Simulation Game „InnoPoli“
Description 2018

I. Idea and basic structure

I.1 General idea

The game simulates the economic development of a fictive world with countries and regions. The simulation is conducted on the micro-level, meaning that all firms in the fictive world are modeled in their development, represented by their employment, turnover and innovation activity. Furthermore, entries and exists are considered. All firm developments contain random elements. The firm dynamics are modeled such that they are in line with real world dynamics. The development and characteristics of the modeled industries is inspired by reality but do not resemble the real world. Many real-world aspects and mechanisms are not included. Hence, the simulated world is a fictive world

The developments of the firms in this fictive world depend on their circumstances, such as governmental support, nearby public research and education, and nearby other related firms. The market that is supplied by firms is assumed to be global. All locations provide the same access to the market. Firms in the same industry compete on one global market, so that it is unimportant for the own market situation whether the competitors are located nearby or far away.

In order to keep the game world traceable, only a number of industries are explicitly modeled, while all other industries are ignored. The industries that are explicitly considered change from game to game.

Each player represents the government of one country, containing several regions. Governments can decide on the tax rate in their country and several governmental expenditures, such as universities, public research, innovation support and start-up support. With these decisions they try to influence the firms and, thus, the economic development in their country positively. Several rankings allow for observing the developments and compare them with other countries.

I.2 Course of game

Within the game a total time span of 20 years is simulated, starting with January 1st, 2000 and ending with December 31st, 2020. All data within the game is generated and available monthly in game time. However, three months are always simulated together, each day at midnight. The whole game takes 80 days of real time to play.

Decisions can be made or changed at any time. However, they become relevant only when the next three months are simulated. At the time of simulation the actual values are used for all decision variables, independent of the time at which they have been put in. The decision variables are automatically transferred to the next time period (next three months). Hence, it is not necessary to change decisions each day. Changes are necessary if players want to change the strategy/behaviour of their government.

I.3 Countries and regions

The number of countries depends on the number of players. Within each country there are seven regions with a fixed number of inhabitants (mobility of inhabitants is not simulated). Countries as well as regions have the shape of a hexagon. Each country has a central region and six regions around it (see Figure 1).

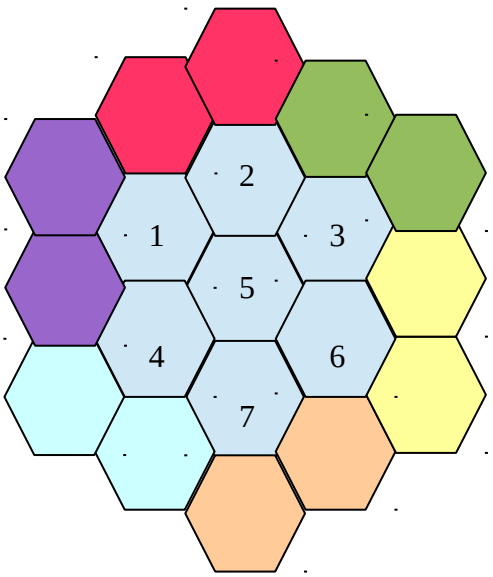


Figure 1: Spatial structure within a country

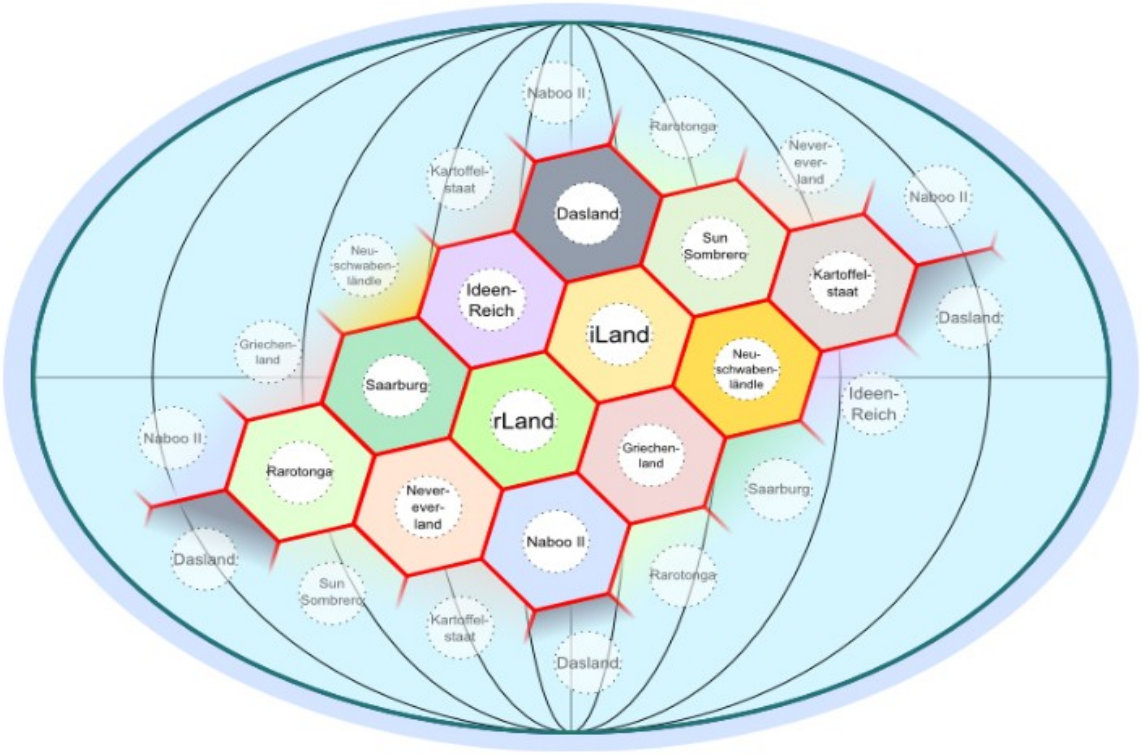
The regions are interpreted as consisting of a city in the middle and its hinterland. All countries are identical in their shape, the location of their regions and the number of inhabitants in these regions. The number of inhabitants remains the same during the game and is given in Table 1. Furthermore, the economic situation is identical in each country at the beginning of the game.

Region	Inhabitants
1	2.000.000
2	200.000
3	500.000
4	200.000
5	1.000.000
6	2.000.000
7	200.000

Table 1: Inhabitants in the regions

Each country has also the same situation with respect to the location and number of neighbours. The world map represents one possible perspective of the world and the countries therein, similar to a real world map. However, countries at the edge, e.g. on the right edge of the map, also have neighbours in each direction. E.g. the right neighbour of a country on the right edge is the respective country on the left edge of the world map. The same holds for the upper and lower edge (see Figure 2).

F*igure 2: World map of a game run in the past*



II. Governmental decisions

Governments have to decide two things: the overall tax rate in their country and their activities to support the economy. The tax rate is a turnover tax. No other taxes exist in the game.

Governments cannot freely use all the tax that they collect. There are many governmental activities that are not explicitly considered in the game, but have to be financed; such as schools, roads, military and so on. Hence, 32% of a country's turnover is needed by the government for all other necessary things, not explicitly considered in the game. If a government sets a tax rate above 32%, the additional revenues can be spend on the various support activities that are described below. If a government sets a tax rate below 32% it spends more than it obtains. The initial tax rate is 33% which provides 1% of turnover as budget for the spendings in the game. Tax rates can be changed as all other decisions every quarter of year (each day in real time).

Countries that end a period (three months) with a negative account have to pay a penalty fee to all other countries. The penalty fee is 20 Mio. EUR in the first year and 50 Mio. EUR in each successive year and has to be paid to each other country. This measure is meant to hinder governments from developing deficits. Each country starts with a positive account.

Governments have four options to spend their money on support activities: financing universities (tertiary education), financing public research, supporting innovation activities in firms and supporting start-ups. Each of these activities can be separately applied to each region and industry.

II.1 Universities/Education

A government can found or dissolve universities without any additional costs in each period. Each university causes 20 Mio. EUR fixed costs per year (5 Mio. EUR per quarter of year), independent of the number of subjects that are offered and the number of students enrolled. Universities only provide education. They do not conduct research in the game world (public research is modeled separately).

At a university students can be educated in different subjects. In order to keep the simulation model simple, the subjects that can be offered fit the industries that are explicitly modeled in the game. University education costs 200,000 EUR per student. Hence, each quarter of year the government has to pay for each university 5 Mio. EUR plus 0.2 Mio. EUR times the total number of students graduating.

For simplicity it is assumed that governments can decide directly on the number of graduates that leave university in each quarter of year. The time necessary for studying is ignored. Graduation takes place at the 1st of January, April, July and October and leads to an increase in the number of people in the region with the respective qualification. While the total population in regions remains constant, qualified people might move between regions. The game starts with active universities, so that qualified people are present in the regions.

II.2 Public research

Public research is conducted in research institutes. Each research institute conducts research in one field of science. The fields of sciences are directly connected to the industries that are explicitly modeled in the game.

Research institutes can be founded and dissolved at any time in each region and with respect to each subject. The expenditures are set by the government and can be changed at any time. The more money is spent for a research institute, the more scientific results are generated there. The game starts with no research institutes present.

II.3 Innovation support

Governments might support research and development (R&D) activities in firms. To this end, they set up programs. To this end, they decide for each region and industry the following characteristics:

- Percentage of innovation costs that is financed by the government[1]: For each innovation project is supported, the government subsidizes the firm with an amount that corresponds to the chosen percentage of the total costs.
- Budget: The maximal amount of money that is spend in the program within the next three months. If this amount is spend before the three-month period ends the program is terminated earlier and no further innovation projects are supported.

R&D projects of firms cause for the firm costs of between 200,000 and 2 Mio. EUR. For each R&D project the costs are randomly drawn from this range. Governmental subsidies motivate firms to conduct more R&D projects, so that more innovations result. If a R&D support program is active, all firms decide to submit part of the project that they would have conducted anyhow and some additional projects to the program.

1 The usual percentage in reality is around 50%. E.g., the EU does not allow for higher subsidies.

II.4 Start-up support

Start-up support functions in the same way as innovation support. Again support programs are set up, so that governments have to decide for each region and industry the following aspects:

- Percentage of costs that is financed by the government: Each start-up that is supported by an amount that corresponds to the chosen percentage of the total costs of founding the firm.
- Budget: The maximal amount of money that is spend in the program within the next three month. If this amount is spend before the three-months period ends the program is terminated earlier and no further start-ups are supported.

To start a firm requires investment between 500,000 and 4 Mio. EUR. The costs for each start-up are randomly drawn from this range. Again financing some percentage of the start-up costs increases the likelihood that potential founders start a firm.