Cybernetic Automated Economics: Simulation Experiments Using Victoria II

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Abstract

This paper explores the feasibility of cybernetic automated economics through simulation experiments conducted within the historical grand strategy game *Victoria II*. Two experiments are presented. The first experiment employs a heavy-industry economic strategy using the Russian Empire in 1836, wherein a manually executed, code-inspired algorithm is used to balance production and consumption for industrial goods. The second experiment extends this approach to the Ottoman Empire, testing a more comprehensive algorithm over a forty-year period that integrates industrial, infrastructural, and military improvements. The findings indicate that—even within the simplified economic model of a simulation game—a systematic, algorithm-driven approach can meaningfully improve economic performance. The experiments suggest avenues for further research in automating economic policy design and testing models under conditions of uncertainty.

Index Terms— Algorithm, Automated Economy, Cybernetic Economics, Economic Modeling, Historical Simulation, Simulation, *Victoria II*,

I. Introduction

Economic modeling often grapples with the complexity and uncertainty inherent in real-world systems. This study utilizes *Victoria II*—a game with historical economic dynamics—as a test-bed for cybernetic automated economics. By applying a code-like, algorithm-driven methodology to simulate policy decisions and economic adjustments, the study examines whether strategies that work within the game's constraints can offer insights for broader economic theories.

The paper is structured as follows. Section II outlines the methodology and simulation design. Sections III and IV detail the two experiments conducted—the first with the Russian Empire and the second with the Ottoman Empire—highlighting their respective objectives, algorithms, and outcomes. Section V discusses the results and implications, and Section VI concludes this paper.

II. Methodology

A. Simulation Environment

Victoria II was selected due to its simulation of historical economic activities despite inherent limitations (e.g., simplified models and a historical timeline starting in the 1800s). The game environment provides a controlled setting in which economic parameters such as production, consumption, taxation, and resource allocation can be monitored and adjusted.

B. Experimental Approach

In both experiments, a manually implemented "code-like" algorithm was followed. Although the execution was manual, the logical structure of the algorithm was designed to mirror potential automated processes. This approach allowed for iterative adjustments while closely monitoring key performance indicators (KPIs) such as industrial output, treasury balances, and production-consumption ratios.

C. Algorithmic Framework

The algorithm guiding the simulations was developed in a stepwise fashion, with adjustments made during the experiments. Two versions of the algorithm were used:

1) Experiment 1 (Russian Empire)

- **Production Check:** If *steel_production* < *steel_usage* then:
    - If *treasury* > *(required_amount_to_build_steel_factory + 8k)* then build a steel factory.
    - Continue until production exceeds consumption.
    - This was done with cement and machine parts too as they were the items used to build factories.
- **Resource Adjustment:** For any construction item below requirements, purchase the maximum available from the world market until sufficient stocks are reached.
- **Automation:** Once resource thresholds were met, enable trade automation.

Note: The full pseudocode of Experiment 1 is provided in Appendix A.

2) Experiment 2 (Ottoman Empire)

- **Production and Construction:**
    - If *item_produced* < *item_used*, check treasury funds; if sufficient, build the corresponding factory.
    - Purchase necessary construction materials when stocks fall below factory-construction requirements.

- **Investment Adjustments:**
    - When treasury profit is consistently high, invest a fixed percentage in administration and education.
    - Adjust investments downward if sustained losses occur.
- **Infrastructure and Tax Policy:**
    - Build railroads when treasury funds and profit thresholds are met.
    - Gradually reduce taxes within limits defined by wealth segmentation.
- **Sector Prioritization:**
    - Prioritize factories for steel, cement, and machine parts, followed by consumer goods and military goods.
- **Additional Trade Adjustments:**
    - Automate trade for items with production shortfalls.
    - Suspend factory construction when production levels indicate oversupply.

Note: The full pseudocode of Experiment 2 is provided in Appendix B.

III. Experiment 1: Heavy Industry Simulation in the Russian Empire

A. Setup

- **Nation Selected:** Russian Empire (starting in 1836)
- **Focus:** Rapid industrialization with emphasis on steel, cement, and machine parts.
- **Constraints:** The simulation was conducted manually, with algorithmic decisions applied as observed via in-game statistics.

B. Procedure and Results

The algorithm was executed manually. Key interventions included:

- Building steel factories when iron production lagged behind usage.
- Adjusting trade to ensure that construction material requirements were met.

Outcome:

- The heavy industry target was achieved within seven simulated years (by 1843).
- The treasury, initially under strain with high taxation (50% on all classes) and low literacy (7.8%), began showing improvements with moderated expenditures.

- The transition from artisan-based production to factory-led output was successful.
- The results are shown Appendix C

IV. Experiment 2: Comprehensive Economic Simulation in the Ottoman Empire

A. Setup

- **Nation Selected:** Ottoman Empire (starting in 1836)
- **Focus:** A broad-based economic improvement across all sectors with lower initial emphasis on military expansion.
- **Duration:** Approximately 40 simulated years, incorporating multiple wars (including a short world war) and significant internal adjustments.

B. Procedure and Results

The enhanced algorithm was applied to drive improvements in several sectors:

- **Budget Reforms:**
    - Progressive tax policies were implemented, increasing literacy from 7.8% to 30.7%.
- **Production Metrics:**
    - Cotton production increased by 1163.89%, iron by 1093.44%, and coal by 951.35% etc. and many new types of factories were started.
    - Shifts from artisan-based to factory production were observed.
- **Industrial Infrastructure:**
    - The Ottoman Empire ended the simulation with the highest number of factories globally.
    - Infrastructure improvements included extensive railroad construction.
- **Military Considerations:**
    - Targeted investments increased army size by 39.13% and naval capacity by 275.68%.

The results are shown in Appendix D

V. Discussion

The experiments illustrate that an algorithm-driven approach can meaningfully alter economic performance in a game simulation. Key takeaways include:

- **Validation Through Simulation:** The success suggests that a fully automated system might yield even better results.
- **Limitations:** The use of *Victoria II* introduces constraints, and manual execution may introduce human errors.
- **Interdisciplinary Implications:** The research combines economics, computer simulation, and cybernetic control.

VI. Conclusion

This study presents a novel approach to economic automation testing. The experiments using the Russian and Ottoman Empires in *Victoria II* demonstrate that a code-inspired algorithm can significantly improve industrial output, budget performance, and overall efficiency.

Author Note

This research is done by the author himself without any external support. The author will upload all information and results etc. about this research on the Open Science Foundation Website- OSF | Cybernetic Automated Economy Research and Simulations. The research will be continued and all progress will be uploaded on the OSF Website.

Appendix A

Psuedo-code for Experiment 1:

if steel_production < steel_usage then:

if treasury > required_amount_to_build_steel_factory + 8k then:

build steel factory

until steel_production > steel_usage

if any construction item < requirements then:

buy max from world market until construction items are enough

when construction items are enough:

automate trade

and same will follow with cement and machine parts too

Appendix B

Pseudo-code for Experiment 2:

If item_produced< item_used then

if treasure > factory_cost+5k then

Build item_factory

Until item_produced > item_used

If any construction_item< factory_construction_requirements then

buy 2000 from the world market and build factory of the same material

When construction_items<= factory_construction_requirements then

automate trade

(This will follow with all other items and Heavy Industry will be prioritised then normal good then military goods)

Build factories in the province with the most unemployed craftsmen

If item_production=item_used then

Build 1 factory of the same type

If treasury_profit>100 for more than 10 days then
Invest 5 percent in Administration and Education

Wait for 15 days

If treasury_profit<0 for more than 15 days then

remove 5 investment from Education and Administration

wait for 10 days

If estimated_output_of_item > 150% item_consumption then

Stop building more item_factory

Factory Construction Priority:

Steel, Cement, Machine Parts > Other Consumer Goods > Synthetic Raw Material > Military Goods

Also build those factories first with a higher gap between production and usage

If education =100% and administration= 100% then

Start military investment and progress according to the previously used algorithm but now just including this investment

If treasury>50k and profit>0 then

Build railroads

Until all possible railroads in all provinces have been build while keeping budget constraints in mind

Minimum treasury should be 20k

If treasury > 100k and treasury_profit>50 and investments=100% and no railroads can be made then

Decrease tax by 5% for payment until it reaches minimum level supported by the formula (The tax reductions will be done gradually)

high_tax= middle_tax + 20%

middle_tax= low_tax + 10%

wait for 10 days

(these high, middle and low are sections of the society according to their wealth and prosperity as categorized in Victoria II)

If any factory_use_material is low then

Buy 2000 from market

If treasury_profit<0 then

automate the least important trade

If (factory_production = 0) = 2 for a specific item then

Stop building item_factory

Appendix C

Results of Experiment 1:

Figure 1: Steel Production Screen of Experiment 1 (Russian Empire)

Figure 2: Cement Production Screen of Experiment 1 (Russian Empire)

Figure 3: Machine Parts Production Screen of Experiment 1 (Russian Empire)

Appendix D

Results of Experiment 2:

These are the percentages of production of some important things-

- **Ammunition, Small Arms, Artillery, Steel, Machine Parts, Explosives**: New factories
- **Cotton**: +1163.89%
- **Iron**: +1093.44%
- **Coal**: +951.35%
- **Sulphur**: +686.11%
- **Furniture**: +329.90%
- **Glass**: +234.93%
- **Wool**: +220.36%
- **Grain**: +212.69%
- **Lumber**: +187.50%
- **Timber**: +139.53%
- **Liquor**: +113.49%
- **Fabric**: -77.76%
- **Regular Clothes**: -65.98%
- **Cement**: +55.56%
- **Fertilizer**: -51.52%
- **Luxury Furniture**: -50.00%
- **Wine**: -47.65%
- **Paper**: +44.91%
- **Luxury Clothes**: -33.33%
- **Canned Food**: -30.30%

The production is reduced in some items because of low demand and full mobilization.

Figure 4: Budget screen at the start of the simulation in Experiment 2 (Ottoman Empire)

Figure 5: Budget screen at the end of the simulation in Experiment 2 (Ottoman Empire)

At the start of my simulation in the Figure 4, there was 50 percent tax on all types of citizens and education, military and administration spending was at 50 percent. You can also see that the treasury is really low and there are losses, so it cannot sustain itself with the current budget. Also if you see at the top, the literacy rate is 7.8%. In Figure 5, after nearly 40 years, the situation has changed completely. The treasury is first of all overflowing with money, the tax is now progressive with the poor section only being taxed 25%. The education, administration and military spending is also at 100% and if you see on the top, the literacy rate is now 30.7%!