UNITED NATIONS

E

ECONOMIC AND SOCIAL COUNCIL

Distr.
LIMITED
E/ESCWA/C.6/2023/8
17 January 2023
ORIGINAL: ENGLISH

Economic and Social Commission for Western Asia (ESCWA)

Committee on Trade Policies in the States Members of the Economic
and Social Commission for Western Asia
Third session
Tunis, 7–8 March 2023

Item 10 of the provisional agenda

New release of the Arab Trade Simulator Interface

Summary

The Economic and Social Commission for Western Asia (ESCWA) has developed a user-friendly interface for a global computable general equilibrium (CGE) model tailored to Arab economies, namely the Arab Trade Simulator Interface (ATSI). ATSI is an analytical tool that enables users to perform trade simulations in a user-friendly manner, without being a specialized modelling expert with strong mathematical and coding skills in the general algebraic modelling system (GAMS).

The present document provides a quick overview of the new version of ATSI in terms of functionalities and policy analysis. It concludes with major steps that should be followed in the future to keep the Interface up to date in terms of data and policy dimensions. The Committee on Trade Policies in the States Members of ESCWA is invited to review the present document and make comments thereon.

23-00051

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Introduction

1.   Trade reform is too complex to analyse, as it combines a variety of economic mechanisms at the same time. These mechanisms cover both macroeconomic effects and sectoral effects in the short and long runs. In addition, the impact of a trade reform depends significantly on the status quo in terms of tax levels, distortions between activity sectors, trade, production and consumption patterns. A reform aimed at eliminating low and uniform tariffs will not produce the same effects as one aimed at correcting large distortions. The initial position of a country compared with others regarding trade protection (tariffs and non-tariff barriers) is equally important when negotiating a trade agreement. Consequently, theory is insufficient to identify optimal policies; detailed empirical analysis based on a reliable and detailed picture of concerned economies is essential.

2.   It is widely acknowledged that computable general equilibrium (CGE) modelling has become the preferred tool of choice for analysing a wide range of policy issues in both developing and developed countries in a variety of settings. In particular, CGE modelling is useful for analysing the effects of trade policy addressing second-best issues, where there are significant interactions between policy measures in one sector and distortions in the rest of the economy.

3.   The general equilibrium framework contains all commodities, market factors (labour, physical capital, and natural resources), decision-making agents who respond to price changes, and many important feedback effects. These models are useful for analysing changes in sectoral output, product prices, factor usage, and factor prices, and resulting changes in national welfare measures.

4.   In addition to the common advantages of the general equilibrium framework, global CGE models are more equipped for trade policy analysis through additional advantages largely omitted by national models. These advantages lie in their capacity not only to simulate the impact of national policy changes related to the implementation of a specific preferential trade arrangement on a targeted country, but also to assess the impact of implementing the same trade arrangements by partner countries on the economy of the same targeted country.

5.   To this end, ESCWA has developed a user-friendly interface for a global computable general equilibrium (CGE) model tailored to Arab economies called the Arab Trade Simulator Interface (ATSI). ATSI is an analytical tool that enables users to perform trade simulations in a user-friendly manner, without being a specialized modelling expert with strong mathematical and coding skills in the general algebraic modelling system (GAMS).

6.   Compared with the beta version of the interface presented at the second session of the Committee on Trade Policies in the States Members of ESCWA in September 2021, the new interface and its modelling framework has been further developed to include additional key features. These new features cover both the extension of the core model's technical specification, and the technology used in developing the user-friendly web interface.

7.   The present document provides an overview of the new version of the model and its interface in terms of functionalities and policy analysis. It also sets out the main steps that should be followed in the future to keep the model up to date in terms of data and policy dimensions.

I. The new ATSI

A. The new ATSI model

8.   Compared with the beta version of ATSI launched in September 2021, the most recent model used for the new interface includes the following four major new developments:

1. *Linking trade reforms to foreign direct investment flows
by origin, destination and sector*

9.   The increasing commitment of most developing countries to free trade agreements (FTAs) confirms their willingness to adopt strategies that open up their economies to promote exports and attract foreign direct investment (FDI), rather than substitute imports with over-protected, and often unprofitable, local production. Through regional integration, both developed and developing countries are attempting to become more attractive to exporting enterprises, both national and foreign. Moreover, all economies can no longer limit their activities to the local level owing to rapid technological progress. As companies develop new technologies, they rush to cover the fixed costs related to those innovations before competitors can access them. FTAs increase trade and consequently inflate profits so that companies can cover those costs.

10.   To assess the links between trade reforms and FDI flows, the new ATSI offers a new modelling framework linking FDI flows by origin and sector to trade policy changes at the national, regional and global levels. The new version has been developed by ESCWA based on an original database of FDI structures by sector, origin and destination. Through this new feature, users can assess the impacts of a large number of alternative trade policies and external shocks on FDI flows for a given country by origin, destination, sector and year.

2. *Linking trade reforms to greenhouse gas emissions by sector*

11.   In general, there are three effects of economic growth on emissions: scale, technology, and composition effects. The scale effect is observed when greater economic activity raises demand for all inputs and increases emissions. A technological effect exists and tends to reduce emissions when higher effluent charges encourage firms to shift towards cleaner production processes. Lastly, a composition effect is observed when income growth and/or environmental awareness accelerate the process of shifting preferences towards cleaner goods, which positively affects the environment through falls in the share of pollution-intensive goods in output.

12.   Regarding the three effects of economic growth on the volume of pollution emissions, preferential trade schemes are often expected to raise income, which means that scale and technology effects tend to offset each other. The net impact on the environment is then determined by the composition effect. Efficiency gains induced by outward-oriented strategy lead to positive scale effects on pollution. The technology effect is also influenced by trade policy, as removal of trade restrictions changes relative input prices, input mix, and hence the pollution intensity of production. The composition effect reflects the realization of comparative advantages, which may be in either dirty or clean activities. The new version of ATSI provides detailed assessments of the effects of trade policy changes and external shocks on the volume of emissions for the major greenhouses gases (GHGs) at the economy-wide level, by sector and by year.

13.   This new feature is useful for the Arab region for two major reasons. Firstly, Arab economies are increasingly involved in global value chains through a multitude of preferential trade agreements, where mainstreaming climate change and pollution issues in their national trade policies has become a priority for all countries. Secondly, most Arab economies are dominated by energy-intensive sectors, making them a potential source of additional environmental damage if additional productive resources are oriented to energy-intensive sectors that may become more competitive in the context of trade integration and liberalization.

14.   The new ATSI offers users the capacity to evaluate the effects of trade reforms on the level of emissions for four major GHGs: nitrous oxide (N_2O), methane (CH_4), fluorinated gases, and carbon dioxide (CO_2).

3. *Integrating migration and remittances*

15.   To date, attempts to endogenize migration in global trade models remain limited for many reasons. A lack of detailed and up-to-date data on regulations and rules governing migration in both origin and destination countries is a major constraint. However, the launch of the World Bank's database on migration has improved

data generation, and new tailored global tools are being developed and used for policy analysis of international migration issues.

16.   Using the World Bank's data on movements and stocks of migrants by origin and destination, a new feature has been added to the ATSI model to test the economic impact of changing the number of migrants by destination and from specific origins. Moreover, the ATSI distinguishes between skilled and unskilled migrants, which can assist member States in negotiating modalities for the movement of persons under various regional integration schemes.

17.   The techniques used in modelling migration in the new ATSI are based on revising the supply functions of the skilled and unskilled labour categories to include migrants. Using the new supply functions for both skills categories, the new interface allows users to evaluate the specific economic impact of changing the number of migrants by origin and destination countries on each economy and the rest of the world.

18.   In terms of functionality, the new ATSI offers two new instruments related to skilled and unskilled migrants and three additional categories of output results: number of skilled and unskilled migrants by origin, by destination, and by year.

4. *Simulation period*

19.   The simulation timeline for the new version has been extended from 2025 to 2030, given that it is important to align the impact assessments of trade reforms to the end period of implementation of the Sustainable Development Goals.

B. The database

20.   Similar to the beta version of the interface, the new version is based on the same Global Trade Analysis Project (GTAP) data set, version 10.0 published in June 2019 by the University of Purdue. The GTAP data set is particularly attractive for trade analysis since it includes a fully consistent set of bilateral trade flows, bilateral trade measures (both on the export and import sides), and bilateral trade and transport margins.

21.   The GTAP database presents a unique and reliable representation of the world economy for a pre-determined reference year, which is 2014. Using this database, a new and tailored sectoral and regional aggregation has been developed to fit three objectives. Firstly, to individually integrate the maximum number of Arab countries and their major trade partners and economic players worldwide. Secondly, to reduce the calibration process of the model and the required data. Thirdly, to keep the time for running a simulation acceptable for users. Below, the sectoral and geographical dimensions of ATSI are displayed while the annex to the present document sets out the adopted mapping between the structure of ATSI and the original GTAP 10.0.

1. *Sectoral composition*

22.   The current version of the model includes the following sectors: cereals; other crops; livestock; extractive industries; crude oil and natural gas; food industries; textile, apparel and leather products; other manufacturing; chemical industries; electrical and electronic equipment and machines; mechanical equipment and machines; other services; construction and building; tourism and hotels; transport services; recreational services; public services; and health services. These sectors are based on an aggregation of the original 65 sectors covered by GTAP 10.0.

2. *Geographical composition*

23.   The model and its interface include the following Arab countries: Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, the State of Palestine, Qatar, Saudi Arabia, the Sudan, the Syrian Arab Republic, Tunisia, the United Arab Emirates, and Yemen.

24. In addition to Arab countries, the following list of regions and countries are included in ATSI: China, France, Germany, India, Iran, Israel, Italy, Japan, Korea, Spain, Türkiye, the United Kingdom of Great Britain and Northern Ireland, the United States of America, the rest of Asia, the rest of America, the rest of Africa, the rest of Europe, the rest of the European Union, the rest of the North American Free Trade Agreement (NAFTA) countries, namely Canada and Mexico, and the rest of the world.

25. The ATSI geographical structure reflects first the 141 countries and regions included in the GTAP 10.0 database and the additional disaggregation undertaken by ESCWA to include additional Arab countries through further disaggregation of the following regions: the rest of Western Asia, the rest of North Africa, the rest of Western Africa, and rest of Eastern Africa.

II. The interface

A. The technology

26. While the model was coded using GAMS software, the interface was developed using the latest technology called "model interface with rapid orchestration" (GAMS-MIRO). It represents a new solution application developed by GAMS corporation that makes it easy to turn any GAMS model into interactive end-user applications that can be distributed among different users (colleagues, policymakers, researchers).

27. The user-friendly interface allows users to interact with the underlying GAMS model, quickly create different scenarios, compare results and much more. The GAMS-MIRO extensive data visualization capabilities provide users with the ability to easily create powerful charts, time series, maps and widgets.

28. To use the ATSI interface under GAMS-MIRO, no programming knowledge is required. The purpose is to provide non-specialized users with the option to undertake simulations and visualize results in a simple and user-friendly way.

B. How to run a simulation using ATSI

1. *Login section*

29. The user will have access to ATSI either through the ATG website (a one-stop shop for trade policymakers developed by ESCWA) or by following a direct link.

Figure 1. Access to ATSI
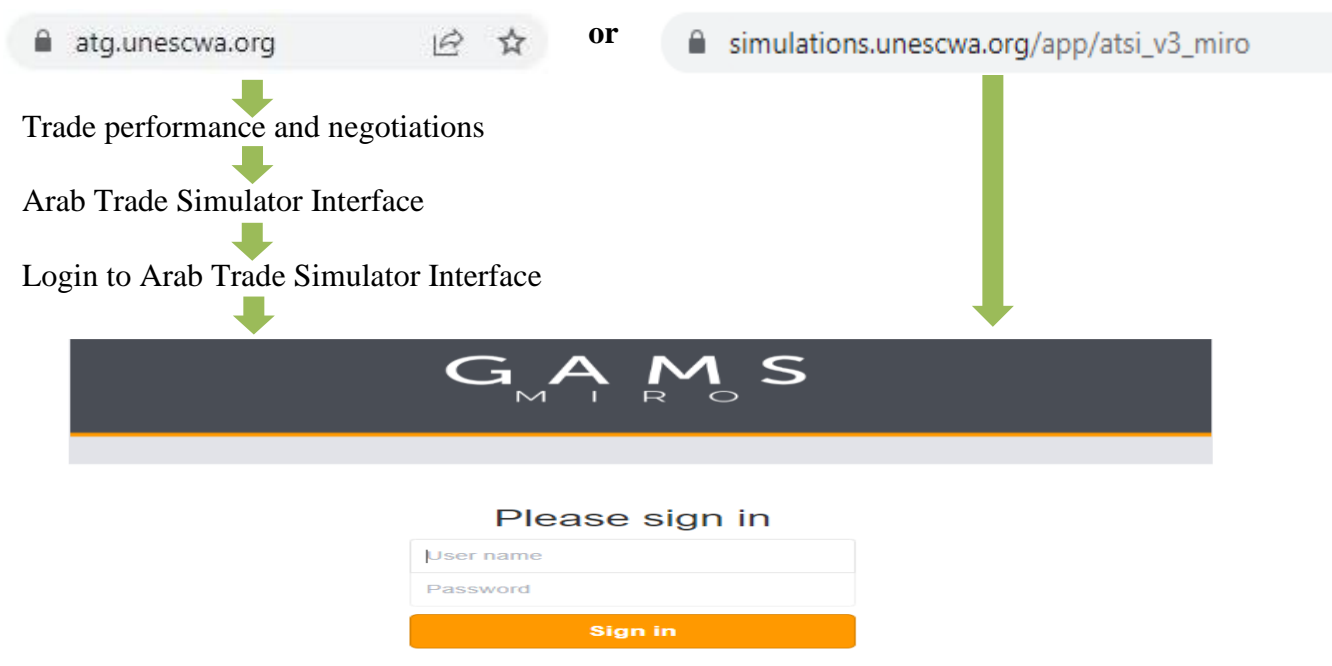
2. *Quick steps*

30.   If users want to run a certain simulation for any country or region covered in the model, they should select it from the list of importers on the left side of the home page. Once the importer country is selected, users should select the partner country or region from the list of exporters on the right side of the home page. Users may add as many shocks as they like with different partners, and users may select the percentage and offset to be added to the shock's formula per selected policy instrument.

31.   Once parameters are selected, users should click on Add and the shock will be added to the grid. Once all the shocks have been added, the user should click on Run and wait for the simulation to be complete. It may take between two and three minutes. The results are organized into tabs. Users can click on any tab to view results, and can click on any indicator to access the graph popups.

32.   The steps to be followed in introducing and running a simulation are shown in figure 2.

Figure 2.   Introducing and running a simulation using ATS

3. *Parameters to implement a policy shock*

33.   This section is used to specify the parameters that the user wants to add to the simulation before running it, as shown in figure 2. There are seven parameter types that can be selected by users, as follows:

- Step 1: Importer: the main parameter type. It is a dropdown list containing all countries and regions individually included in the application.

- Step 2: Exporter: a dropdown list that allows the user to select one (or all) partner to be used in the shock. The list of countries and regions is the same as in the importer list.

- Step 3: Policy: a dropdown list with the following possible four options: tariffs, other trade cost, skilled migrants, and unskilled migrants.

- Step 4: From/to year: the parameter where the user can specify the "from year" and "to year" values. The possible range is 2022 to 2030.

- Step 5: Percentage: refers to the percentage which will be added to the shock's formula per selected policy.

- Step 6: Offset: refers to the offset value that will be added to the shock's formula.

- Step 7: Sector: refers to the sector to which the shock is added. The model accepts one (or all) of the considered sectors. If the simulation covers only a few sectors (not one and not all), users should design shocks by sector and add them one by one to the global shock.

4. *Indicators or results section*

34.   Once the shock is resolved, the results area is split into the following seven main sections:

- Dashboard.

- Macro reports.

- Economic integration report.

- Gas reports.

- Sectoral reports.

- Trade reports.

- Sectoral trade reports.

35.   Each section shows results for a number of variables in various formats that could be selected by users according to their own preference.

III. Way forward

36.   The interface and its model are not designed to forecast the future, but rather to look at the impact of alternative trade reforms and external shocks on the structure of individual Arab economies individually included in ATSI. Consequently, the fact that the model uses data from 2014 to describe Arab and global economies should not be seen as a major shortfall. However, with structural changes affecting all economies worldwide as a result of the COVID-19 pandemic and the recent crisis in energy supply and prices, the interface and its model should be updated with the latest available information on technological coefficients. ESCWA is proposing the following two interlinked phases:

(a)   Update the model with the new release of the GTAP database to be published in 2023, with 2017 as the new reference year. In parallel, the new national social accounting matrices developed by ESCWA for a number of its member States will be used to update national technological coefficients with the latest available information;

(b)   In addition to the standard online version of ATSI, with the adopted sectoral and geographical disaggregation accessible through ATG, more tailored national versions could be developed for member States to better reflect their priorities in terms of sectoral and geographical disaggregation. These new "country

specific versions of ATSI" will be made available only to concerned member States for their own use. They will be part of a package of tools to be made available to member States and to be used under GAMS-MIRO;

(c) In addition to regularly updating the interface and its database, additional policy instruments could be integrated in the original tool (the model used in building the interface called ATSI) to allow users to analyse additional and important dimensions related to trade reforms and regional integration initiatives. In this respect, both the regional and national versions of ATSI could be developed to tackle new areas and policy issues, mainly in trade in services, non-tariff barriers on imports of goods, pollution abatement policies in the context of trade liberalization, global tax on revenues and profits, food security, and poverty.

Annex I

Geographic coverage of the simulator

Description	Mapping with GTAP 10.0
Kuwait	102
United Arab Emirates	107
Oman	103
Saudi Arabia	105
Qatar	104
Bahrain	98
Jordan	101
Morocco	110
Egypt	109
Tunisia	111
Yemen	108–1
Iraq	108–2
Syrian Arab Republic	108–2
Lebanon	108–4
State of Palestine	108–5
Algeria	112–1
Libya	112–2
Mauritania	122–1
China	4
Japan	6
South Korea	7
India	22
United States	28
United Kingdom	81
Iran	90
Türkiye	106
Rest of Asia	218, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 91, 92, 93, 94, 95, 96, 97, 100
Rest of NAFTA (Canada and Mexico)	28, 29
Rest of America	30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48
European Union (27 countries)	54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80
Rest of sub-Saharan Africa	113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140
Rest of the world	108, 1, 2, 3, 49, 50, 51, 52, 53, 141
Rest of Europe	82, 83, 84, 85, 86, 87, 88, 89, 90

Note: The full description of the geographical details of GTAP 10.0 is available at www.gtap.agecon.purdue.edu/databases/regions.aspx?version=10.211.

Annex II

Sectoral coverage of the simulator

Description	Mapping with the original GTAP 10.0
Cereals	1, 2, 3
Other crops	4, 5, 6, 7, 8, 13, 14
Livestock	9, 10, 11, 12
Crude oil and natural gas	16 and 17
Extractive activities	18
Food manufacturing	19, 20, 21, 22, 23, 24, 25, 26
Textile, apparels, and leather products	27, 28, 29
Chemical industries	32, 33, 34, 35
Mechanical equipment and machines	42, 43, 44, 45
Electrical and electronic equipment and machines	40, 41
Other manufacturing	30, 31, 36, 37, 38, 39
Transport services	52, 53, 54
Tourism and hotels	51
Public services	62
Construction and building	49
Health services	64
Recreational services	61
Other services	46, 47, 48, 50, 55, 56, 57, 58, 59, 60, 63, 65

Note: The full description of sectoral coverage of GTAP 10.0 is available at
www.gtap.agecon.purdue.edu/databases/contribute/detailedsector.asp.