant returns to scale in all production and trade activities, and profit and utility maximizing behavior of firms and households respectively, and it is solved using GEMPACK software.[3]

[2] See more details in Hertel (1997). A graphical presentation of the GTAP model with particular emphasis on the accounting relationships is given by Brockmeier (2001). A more rigorous approach is resented by Hertel and Tsigas (1997).

[3] For more details about Gempack and its related software packages, see Harrison & Pearson (1996).

Each region in the GTAP model has a single representative household named the regional household, the income of which is generated through factor payments and tax revenues net of subsidies. Expenditure categories include private household expenditure, government expenditure, and savings according to a Cobb-Douglas per capita utility function. The private household buys commodities to maximize utility subject to its expenditure constraint represented by a Constant Difference of Elasticity (CDE) as an implicit expenditure function. They spend their income on consumption of both domestic and imported commodities and pay taxes. This consumption is a Constant Elasticity of Substitution (CES) aggregate of domestic and imported goods, where the imported goods are also CES aggregates of imports from different sources (regions). Taxes paid by the private household are commodity taxes for domestically produced and imported goods and the income tax net of subsidies.

The government also spends its income on domestic and imported commodities and pays taxes. For the government, taxes consist of commodity taxes for domestically produced and imported commodities. Like the private household, government consumption is a CES composition of domestically produced goods and imports, but a Cobb-Douglas sub-utility function is employed to model the behavior of government expenditure (Hertel, 1997).

Producers receive their income from selling consumption goods and intermediate inputs to consumers in the domestic market and/or to other regions. This income must be spent on intermediate inputs, factor payments, and taxes paid to the regional household in order to satisfy the zero profit assumption employed in the model. For production, a nested production technology is employed assuming that every industry produces a single output, that constant returns to scale (CRS) prevail in all markets, and that the production technology is Leontief. Producers maximize profits by mixing a composite of factors and composite intermediate inputs. Value added itself is a CES function of labor, capital, land, and natural resources, while the intermediate composite is a Leontief function of material inputs, which are in turn a CES composition of domestically produced goods and imports. Imports are sourced from all regions according to a CES function (Brockmeier, 2001).

In the multiregional setting, the model is closed by assuming that regional savings are homogenous and contributes to a global pool of savings (global savings) and that the demand for investment in a particular region is savings driven. These savings are then allocated among regions for investment in response to the changes in the expected rates of return in different regions. If all other markets in the multiregional model are in equilibrium and all firms earn zero profits while all households are on their budget constraint, such a treatment of savings and investment will lead to a situation where global investment must equal global savings, and Walras' Law will be satisfied (Tekle, 2006).

The Representation of trade in the GTAP model

The GTAP model employs the Armington assumption in the trading sector, which provides the possibility to distinguish imports by their origin, and explains intra-industry trade of similar products. Accordingly, imported commodities are assumed separable from domestically produced goods and combined in an additional nest in the production tree. The elasticity of substitution in this input nest is equal across all uses. Under these circumstances,

firms decide first on the sourcing of their imports and, based on the resulting composite import price, they then determine the optimal mix of imported and domestic goods. Accordingly, the model includes separate conditional demand equations for domestic and imported intermediate inputs (Hertel and Tsigas, 1997).

The government and private households spend their income on domestically produced commodities and imported ones and they pay additional commodity taxes on imports to the regional household. Similar to the firms' behavior, the model includes conditional demand equations for imported commodities reported for government and private consumption. Imported commodities and domestically produced commodities are combined in a composite nest for both private and government expenditures, respectively. The elasticity of substitution between imported and domestically produced goods in this composite nest of the utility tree is assumed equal across uses. Accordingly, firm and household import demand equations differ only in their import shares (Hertel and Tsigas, 1997).

The rest of the world receives payments for selling their goods for private consumption, government, and firms. These revenues will be spent on commodities exported from the single country under consideration (Sudan) to the rest of the world, import taxes, and export taxes paid to the regional household.

Trade generated tax revenues and subsidy expenditures are computed in a similar way as domestic policy instruments used in the domestic market. They only differ in that the tax or subsidy rates are defined with respect to market and world prices. If there is an import tax (subsidy), the market price is higher (lower) than the world price, so that the power of the ad valorem tax is greater (smaller) than one. In the case of an export tax (subsidy), the market price lies below (above) the world price and the power of the ad valorem tax is smaller (greater) than one (Brockmeier, 2001).

Data and Aggregation

GTAP database contains bilateral trade, transportation, and protection data, together with individual country's Input/output databases that account for international linkages within each region. These different arrays of datasets were taken from different sources. Data on private household consumption and government purchases of goods and services were obtained from World Bank. Regional database were derived from individual country's Input/output Tables (IOT). Merchandized tariff data are taken from the World Integrated Trade Solutions (WITS) of the World Bank and UNCTAD. Tariffs on food and agriculture are taken from the Agriculture Trade Policy Database of the United States Department of Agriculture (USDA). Free on board (fob) exports and cost insurance and freight (cif) import values are taken from trade data of United Nations COMTRADE database (Karingi et al., 2006).

Regions Aggregation

In the GTAP version 6.2a database, there are 96 regions. The specific aggregation of this study considered Sudan as a separate region in order to capture the effect of trade policy and domestic tax changes on the overall economic variables. Owing to the trade role of the COMESA as the only free trade area in which Sudan is an active member, it is treated as a

separate region after excluding Sudan. The multi-trillion dollar economies of the United States, the European Union, and Japan, which together make up 70% of the world GDP (Dimaranan and McDougall, 2002) were also treated as separate regions. China, Korea, and Australia as newly advancing economies with strong trade relations with Sudan are each treated as separate region. As strategic trade partners as well as having strong cultural and geographical ties with Sudan, the MENA countries are aggregated into one region (MENA). Finally, the rest of the world's countries are aggregated together in (ROW). Accordingly, the model consists of 10 aggregated regions.[4]

Sectors Aggregation

GTAP database version 6 includes 57 sectors. These sectors were additionally aggregated for the purpose of this study to the 34 sectors of the Sudan's IOT, which have been contributed to GTAP global database under GTAP Africa Data Base Project. A list of the sectors incorporated in the Sudanese IOT is shown in Table 1. In addition, detailed mapping between Sudan's IOT sectors and the 57 GTAP sectors as well as the detailed description of each sector are shown in Appendices (2 and 3) of the paper.[5]

Table 1. The detailed description of the Sudan's IOT sectors

No.	Description	No.	Description
1	Wheat	18	Metal industries
2	Cereals (nec)	19	Machinery
3	Other crops (nec)	20	Other manufactories
4	Cotton	21	Electricity
5	Oil seeds	22	Water
6	Livestock	23	Construction
7	Raw milk	24	Trade services
8	Forestry	25	Transport (nec)
9	Sugar	26	Water transport
10	Food industries	27	Air transport
11	Fishery	28	Communication
12	Other mining	29	Finance
13	Petroleum	30	Insurance
14	Textile	31	Business services
15	Wood	32	Social services (nec)
16	Paper	33	Public Administration
17	Chemicals	34	Dwellings

Source: Siddig (2009a).

III. SIMULATION RESULTS AND DISCUSSION

This paper specifically tries to provide empirical answers to the following three questions: First, what would be the gains and losses to Sudan from abolishing its entire trade restrictions including tariffs, export subsidies/taxes, and domestic taxes? This although representing an

[4] For a list of the regions considered for the purpose of the paper, see appendix 1.
[5] For complete documentation of the Sudanese IOT is available in Siddig (2009a).

extreme scenario in the way to the politically blocked WTO negotiations, it worth doing to assess the sensitivity of the overall economy to trade policy changes. The responses of the economy are measured by the changes in macroeconomic aggregates, domestic output, and factors market. Second, which sectors in the country are most likely to gain or lose from the intended liberalization scenarios, and which of them would be able to compete in the international market? Third, what are the welfare and trade implications for Sudan from eliminating domestic taxes on producers and households? The results revealed from the two described scenarios are shown and discussed in the remaining part of this section.

Table 2 reports the percentage changes from the baseline in the volume of merchandize exports, and imports, terms of trade, and the trade balance for each Sudan under the two experiments. Commodity terms of trade is as important as commodity production, because a hundred percent increase in the production of specific commodity, will have no impacts on the exporter's budget when it is accompanied by a hundred percent decrease in the world terms of trade for the same commodity.

Table 2. Effects of liberalization scenarios on regional trade

	Scenario 1: full liberalization scenario	Scenario 2: elimination of domestic taxes
Imports (%)	-10.4	16.6
Exports (%)	66.2	-14.1
Terms of trade (%)	-10.9	3.1
Trade balance (US$ million)	-608.0	1110.9

Source: Model results.

The results suggest that Sudan's terms of trade deteriorate by 11% under the first scenario, while they improve by 3% under the second experiment reflecting the role of eliminating production and consumption taxes on enhancing the trade performance of the economy. Trade balance would also decline by US$ 608 million under the first scenario, while improving by US$ 1111 million due to scenario 2.

Commodities' balance of trade reflects the direction of producers' preferences either towards the local market or to the international market given the comparative advantage that each sector has and its ability to compete. Table 3 shows the changes in the balance of trade (the change in exports minus the change in imports) for the Sudanese commodities under the two scenarios. It is clear from the results that full liberalization of trade as represented by scenario 1 would reduce the trade balance of all the commodities. On the other hand, removing the domestic taxes would improve the commodities balance of trade as shown in the third column of Table 3. The size of changes differs across commodities due to the different level of the taxes in the baseline.

Table 3. Effects of liberalization scenarios on the balance of trade (US$ million)

Commodities	Scenario 1	Scenario 2
Wheat	-52	4
Cereals (Sorghum, Millet, and Maize)	-18	8
Other crops	-79	39
Cotton	-22	22
Oilseeds	-60	52
Livestock	-48	24
Sugar	-24	9
Food Beverage and tobacco	-79	-5
Petroleum products	-11	403
Textile products	-91	47
Wood products	-13	-2
Paper products	-16	8
Metal industries	-19	125
Machinery and equipments	23	202
Other manufactured products	-63	125
Trade services	-6	7
Transport	-9	7
Communication	-4	5
Business services	-6	7
Public services	-7	10

Source: Model results.

Table 4 reports the equivalent variation (EV) changes for Sudan as well as the household income, and GDP under the two scenarios. The equivalent variation change, which reflects the income change that at base prices will yield the equivalent change in welfare to that produced by the simulation, for the Sudan is negative and high under scenario1, attributed to the losses in the terms of trade as well as losses in allocative efficiency in most of the sectors.

Table 4. Effects of the liberalization scenarios on welfare, income, and GDP

	Scenario 1: full liberalization	Scenario 2: domestic tax elimination
Equivalent variation (US$ million)	-1324.2	309.0
Private household income (%)	-213.8	-67.5
GDP (US$ million)	-207.4	-62.3

Source: Model results.

As it is argued that trade liberalization does not always improve welfare levels, the case of Sudan, provide evidence in that respect based on the results obtained from scenario 1. According to Karingi et al. (2006), welfare under free trade must be at least as great as welfare

under autarky and welfare literally increases with the movement towards free trade. In contrast, the results of scenario 2 suggest that tax elimination would enhance welfare (EV) and creates a positive change of US$ 309 million. On the other hand, the two policy scenarios turned out to be harmful to the country's GDP, which is shown to deteriorate by US$ 207 million and US$ 62 million under scenario 1 and scenario 2, respectively.

Contrary the stated goal of the country's consecutive governments to enhance agricultural exports, the agricultural exports remain facing different kind of taxes from the production stage to export. This burden on exporters is seen to be significant as the results of scenario 2 provide empirical evidences. Removing taxes on producers and consumers in the country would improve the agricultural output specifically for the export-oriented crops such as oilseeds, sugar, and cotton. They show 35%, 22%, and 28% increases, respectively from their baseline values of output (Table 5). The huge percentage increase in machinery output is irrelevant here due to the small size of the sector's output in the baseline. Petroleum output would also improve by 6% and 30% under the two scenarios, respectively.

Table 5. Effects of the liberalization scenarios on output (percentage change)

Sectors	Scenario 1	Scenario 2
Wheat	-33	11
Cereals (sorghum, millet, and maize)	7	3
Cotton	-24	28
Oilseeds	-36	35
Livestock	11	7
Raw milk	18	6
Forestry	19	4
Sugar	-43	22
Food beverage and tobacco	11	2
Other mining & quarrying	-7	5
Petroleum products	6	30
Chemicals	44	40
Metal industries	-8	53
Machinery and equipments	79	151
Other manufactured products	4	11
Building and construction	-12	-24
Trade services	8	3
Public administration, defense, and education	-70	-82

Source: Model results.

Service sectors showed a declining trend under the two scenarios especially for public services and construction, which showed more than 12% and 24% decreases due to scenario 1 and scenario 2, respectively. This is attributed to the domestic nature of service sectors in Sudan and to that production factors are being allocated out to other sectors.

Changes in the demand for value added by sector are found to follow those of output as output relies on the production factors together, with the intermediate inputs, with the substitution between the two to be fixed based on the baseline coefficients.

IV. CONCLUSIONS AND POLICY IMPLICATIONS

In this paper, an attempt has been made to investigate the possible impacts of two policy experiments related to trade liberalization and domestic taxes on the Sudanese economy. Namely, an extreme liberalization scenario that abolishes trade restrictions on the side of Sudan including tariffs and exports subsidies/taxes is simulated with its results reported under the name of scenario 1. In addition, scenario 2 simulates all the domestic taxes levied on producers and consumers to be removed. The first scenario is related to the WTO negotiations, that the country has started before more than 15 years without reaching a conclusion due to several factors including political lobbying. Therefore, it is simulated to represent the far unlikely target of the negotiators.

On the other hand, the second scenario tries to investigate the response of the economy to a situation where the stated goals of the consecutive governments in Sudan of improving the agricultural output and exports through producers and exporters'friendly policies are adopted. Therefore, it abolishes the entire taxes levied in the domestic market including production, sales, and income taxes. The general equilibrium-modeling framework is selected to be the underlying methodology for undertaking this exercise. The rationale was that it allows for the forward and backward linkages among the entire economy actors including producers, consumers, and institutions, hence the overall impact of the intended policy experiments could be captured.

The main conclusions that can be drawn from the results are that, full liberalization, although unlikely to take place with its simulated specifications, will be harmful for the Sudanese economy irrespective of how the issue is looked at. The likely-to-happen stepwise liberalization, although not investigated in this paper, may have better consequences. It may enable the economy to adapt transferring its trade to liberalization in a harmonized way. This should be given sufficient lead-time to allow the country's producers build the requisite competitiveness. Moreover, other direction like widening trade relations with the strategic partners like MENA countries could be essential as a pre-liberalization step. This has become obvious after the recent inclination of Arab countries to increase their investments in the Sudanese agriculture affected to the global food crises. Moreover, COMESA could also represent a good market for the country's agricultural exports.

Abolishing the domestic taxes on the other hand has shown significant impact of the production, exports, and private income. Eventually, based on the magnitudes and direction of impacts under the two scenarios, any trade distortion dismantlement in Sudan will need to be implemented in phases hand in hand with unrestricted market access for the country's exports to other international markets.

However, an important point to be considered in this context is that this paper does not focus on the expected deterioration in the government budget due to the two simulation scenarios. In general, tax and tariff revenues represent a big chunk of the government budget revenue in

most of the developing countries. Therefore, it is hard to conclude about the overall implications of such scenarios taking only the production and trade structures into account and without simulating replacement components with respect to the government revenue.

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Appendices

Appendix 1. Regions aggregation

No.	Code	Description
1	SDN	Sudan
2	MENA	Middle east and North Africa countries, less Sudan, Egypt, and Libya
3	XCOM	Common Market of Eastern and Southern Africa (COMESA), less Sudan
4	CHN	China
5	JPN	Japan
6	EU25	The European union (EU25)
7	KOR	Korea
8	USA	United States (USA)
9	AUS	Australia
10	ROW	The rest of the world

Source: Siddig (2009).

Appendix 2. The detailed description of the Sudan's IOT sectors

No.	Description	Code	No.	Description	Code
1	Wheat	wht	18	Metal industries	metl
2	Cereals (nec)	ogrs	19	Machinery	ome
3	Other crops (nec)	ocrs	20	Other manufactories	mnfc
4	Cotton	pfb	21	Electricity	ely
5	Oil seeds	osd	22	Water	wtr
6	Livestock	liv	23	Construction	cns
7	Raw milk	rmk	24	Trade services	trd
8	Forestry	for	25	Transport (nec)	otp
9	Sugar	sgr	26	Water transport	wtp
10	Food industries	btofd	27	Air transport	atp
11	Fishery	fsh	28	Communication	cmn
12	Other mining	cogm	29	Finance	ofi
13	Petroleum	opc	30	Insurance	isr
14	Textile	twl	31	Business services	obs
15	Wood	lum	32	Social services (nec)	ros
16	Paper	ppp	33	Public Administration	osg
17	Chemicals	crp	34	Dwellings	dwe

Source: Siddig (2009a).

Appendix 3. The mapping between Sudan IOT sectors and GTAP sectors

No.	GSEC	Sudan SEC	No.	GSEC	Sudan SEC	No.	GSEC	Sudan SEC
1	pdr	ogrs	20	omt	liv	39	otn	mnfc
2	wht	wht	21	vol	btofd	40	ele	mnfc
3	gro	ogrs	22	mil	btofd	41	ome	ome
4	v_f	ocrs	23	pcr	ogrs	42	omf	mnfc
5	osd	osd	24	sgr	sgr	43	ely	ely
6	c_b	ocrs	25	ofd	btofd	44	gdt	cogm
7	pfb	pfb	26	b_t	btofd	45	wtr	wtr
8	ocr	ocrs	27	tex	twl	46	cns	cns
9	ctl	liv	28	wap	twl	47	trd	trd
10	oap	liv	29	lea	twl	48	otp	otp
11	rmk	rmk	30	lum	lum	49	wtp	wtp
12	wol	live	31	ppp	ppp	50	atp	atp
13	frs	for	32	p_c	opc	51	cmn	cmn
14	fsh	fsh	33	crp	crp	52	ofi	ofi
15	coa	cogm	34	nmm	mnfc	53	isr	isr
16	oil	opc	35	i_s	metl	54	obs	obs
17	gas	cogm	36	nfm	metl	55	ros	ros
18	omn	cogm	37	fmp	metl	56	osg	osg
19	cmt	liv	38	mvh	mnfc	57	dwe	dwe

Source: Siddig (2009a).