Report Advanced SD - resource trap

Erik Pronk (4786556)
Daan van Beek (4245342))
Philip Seijger (4272803)
Irene van Droffelaar (4365461)

H.U. Sverdrup distinguishes two types of scarcity: *soft* scarcity, where the market supply does not match the demand, leading to an increased price, which curbs demand or increases supply, and *hard* scarcity, where he distinguishes economic (the lack of economic resources to facilitate extraction) and physical scarcity (failure of provision due to physical absence of resource)[1].

Based on data exploration, we assume that physical scarcity is not expected in the next 40 years, as global reserves are sufficiently large. Economic scarcity is also not expected in Chile, due to a plethora of foreign and domestic investments in the sector. Expected are market dynamics due to soft scarcity, driving the price up exponentially, as already observed in the past decade. This demand curve is modeled as a lookup to demonstrate resource curse dynamics, instead of modeling future lithium markets and their uncertainty.

Model Communication
Often, a "resource curse" is looked down upon by "richer", Western countries, like it's something that is so easy to avoid if you "just" manage your resources and their resulting wealth well. However, it can be more accurately described as a trap, where a country has to balance short term and longer term goals, or, more accurately, temptations. If your people are starving, you won't put money away to save for later.

To show this ‘trap’ mechanism, we have developed a game. The game designed for this project is a proof of concept, demonstrating the real-time interaction between the SD model in Vensim and the game in Python using the PySD package. Using this link, possibilities in game mechanisms and visualizations are virtually endless, unlike using commercial packages like Forio.

This project explicitly focuses on the game design and the integration of Python and Vensim. Naturally, the model portrays the behaviour required for the game mechanisms, but some structures require further exploration, for example using the structural uncertainty techniques as demonstrated by Willem Auping. Instead, basic machine learning algorithms were used to find relations between variables over time.

---

[1] Sverdrup, H.U., Ragnarsdottir, K.V. & Koca, D. Biophys Econ Resour Qual (2017) 2: 4. https://doi.org/10.1007/s41247-017-0017-0

Triadic Game Design

Following the Triadic Game Design framework as laid out by Harteveld in 2011 [2], the following sections of the report focus on the game's future development concerning reality, play and meaning.

Reality

Compared to reality, the game is quite boxed-in in terms of policy levers and KPIs: it only contains a fraction of the policy levers available to governments. However, it was attempted to include a wide variety of country dynamics to how difficult it is to balance multiple objectives.

Play

On the start screen, the setting, goals and mechanics of the game are explained. This should help the player be able to relate the game to reality (*Meaning*).

The game lacks some transparency in KPI development. In reality, one would depend on projections and predictions (for example for resource demand and GDP). In a next version of the game, one could work with multiple 'advisors' on which the player can base its policy choices. Just like reality, these advisors may be off.

The game is relatively short considering the message it tries to convey. However, this also lowers the barrier to play and may reach a wider audience.

Meaning

In a next version of the game, its meaning should be communicated to the player in more depth. Currently, it is not yet trivial to record the players' policy choices and communicate their performance accordingly. Therefore, it is currently advised to play the game in a classroom setting, where this meaning can be communicated by a mediator.

If the game were to be used with decision makers in the future, one would have to be careful in the terminology used in the game. Currently, it contains some assumptions on 'good' and 'bad' decisions, while country-specific situations are most likely not as black and white.

How to run the game

The Jupyter notebook attached contains instructions on how to run the code. Simply running the cells in sequence should open a game window.

[2] Harteveld, C. (2011). Triadic Game Design: Balancing Reality, Meaning and Play. Springer, Amsterdam.