

GTAPSim: A User-Friendly Interface for the Standard GTAP model in GAMS

User guide for GTAPSim v1.0

Lindsay Shutes (Elevate Economics)
Robin Schuchmann (GAMS Corporation)
Dominique van der Mensbrugghe (GTAP Center, Purdue University)
Katerina Kavallari (FAO)
George Philippidis (CITA)

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Contact:
lindsayjshutes@gmail.com

TABLE OF CONTENTS

A. Overview2

B. Data and model3

C. The GTAPSim interface3

D. References11

E. Annex 1: Licencing12

F. Annex 2 Aggregation13

Preparing to run GTAPSim

1. Ensure that the following software are installed: GAMS with MIRO connector licence, GAMS MIRO desktop, GitHub Desktop
2. Clone the GTAPSim main repository and make a branch (if you plan to upload changes in the code)
3. Run AggGTAP.gms to create the 10x10 database by putting --basename=10x10 in the command line box in GAMS. The current version is tied to the 10x10 aggregation for v11, although any version with the same region names should work as long as it is named 10x10. For those using v10, the only name change should be EU28->EU27. The mapping file for 10x10 for GTAPv11 is included in the repository (10x10map)
4. Launch MIRO by opening GTAPSim.gms in GAMS studio and pressing F8.
5. If it doesn't work, debug GTAPSim.gms by running with F10 and contact the corresponding author if needed.

A. Overview

Pressing global policy questions concerning the climate crisis, geopolitical shifts and humanitarian challenges such as migration and pandemics demand robust analysis from the field of economics. Much of this type of analysis is conducted – by international organisations and governments – using economy-wide CGE models. These models offer insights into first round and higher order effects, international and domestic impacts, as well as synergies and trade-offs across the three pillars of sustainable development: social, economic and environment. As such, this class of models is a powerful tool to inform policy making.

However, CGE models are complex and using them requires substantial training in economic theory, computer coding, and the interpretation of results. These requirements act as barriers to entry for policy analysts and reduce their potential value to policy makers. The refrain of these models as ‘black boxes’ rings out whilst, in fact, CGE models are fully deterministic and fully explainable.

GTAPSim is a user-friendly interface to the standard GTAP model in GAMS (van der Mensbrugghe, 2022) powered by GAMS MIRO¹ software (GAMS Software GmbH, 2023). The interface allows users to harness the full power of the comparative static² standard GTAP model in GAMS³ to run policy scenarios – hosted locally or on a server - in an accessible way with a much lower training requirement.

¹ GAMS MIRO (Model Interface with Rapid Orchestration) <https://www.gams.com/miro/>

² The model is run in comparative static mode via the interface, meaning that the impact of a change in a policy instrument is shown compared to the base situation. The comparative static mode is selected as the interface is a ‘sandbox’ environment in which users can quickly explore a wide range of scenarios. Running scenarios over many years, particularly in global models, leads to long run times that are out of step with this purpose.

³ The full representation of the GEMPACK version of the GTAP model with additional flexibility in key aspects.

The GTAPSim user interface is powered by GAMS MIRO (Model Interface with Rapid Orchestration) software (GAMS Software GmbH, 2023) using data and a model from the GTAP Center at Purdue University. A summary of the required software, inputs and licences is provided in Annex 1. Users are responsible for ensuring that the licence terms are met before using the interface.

This user guide continues with a brief overview of the data and model, followed by a detailed description of the GTAPSim interface.

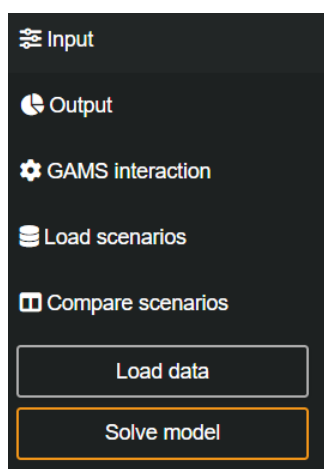
Disclaimer: The material and information contained in the GTAPSim user interface is for general information purposes only. The proprietors listed in Annex 1 accept no liability for consequences arising from the use of the interface or data and models therein. Any reliance placed on such material is therefore strictly at the user's own risk.

B. Data and model

GTAPSim allows for the assessment of the impacts of global free trade agreements, changes in export subsidies and taxes and domestic subsidies on household consumption. The interface is tailored to a worldwide CGE model, the standard GTAP model in GAMS v7.1 (van der Mensbrugghe, 2022), based on 2017 data from the Global Trade Analysis Project (GTAP) (Aguiar et al., 2022). The model includes regions with 10 activities producing 10 commodities using 8 factors (land, 5 types of labour, capital and natural resources). A single representative household is included in the global model. Details of the global model aggregation are available in Annex 2.

C. The GTAPSim interface

The structure of the GTAPSim interface follows *Input*, *GAMS interaction*, *Load scenarios*, and *Compare scenarios*. The GTAPSim interface is navigated via the menu bar on the left-hand side of the screen.



Documentation of the GAMS MIRO software is available at <https://www.gams.com/miro/start.html> and complements this user guide.

C.1.1. Input

The *input* section is comprised of welcome screen, model set-up options, and simulations tabs. A detailed description of the contents of the input tabs in the interface is shown in Table C-1.

The user begins by uploading the zip file created by running aggGTAP.gms with their aggregation:

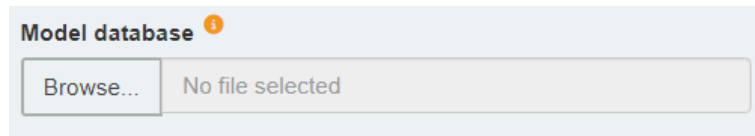


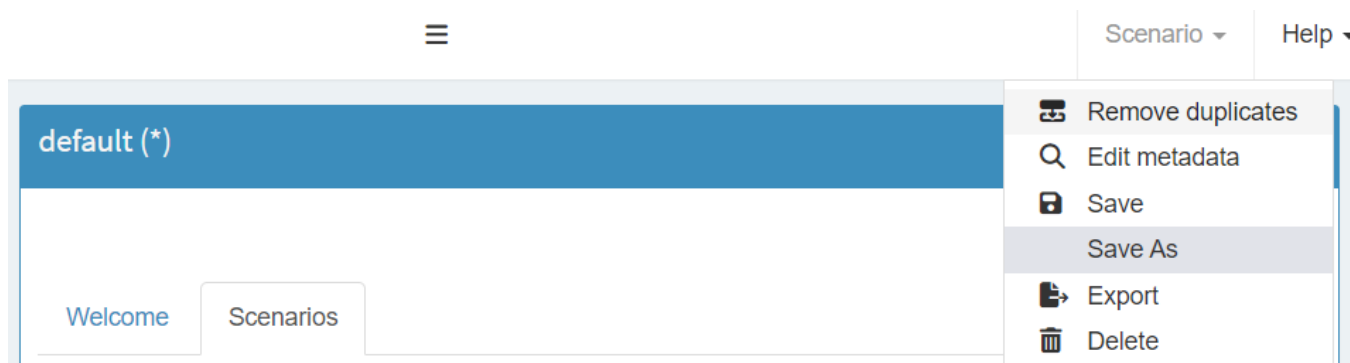
Table C-1 Inputs in the GTAPSim interface

Tab name	Description	Type
Welcome	Introduction to the GTAPSim interface.	Information
Model: set-up	Name of model database to load Choice of utility function (CDE/CD) Choice of capital account closure Choice of model configuration (currently only Comparative Static) Numeraire check (set >1 to check model homogeneity)	Assumptions
Model: Land supply	Land supply specification by region. 0 = fixed land supply (default) >0 = land supply curve using the specified elasticities	Assumptions
Model: Export transformation: Top level export transformation	Transformation between domestic and aggregate export products. Checkbox off = perfect transformation (default) Checkbox on = imperfect transformation in all regions using the specified elasticities	Assumptions
Model: Export transformation: Second level export transformation	Transformation of exports between foreign destination markets. Checkbox off = perfect transformation (default) Checkbox on = imperfect transformation in all regions using the specified elasticities	Assumptions
Simulations: Import tariffs	Global Free Trade Checkbox off = existing import tariffs Checkbox on = import tariffs reduced to zero Global import tariffs:	Simulations

	Change in global import tariffs Import tariffs by region: Change in import tariffs by region Import tariffs by commodity: Change in import tariffs by commodity	
Simulations: Export taxes	Global export taxes: Change in global export taxes Export taxes by region: Change in export taxes by region Export taxes by commodity: Change in export taxes by commodity	Simulations
Simulations: Export subsidies	Global export subsidies: Change in global export subsidies Export subsidies by region: Change in export subsidies by region Export subsidies by commodity: Change in export subsidies by commodity	Simulations
Simulations: Domestic subsidies	Domestic subsidies on household consumption: Change in domestic household consumption subsidies by commodity and region. N.B. As the values of the subsidies are shown, the user directly specifies the new value of the subsidy.	Simulations

A *Reset scenario settings to default* button is available for all settings.

Save the scenario by selecting Scenario>Save as via the drop-down menu in the top right-hand side. Choose a name for the scenario and add tags if you would like, e.g., for a Global Free Trade simulation with land supply curves in all regions, *GFT* and *LandSupplyAll* are suitable tags.



C.1.2. Output

The Output section contains a dashboard of results from the last scenario run in, or loaded into, GTAPSim.

Navigating the dashboard

The dashboard is navigated via the ‘tiles’ on the right-hand side of the screen as shown below. The tiles show headline results for the current scenario for results with a global average percentage change. More detailed results are accessed by clicking on each tile as detailed in

Table C-2.

Global indicators (real)	
 GDP +0.12%	 ABSORPTION +0.16%
 OUTPUT +0.04%	 FACTOR PRICES (GLOBAL NUMERAIRE)
 EXPORTS +3.88%	 IMPORTS +4.2%
 SAVINGS +0.58%	 HOUSEHOLD DEMAND +0.17%
 GOVERNMENT TAX REVENUE -1.86%	 WELFARE
 SCENARIO SHOCKS	

Table C-2 Dashboard outputs

Indicator	Description	Type
GDP (percentage change)	Percentage change in real Gross Domestic Product (GDP) in the scenario compared to the base.	Tile
GDP by region (percentage change)	Percentage change in real GDP by region in the scenario compared to the base.	Bar chart
Absorption (percentage change)	Percentage change in real absorption in the scenario compared to the base.	Tile

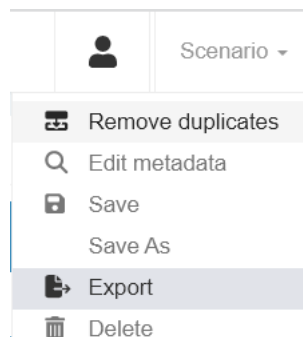
Absorption by region (percentage change)	Percentage change in absorption in the scenario compared to the base, where absorption = C (private consumption) + I (investment) + G (government consumption).	Bar chart
Output (percentage change)	Percentage change in real output in the scenario compared to the base.	Tile
Output by region (percentage change)	Percentage change in real output by region in the scenario compared to the base.	Bar chart
Output by region and activity (percentage change)	Percentage change in the output of each activity in each region in the scenario compared to the base. The graph can be filtered by region and activity.	Bar chart
Factor prices (global numeraire)	Global percentage change = 0 as the global numeraire	Tile
Factor prices by region (mobile, percentage change)	Percentage change in returns to mobile factors in the scenario compared to the base.	Bar chart
Price of natural resources used in extraction by region (sluggish, percentage change)	Percentage change in the price of sluggish factors by activity and region in the scenario compared to the base, here: the price of natural resources used in extraction.	Bar chart
Exports (percentage change)	Percentage change in real exports in the scenario compared to the base.	Tile
Export supply (percentage change)	Percentage change in real export supply by region in the scenario compared to the base.	Bar chart
Export supply by commodity (percentage change)	Percentage change in real export supply by region and commodity in the scenario compared to the base. The graph can be filtered by region and commodity.	Bar chart
Imports (percentage change)	Percentage change in real imports in the scenario compared to the base.	Tile

Import demand (percentage change)	Percentage change in real import demand by region in the scenario compared to the base.	Bar chart
Import demand by commodity (percentage change)	Percentage change in real import demand by region and commodity in the scenario compared to the base. The graph can be filtered by region and commodity.	Bar chart
Savings (percentage change)	Percentage change in savings in the scenario compared to the base.	Tile
Regional and foreign savings (million USD)	Percentage change in real savings by source (regional and foreign) and region in the scenario compared to the base.	Bar chart
Household demand (percentage change)	Percentage change in real household consumption demand in the scenario compared to the base.	Tile
Household demand (percentage change)	Percentage change in real household demand by region in the scenario compared to the base.	Bar chart
Household demand by commodity (percentage change)	Percentage change in real household demand by region and commodity in the scenario compared to the base. The graph can be filtered by region and commodity.	Bar chart
Government tax revenue (percentage change)	Percentage change in government tax revenue in the scenario compared to the base.	Tile
Government tax revenue (percentage change)	Percentage change in government tax revenue by region in the scenario compared to the base.	Bar chart
Government tax revenue by source (percentage change)	Percentage change in government tax revenue by tax source region and commodity in the scenario compared to the base. The graph can be filtered by tax type.	Bar chart

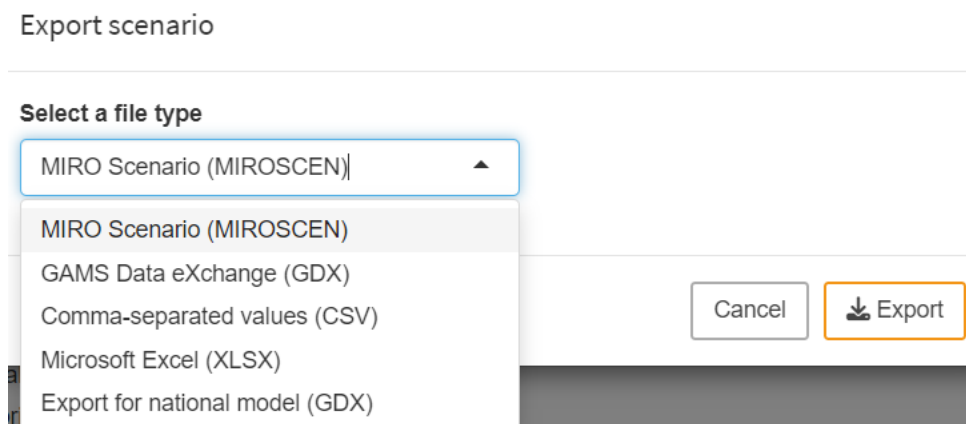
Welfare	No global average percentage change.	Tile
Household welfare (percentage change)	Percentage change in household welfare measured by Equivalent Variation and Compensating Variation.	Radar plot
Simulation shocks	Shows the model settings and simulations applied in the current scenario.	Table

Exporting results

To export results from GTAPSim, select *Export* from the Scenario drop down menu:



Then select the format you prefer and click *Export*



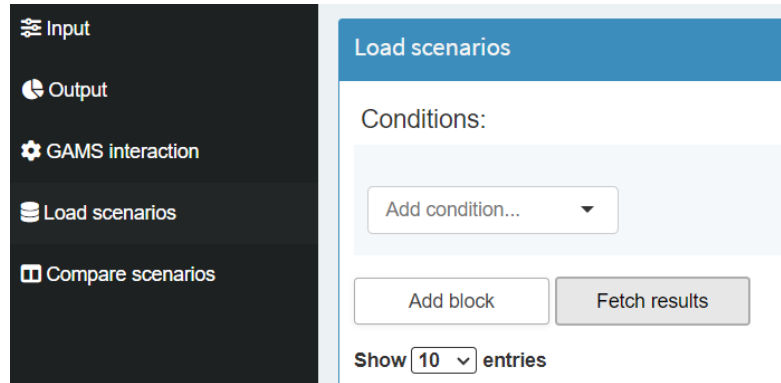
C.1.3. GAMS interaction

The GAMS interaction section of GTAPSim provides information during and after the solving of the model. The Model Status bar shows the status of the model run while the GAMS output section provides information about the solution of the model.

The user can stop an active model run by pressing the *Stop* button. Further information on this section is available at <https://www.gams.com/miro/start.html> in the *Solve the model* section.

C.1.4. Load scenarios

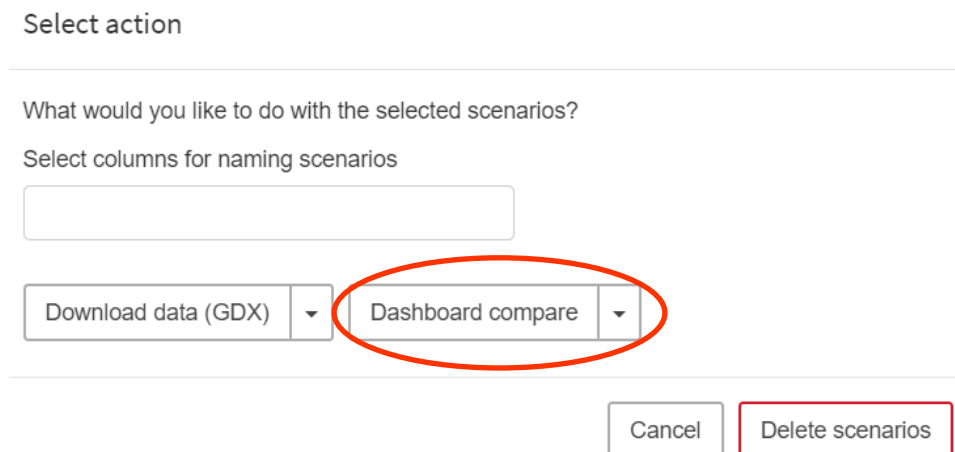
The *Load scenarios* section allows the user to load scenarios from the GTAPSim database of saved scenarios. Selecting *Fetch results* returns a list of all saved scenarios which can be ordered by time created, tags and all scenario settings.



Alternatively, the user can restrict the scenarios fetched by using conditions to specify tags or lever values. Further information on this section is available at <https://www.gams.com/miro/start.html> in the *Finding and loading scenarios* section.

C.1.5. Compare scenarios

The *Compare scenarios* section is similar to the *Output* section but with comparisons across multiple scenarios. To load scenarios, select *Compare scenarios* and then *Load*. Choose which scenarios you want to include, click *Choose selected scenarios* and then *Dashboard compare*:



By default, the scenarios are named according to their saved name. The user can specify other fields to name the scenarios using the *Select columns for naming scenarios* option above.

The indicators in the *Compare scenarios* section follow those in the *Output* section. The user can populate the tiles on the right-hand side using the drop-down menu:

Summary indicators (percentage change for selected scenario)

Select scenario ▼

D. References

Aguiar, A., Chepeliev, M., Corong, E. & van der Mensbrugghe, D. (2022). The GTAP Data Base: Version 11. *Journal of Global Economic Analysis*, 7(2), 1-37. Retrieved from <https://www.jgea.org/ojs/index.php/jgea/article/view/181>

GAMS Software GmbH (2023). GAMS MIRO. https://www.gams.com/sales/miro_facts/

van der Mensbrugghe, D. (2022). *The Standard GTAP Model in GAMS. Version 7.1. GTAP Technical Paper*. Center for Global Trade Analysis, Purdue University.

E. Annex 1: Licencing

Component	Proprietor	Licence
GTAP database	GTAP Center, Purdue University	Available for purchase at https://www.gtap.agecon.purdue.edu/databases/v11/
GTAPSim	Lindsay Shutes	Open source
GTAPinGAMS	Dominique van der Mensbrugghe	Open source, available at https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=6825
GAMS	GAMS Development Corp. GAMS Software GmbH	Available for purchase at https://www.gams.com/sales/pricing_regular/
GAMS MIRO	GAMS Development Corp. GAMS Software GmbH	GAMS MIRO Desktop. Open source, available from https://www.gams.com/miro/download.html GAMS Connector license available for purchase at https://www.gams.com/sales/pricing_regular/ A demo version of GAMS which includes GAMS Connector can be requested at: https://www.gams.com/try_gams/

F. Annex 2 Aggregation

Group	Description	Members
Regions		
Oceania	Oceania	Australia, New Zealand, Rest of Oceania
EastAsia	East Asia	China, Hong Kong, Japan, Republic of Korea, Mongolia, Taiwan, Brunei Darussalam, Rest of East Asia
SEAsia	South-East Asia	Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Philippines, Singapore, Thailand, Viet Nam, Rest of Southeast Asia
SouthAsia	South Asia	Bangladesh, India, Nepal, Pakistan, Sri Lanka, Rest of South Asia
NAmerica	North America	Canada, United States of America, Mexico, Rest of North America
LatinAmer	Latin America	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela, Rest of South America, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, El Salvador, Rest of Central America, Dominican Republic, Jamaica, Haiti, Puerto Rico, Trinidad and Tobago, Rest of Caribbean
EU_27	European Union	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden
MENA	Middle East & North Africa	Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syrian Arab Republic, Türkiye, United Arab Emirates, Rest of Western Asia, Algeria, Egypt, Morocco, Tunisia, Rest of North Africa
SSA	Sub-Saharan Africa	Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Guinea, Mali, Niger, Nigeria, Senegal, Togo, Rest of Western Africa, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, South-Central Africa, Comoros, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Sudan, Tanzania, Uganda, Zambia, Zimbabwe, Rest of Eastern Africa, Botswana, Eswatini, Namibia, South Africa, Rest of Southern African Customs Union
RestofWorld	Rest of the world	United Kingdom, Ireland, Norway, Switzerland, Rest of EFTA, Albania, Serbia, Belarus, Russian Federation, Ukraine, Rest of Eastern Europe, Rest of Europe, Afghanistan, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, Rest of Former Soviet Union, Armenia, Azerbaijan, Georgia, Rest of the World

Activities/Commodities		
Staples	Staple crops	Paddy rice, Wheat, Cereal grains nec
OthCrops	Other crops	Vegetables, fruit, nuts, Oil seeds, Sugar cane, sugar beet, Plant-based fibers, Crops nec
Livestock	Livestock	Bovine cattle, sheep and goats, horses, Raw milk, Wool, silk-worm cocoons
OthAnimProd	Other animal products	Animal products nec
Coal	Coal	Coal
Oil	Oil	Oil
Gas	Gas	Gas
Extraction	Extraction	Forestry, Fishing, Other Extraction
ProcFood	Processed foods	Bovine meat products, Meat products nec, Vegetable oils and fats, Dairy products, Processed rice, Sugar, Food products nec, Beverages and tobacco products
TextWapp	Textile and wearing apparel	Textiles, Wearing apparel
PetrCoal	Petroleum and coal	Petroleum, coal products
Chem	Chemicals	Chemical products
LightMnfc	Light manufacturing	Leather products, Wood products, Paper products, publishing, Metal products, Computer, electronic and optical products, Electrical equipment, Manufactures nec
HeavyMnfc	Heavy manufacturing	Basic pharmaceutical products, Rubber and plastic products Mineral products nec, Ferrous metals, Metals nec, Machinery and equipment nec, Motor vehicles and parts, Transport equipment nec
Util_Cons	Utility and consumption	Electricity, Water, Construction
GasDist	Gas manufacture and distribution	Gas manufacture, distribution
TransComm	Transportation and communication	Trade, Accommodation, Food and service activities, Transport nec, Water transport, Air transport, Warehousing and support activities, Communication
OthService	Other services	Financial services nec, Insurance, Real estate activities, Business services nec, Recreational and other services, Public Administration and defense, Education, Human health and social work activities, Dwellings
Endowments		
UnSkLab	Unskilled labor	Clerical workers, Service and shop workers, Agriculture and other low-skill workers
SkLab	Skilled labor	Technical and professional workers, Management

Capital	Capital	Capital
Land	Land	Land
NatRes	Natural resources	Natural resources