THE ROLE OF INTERACTIVE GAMES IN LEARNING PROCESSES

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Abstract

This paper aims at presenting the design, implementation, and outcomes of an interactive game (MultiCountry), highlighting its potential for fostering mathematical and quantitative learning in economics, as well as its ability to artificially generate quantitative data that can be effectively used in experimental economic research. The game is based on the Macrosim software, developed at the University of Wisconsin-Madison (UW), which can be applied in various contexts, including macroeconomics, the banking industry, and futures contracts. As expected, the results of the game show that students are gradually able to understand how their economy works and how it responds to their own decisions and those made by other players. Moreover, simulation-based games play a crucial role in modern economics education. These tools transform abstract and often complex theoretical models into immersive, interactive environments, thereby facilitating deeper student engagement, enhanced motivation, and improved knowledge retention. They enable experiential learning, allowing students to experiment with policy variables or market decisions in a low-risk setting, observe the dynamics of their choices in real time, and critically reflect on outcomes—elements shown to foster critical thinking, strategic decision-making, and problem-solving skills. Further, simulations provide educators with rich, generated datasets, creating valuable opportunities for analysis, hypothesis testing, and empirical study within experimental economics frameworks. Overall, the combination of active learning, immediate feedback, and realistic modelling situates simulation games as powerful pedagogical instruments for developing both theoretical understanding and quantitative competence in economics students.

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1. Introduction

The aim of this paper is to present the development, implementation, and outcomes of an interactive game carried out within the course "*Scenario Analysis*", offered from the 2005–2006 academic year at the Faculty of Economics, University of Urbino Carlo Bo. The course is part of the postgraduate degree curriculum. The purpose is to highlight the educational potential of this approach, both in terms of fostering mathematical and quantitative learning in economics and in generating artificial quantitative data that can be effectively used in experimental economics research.

Following the example of Anglo-Saxon countries, in recent years Italian economics faculties have increasingly embraced student-centered teaching methods. What are the advantages of this approach? Traditional methods, based solely on textbooks and frontal lectures, tend to emphasize mathematically consistent models used to assess the effects of changes in initial conditions on equilibrium, and to interpret real-world phenomena. However, for purposes of exposition or to obtain closed-form solutions, model equations are often specified in ways that are unrealistic or raise concerns. As a result, limited attention is given to how model outcomes depend on the estimated or assumed values of various parameters. Instead, simplified diagrammatic representations are used, and students are expected to analyse these to understand the effects of changes in policy variables.

In contrast, our perspective is that students are more engaged when confronted with situations that closely resemble the actual functioning of markets. They appreciate being able to test their ability to achieve autonomously chosen goals, and to leverage their competitive spirit in comparison with their peers. These learning Targets can be met by means of interactive applications that simulate specific market environments. In recent years, thanks to low-cost IT developments, the availability of such applications has grown significantly. The Department of Economics at the University of Wisconsin–Madison (UW) has been a pioneer in this field, having introduced the use of interactive games in economics courses as early as the 1970s.[1]

This paper presents the outcomes of an interactive game based on the Macrosim software, developed by Prof. Donald Hester at the UW-Madison, which can be applied in various contexts. Currently, the software allows for the simulation of:

a) A global economy in which each student represents a country
b) A banking market where each student represents a bank aiming to maximize the value of its capital, with the instructor acting as the central banker
c) A futures contracts market.

Our analysis focuses on the global economy game (MultiCountry). The game is interactive in nature, as the collection of countries constitutes a closed global economy in which total exports equal total imports and the world balance of payments is zero.

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[1] See Hester (1987, 1991) for more on these topics.

The game serves multiple purposes. First, it enables students to understand the constraints faced by economies when selecting macroeconomic targets. Second, it encourages the identification of optimal combinations of instruments and decisions to achieve multiple targets. Third, it illustrates the limitations imposed by random shocks, supply constraints, and international economic conflicts. Lastly, it demonstrates how even a basic understanding of economic mechanisms can lead to improved outcomes.

Students are not informed of the model parameters, but they are told that the model – identical for all participants – is composed of equations that represent standard macroeconomic theories of consumption, investment, money demand, and price and wage setting, as commonly presented in textbooks.

The software implementation of the MultiCountry game is an evolution of Macrosim, which has undergone various changes since its initial creation and has been rewritten in multiple programming languages, most recently in Fortran. Macrosim has now been almost entirely redesigned as a web-based application using dynamic pages (ASP Active Server Pages), a Microsoft Access database, and a Windows platform thanks to the contribution of L. Sorini first and M. Cappellacci[2] later. This choice – while not binding – was made to ensure that the game is no longer restricted to proprietary software, but accessible via the web in a cross-platform format. Students can therefore interact with the game beyond class hours and in real time.

The results of the game, based also on student evaluations, have been overall satisfactory. As expected, students progressively learn how their economy works, and how it reacts both to their own decisions and to those of other players.

Nonetheless, some modifications are necessary regarding both the game's conduct and the software itself. For the former, intermediate discussions and presentations of results (e.g., every 3–4 rounds) could enhance comprehension and guide students in preparing the final report. As for the software, one proposed improvement aims at simplifying the input interface: instead of entering numerical values, students would make predefined choices using a "*fuzzy logic*" approach (e.g., "*maintain*", "*slightly increase*", "*significantly decrease*"). This would allow students to focus more on strategy than on specific quantities and reduce the risk of erroneous inputs affecting the instructor's assessment.

To further enhance competitiveness and encourage coalition-building, a real-time ranking system has been introduced. Using a loss function, the system estimates each player's performance relative to their declared targets. This "*popularity index*" is expected to boost motivation and strategic interaction.

Another proposed enhancement is the introduction of a "*policy coherence*" indicator. Currently, students declare which targets they intend to achieve and their corresponding values. It would be useful to require them also to specify the economic policy strategies they plan to use, allowing the system to assess not only the quantitative outcomes but also the consistency of their policy choices.

The game provides two interfaces: a "*Front*" for students and a "*Back*" for instructors. The instructor has access to a web-based console to launch and monitor the game in progress.

The operating model begins with student registration: during a predefined period, each player creates an account with a personal password and selects a country. Once registration

[2] Marco Cappellacci is the current head of ICT at the Carlo Bo University of Urbino

is complete, students access their personal virtual space to begin playing and interacting with others. At this stage, each player is required to declare at least one target among the four available:

Table 1 — Declared policy targets

Declared Policy Targets
NET NATIONAL PRODUCT GROWTH RATE
NATIONAL UNEMPLOYMENT RATE
NATIONAL INFLATION RATE
GOVERNMENT SURPLUS IN PERCENTAGE OF NNP

Once the declaration of intent has been submitted and at least one target has been quantitatively defined, the player can access their personal console, from which they can:

- View the local situation of their assigned country
- View the global economic situation
- Modify their own parameters using specific tools
- Display charts related to selected indicators
- Configure their personal console.

All modifications made by each player/student will take effect at each Run of the model. The Run is managed by the instructor/administrator, who may either execute it manually at their discretion or set it to run automatically, specifying both the execution time and the interval between successive runs (Figure 1). The system's operating logic can be summarized by the following diagram:

Figure 1 — Run scheme

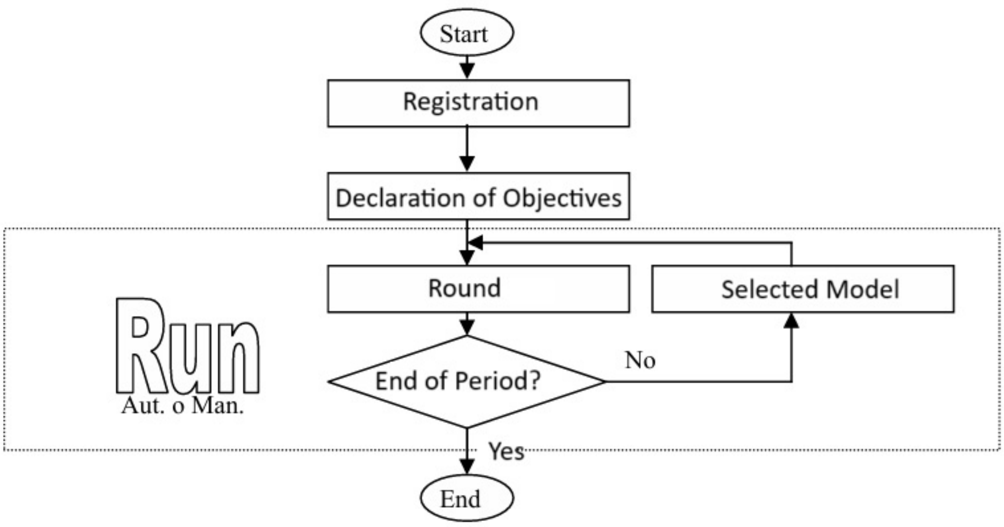
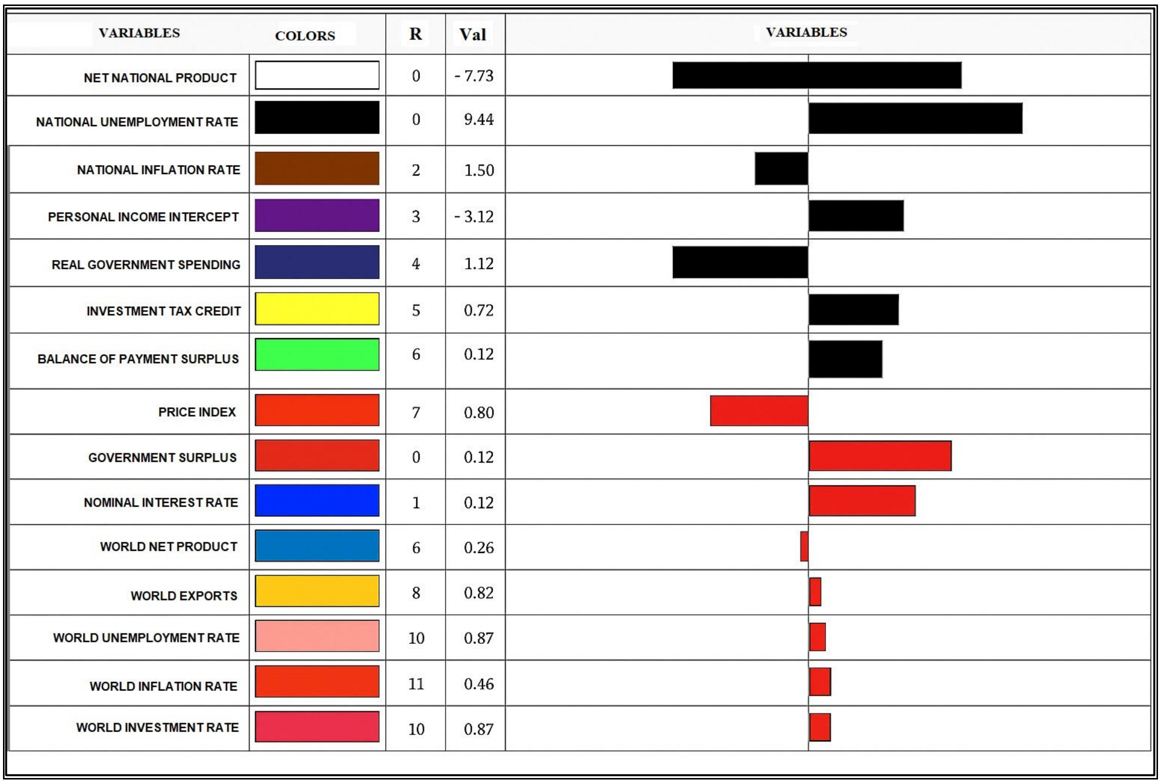


Figure 2 — Console



VARIABLES	COLORS	R	Val	VARIABLES
NET NATIONAL PRODUCT		0	- 7.73	
NATIONAL UNEMPLOYMENT RATE		0	9.44	
NATIONAL INFLATION RATE		2	1.50	
PERSONAL INCOME INTERCEPT		3	- 3.12	
REAL GOVERNMENT SPENDING		4	1.12	
INVESTMENT TAX CREDIT		5	0.72	
BALANCE OF PAYMENT SURPLUS		6	0.12	
PRICE INDEX		7	0.80	
GOVERNMENT SURPLUS		0	0.12	
NOMINAL INTEREST RATE		1	0.12	
WORLD NET PRODUCT		6	0.26	
WORLD EXPORTS		8	0.82	
WORLD UNEMPLOYMENT RATE		10	0.87	
WORLD INFLATION RATE		11	0.46	
WORLD INVESTMENT RATE		10	0.87	

At the end of the period, each player/student can only view the local state, the global state, and the possible convergence toward the previously defined targets, without having the ability to further modify their data using their personal tools.

The instructor/administrator has access to a database of information from which the entire trajectory of each individual player/student can be reconstructed, run by run, from the initial situation to the final one. This allows for a detailed review of all decisions made in relation to both the local and global contexts at each point in time. The following figure 2 shows a screenshot of the student console displaying the graphical trend of the Net Product, both local and global, after 10 runs.

The game allows players/students to cooperate and/or compete, making the simulation more realistic and the study of economic dynamics more engaging.

2. Game Description and Analysis of Results

The following presentation is based on data generated during a role-playing exercise involving sixteen students. While the limited number of participants may constrain the generalizability of the results, this limitation is partially offset by the relatively high number of rounds (10). Nonetheless, the decision was made to present the results to encourage and deepen discussion on the use of this methodology in teaching topics that lie at the intersection of economics and quantitative sciences. Forecasting is a complex process that first and foremost requires a thorough understanding of the environment in which one operates. This environment consists of the relationships among various variables and the behaviour of other actors involved. In real-world settings, such information is typically only partially known, although familiarity tends to increase with time spent operating within the system. Another factor that often significantly affects forecasting results is the occurrence of exogenous shocks to the environment. These shocks may be interpreted as a measure of our ignorance about the functioning of the model describing the environment in which we operate. Finally, forecasting outcomes also depend on decisions made regarding the variables under the player's direct control (i.e., policy instruments). *MultiCountry* is a model that simulates a global economy. Each participant represents an individual economy whose economic outcomes are determined by all the factors mentioned above: the player's ability to learn how the economy works, their decisions, the behaviour of other players, and the occurrence of shocks. The exercise conducted with the students unfolded in several phases. In the first phase, each student was asked to analyse the economic situation of the country randomly assigned to them. This analysis was summarized in a one-page report inspired by existing macroeconomic bulletins (e.g., ISAE reports) distributed at the beginning of the exercise. In the second phase, students were required to declare their economic policy targets. As this was their first experience with the simulation, they were advised to limit the number of selected targets to two or three. To facilitate the selection process, a dedicated web page was made available, allowing students to choose from four targets:

- Real income growth rate
- Unemployment rate
- Inflation rate
- Government surplus-to-GDP ratio.

Table 2 shows the percentage distribution of selected targets, while Table 3 reports the distribution of how many targets each student chose.

Table 2 — Percentage distribution of selected targets

Targets	Absolute Values	Percentage Distribution (%)
Real income growth rate	14	48.3
Unemployment rate	7	24.1
Inflation rate	4	13.8
Government budget balance-to-GDP ratio	4	13.8
Total	29	100.0

It appears that most students were primarily "concerned" with the national income growth rate, which accounts for nearly 50% of the selected targets, followed by the unemployment rate. Less importance seems to have been given to the goals of inflation control and maintaining a balanced government budget.

Most students (over 60%) limited themselves to selecting only two targets. Around 30% chose just one target. No students selected three targets, and only one student chose to set targets for all four goal variables (see Table 3). Specifically, since the game consisted of ten rounds, students were asked to define their targets by round six and maintain them until round ten.

Table 3: Percentage distribution of the number of targets selected per student

Number of selected targets	Absolute values	Percentage distribution (%)
One target	5	31.3
Two targets	10	62.5
Three targets	0	0.0
Four targets	1	6.3
Total	16	100.0

In each round of the game, students could access a personal web page (account) displaying the national accounts of their economy. These accounts reflect the effects of their policy decisions, the presence of shocks, and the decisions of the other participants. The account also shows average values for the global economy. Students were able to access their account and submit values for policy instruments either from the university computer lab or from any other computer with internet access.

Each student's economy is described by a model consisting of several dynamic equations representing the behaviour of different economic agents—such as consumers (consumption function), firms (investment function), etc.—alongside a set of accounting identities (e.g., resource and use equations). Except for five variables that serve as policy instruments (exogenous variables not determined by the model solution), all other variables are endogenous (determined by the model's solution). However, some of the endogenous variables are constrained within specific ranges. For example, Net Domestic Product (NDP) cannot exceed its potential level; the nominal interest rate cannot fall below 1%, and the unemployment rate cannot fall significantly below 4%. Additionally, each economy is prevented from entering a financial crisis due to an excessive reduction in the real money supply.

Each behavioural equation includes random shocks and, in some cases, a trend component. Initially, the economies are similar but not identical; each is affected by different random shocks, and students' policy decisions tend to move them in potentially divergent directions. A notable feature of this simulation is that it represents a closed global economy in which the total exports of all countries are constrained to equal the total imports. Likewise, the global balance of payments is constrained to remain at zero.

The five policy instruments and their respective units of measurement are:

1. The intercept of the disposable income equation (billions of euros), IRd
2. Real public spending (billions of euros), G
3. Nominal money supply (billions of dollars), M
4. Investment tax credit (percentage values), Cti
5. Export tax credit (billions of euros), Ctx

The intercept of disposable income function (IRd) and the export tax credit (Ctx) can take both positive and negative values. The other three policy instruments (G, M, and Cti) must be strictly positive. An investment tax credit of 10 means that firms can deduct 10%

of their capital expenditures from corporate income taxes. This credit must remain below 100%; the software will disregard values above 99%. A value of 20 for the export tax credit means that exporters are granted a €20 billion credit to deduct from their total income tax liability. A positive export credit thus represents a subsidy for exporters. If the value were negative, the subsidy would instead benefit importers. In both cases, the public deficit increases by the absolute value of the tax credit, since it functions as a form of government transfer. The deficit also increases due to the investment tax credit selected by the student. The model assumes that international treaties prohibit import tax credits exceeding €50 billion. It is important to note that the money supply (M) is expressed in nominal terms. Real money supply decreases automatically as inflation rises, unless M is adjusted to offset price increases. Real money supply can easily be calculated using the price index. For example, if the nominal money supply is 293 and the price index is 1.10, the real money supply at the start of the following period is:

$$\frac{293}{1.10} = 266.4$$

Other public transfers and indirect taxes can be controlled by adjusting the intercept of disposable income function (IRd). For instance, a decrease in IRd by 50 implies that indirect taxes have been increased by €50 billion. Conversely, an increase in IRd by 30 implies that other transfers have risen by €30 billion.

In the initial year, potential Net Domestic Product (NDP) is set at 1633; this value increases over time as a function of capital stock (K) and labor force (LF).

Each student can influence changes in K through the dynamics of investment, while the growth rate of the labor force is exogenous and fixed at 2%. Price changes are governed by a traditional Phillips curve, which represents an inverse relationship between the inflation rate and the unemployment rate. Over time, the Phillips curve gradually shifts to the right as the capital stock increases. In year 1, the Phillips curve shows a discontinuity at an unemployment rate of 4%, which corresponds to the potential NDP for that year and an inflation rate of 3%. Finally, exchange rates are flexible and depend on the balance of payments (trade balance and capital flows), which in turn is a function of the real interest rate. In the following graphs, we report the values of the Loss Function, both in aggregate form across all targets and disaggregated for each individual target. The Loss Fun**ction** for a given round *t* is defined as:

$$LF_t = \alpha \frac{1}{N} \sum_{i=1}^{N} (x_i - x^*)^2 + \beta \frac{1}{M} \sum_{j=1}^{M} \left(y_j - y^*\right)^2 + \cdots \quad [1]$$

where:

- α and β are the weights that each student assigns to their selected targets, and they are normalized such that:

$$\alpha + \beta + \cdots = 1$$

- The terms following the weights α and β are the averages, at round t, of the squared deviations between the actual values of the target variables (e.g., x_i) and their preferred/optimal target values (e.g., x^*).

The averages for the two target variables (x and y) are calculated over a different number of observations, since not all students selected the same targets.

For example, referring to Table 3, 14 students chose the income growth rate (x) as a target, while only 4 students selected the inflation rate (y). As a result, $N = 14$ and $M = 4$.

Figure 3 shows the trend of the Loss Function [1] over the course of the various rounds, calculated for the global economy and considering all the target selected by the students.

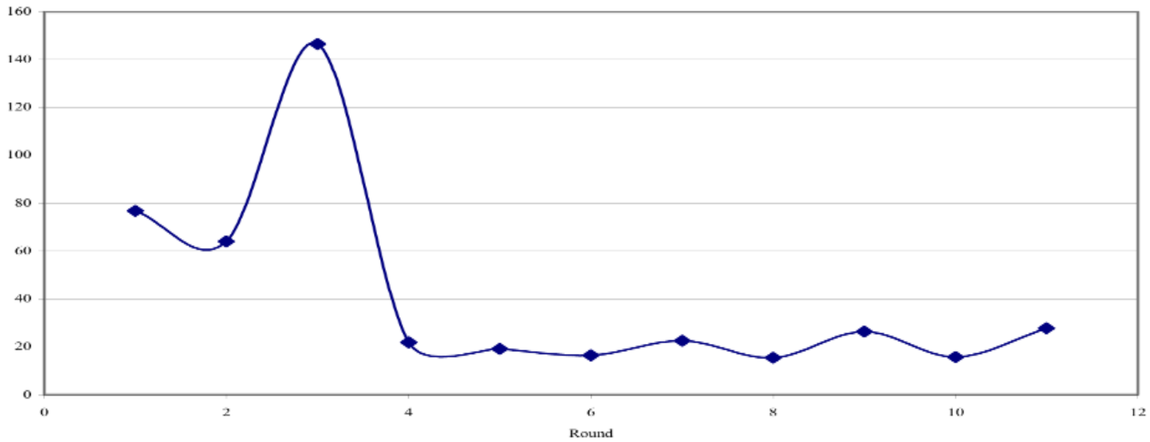
Each target was assigned an equal weight; thus, in the case of two targets, α and β are both equal to 0.5.

Subsequently, the simple average of each student's individual Loss Function was calculated, and these values are reported in Figure 3.

Except for Round 3, where the Loss Function takes on an anomalous value, the overall trend is consistent with expectations, suggesting a gradual learning process by the average player in understanding and managing the model.

Only in the final rounds does the attempt to keep the current target values close to their optimal values result in greater-than-expected variability.

Figure 3 — Loss Function (total)



The following four figures (Figure 4, 5, 6 and 7) refer, respectively, to the Loss Functions for the income growth rate, the unemployment rate, the inflation rate, and the government budget balance-to-GDP ratio.

Figure 4 — Loss Function (Net National Product)

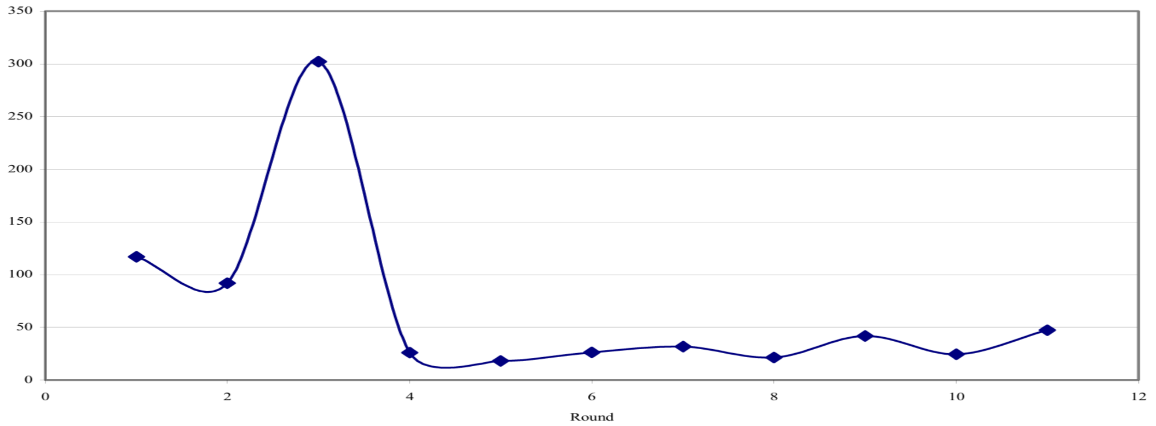


Figure 5 — Loss Function (Unemployment Rate)

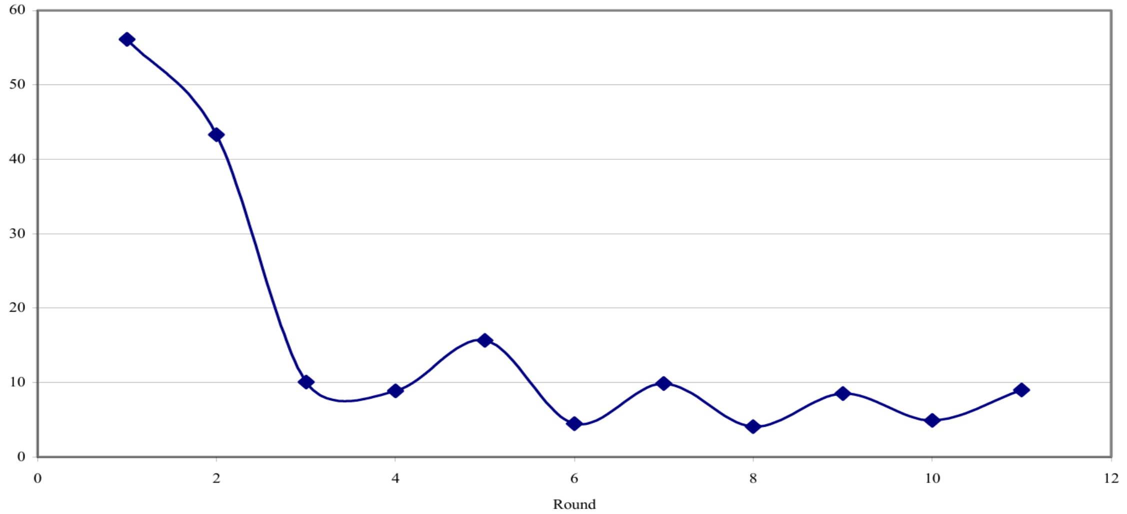


Figure 6 — Loss Function (Inflation Rate)

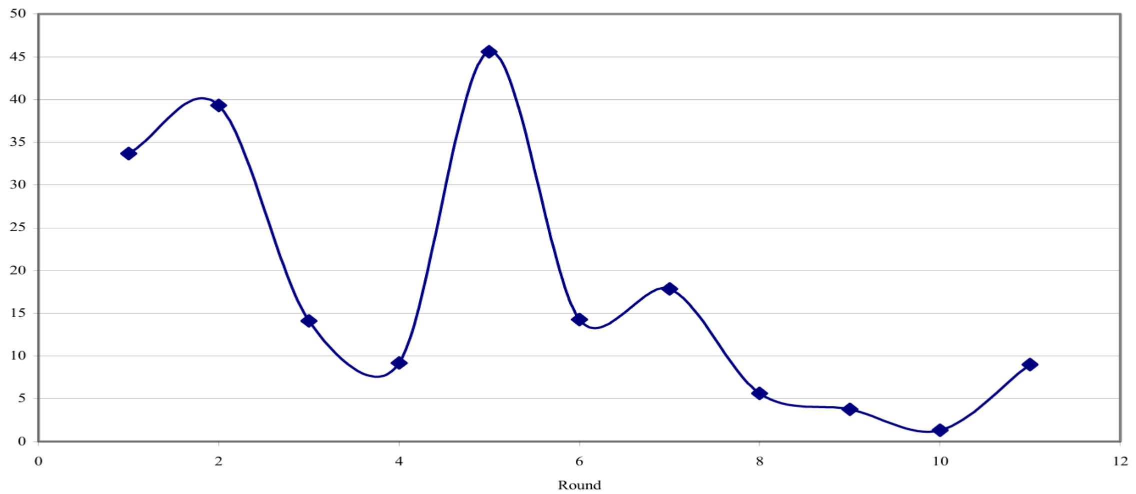
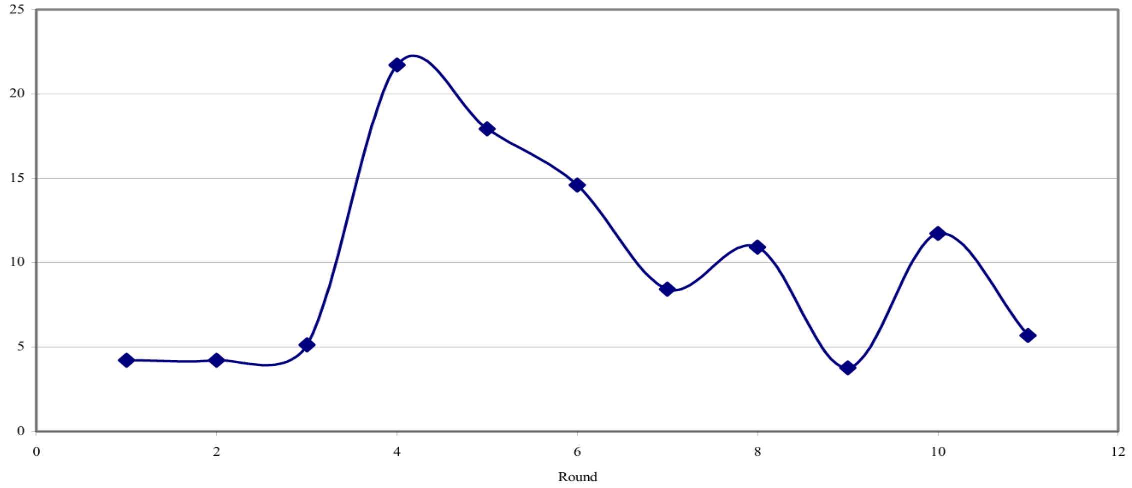


Figure 7 — Loss Function (Government Budget Balance-to-GDP Ratio)



As can be observed, the overall decreasing trend of the total Loss Function is also evident in the functions calculated for each individual target variable. This confirms that the students' process of learning the macroeconomic model was widespread and not merely the result of compensatory effects. In particular, the anomalous spike in the overall Loss Function observed in Round 3 is attributable to the Loss Function related to the income growth rate target (see Figure 4). Furthermore, the variability of the Loss Function in the final rounds appears to be largely associated with the difficulty students had in meeting the target concerning the government deficit-to-income ratio (see Figure 7).

When simultaneously considering the variability of the five policy instruments (measured by their respective standard deviations in each round), it appears that students' reduced ability to meet or maintain their targets may be linked to increased dispersion in their decision-making during the final rounds of the game, compared to the earlier phases. In other words, this phenomenon may reflect behavioural changes, particularly among those students who perceived a lack of satisfactory alignment between their targets and the actual results achieved. The attempt to reach their targets "*at all costs*" may have led some players to make excessive adjustments to the policy variables.

Indeed, a simple correlation analysis between each student's total Loss Function and the variability in their policy decisions reveals a positive relationship in the case of the two main instruments: real money supply (particularly strong in this specific case) and public spending, as well as for the export tax credit.

No significant relationship was found between the standard deviation of transfers to households (i.e., the intercept of the disposable income equation) and the individual Loss Function, while a slightly negative correlation was observed between the LF and the standard deviation of the investment tax credit.

The following figures present the standard deviations for each student across the five policy instruments. This analysis highlights that a few students – although limited in number – demonstrated considerable uncertainty regarding the appropriate direction for adjusting nearly all policy variables in order to reach their stated targets. For instance, Student 4 shows very high variability in the real money supply and is likely responsible for the anomalous LF value in Round 3 (see Figures 3, 4, and 9).

Similarly, Student 12 exhibits marked indecision regarding several policy instruments, particularly in the case of public spending, investment tax credit, and export tax credit, and to a lesser extent in public transfers (see Figures 10, 11, 12, and 8, respectively).

Figure 8 — Standard Deviation of the Intercept in the Disposable Income Equation

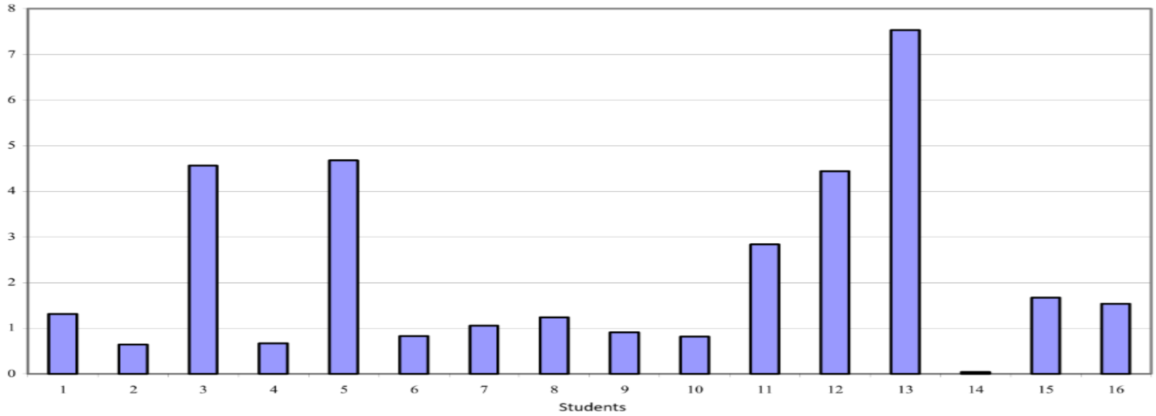


Figure 9 — Standard Deviation (Growth Rate of Real Money Supply)

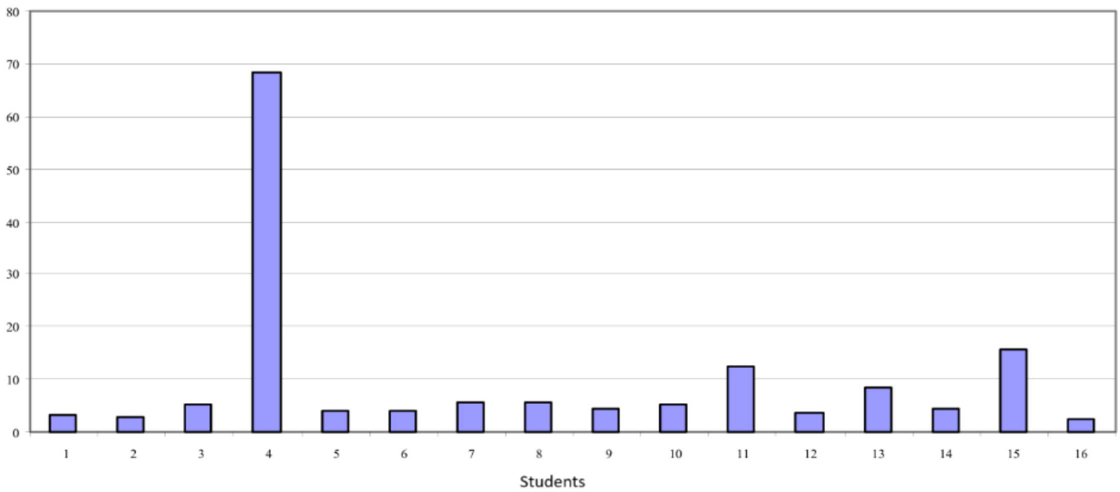


Figure 10 — Standard Deviation (Growth Rate of Public Spending)

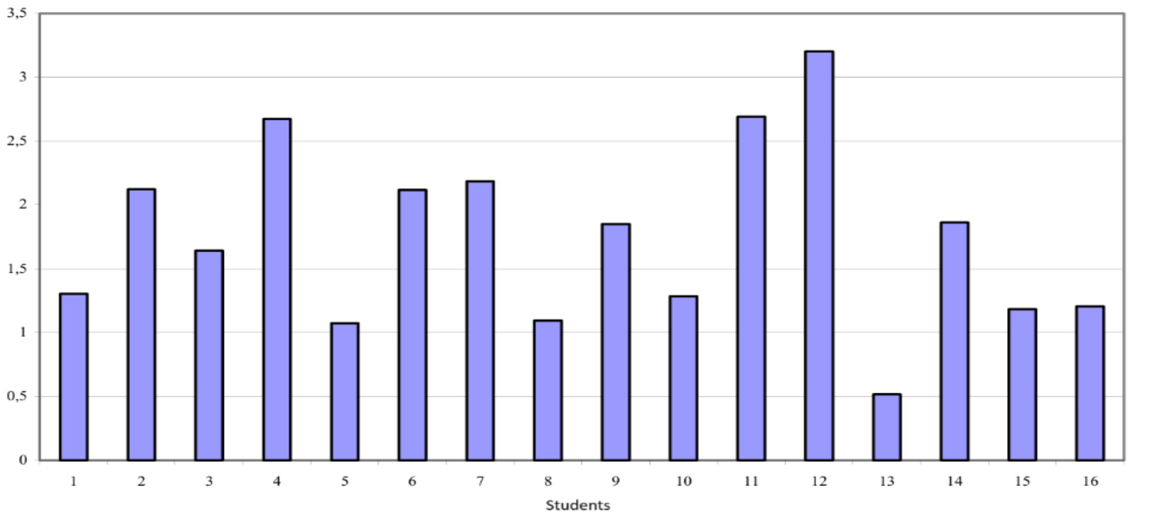


Figure 11 — Standard Deviation (Investment Tax Credit)

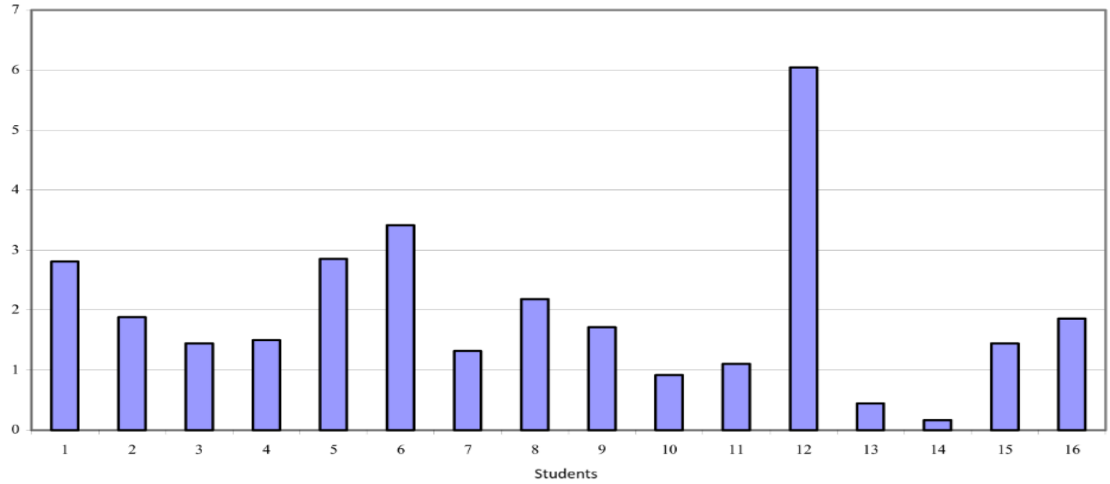
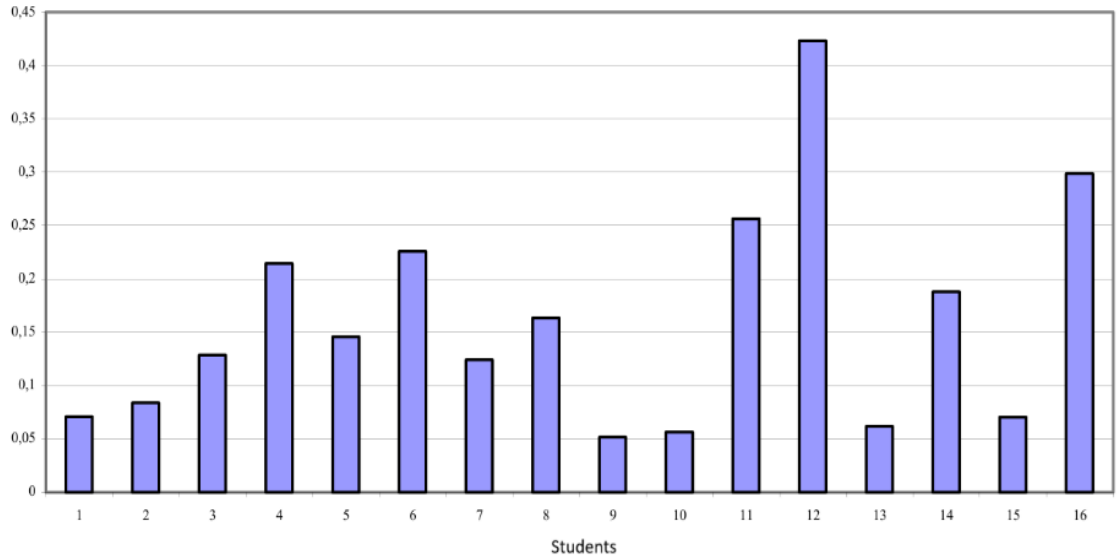


Figure 12 — Standard Deviation (Export Tax Credit-to-Income Ratio)



As a final exercise, the results of the game were evaluated by estimating a simple linear model of the form [2]:

$$y_{it} = b_1 + b_2 IRd_{it} + b_3 Cti_{it} + b_4 Ctx\_exp_{it} + b_5 dM_{it} + b_6 dG_{it} + \lambda_i + \phi_t + \varepsilon_{it} \quad [2]$$

In this model, y represents, alternatively, the income growth rate, the unemployment rate, the inflation rate, or the government deficit-to-income ratio.

The subscript i $(for\ i = 1 \rightarrow 16)$ denotes individual students, and t indicates the game round.

- IRd is the intercept of the disposable income equation, which—as previously noted—serves as a proxy for government transfers
- Cti is the investment tax credit
- Ctx_exp is the export tax credit expressed as a ratio to the level of exports

- dM represents the percentage change in the real money supply
- dG refers to the percentage change in real public spending.

The term λ_i captures unobserved individual-specific effects (student-level fixed effects), ϕ_t are time dummies (round-specific effects), and ε_{it} is the idiosyncratic error term.

It is assumed that $E[\varepsilon_{it}] = 0$, $E[\varepsilon_{it}|\lambda_i] = 0$ and $E[\varepsilon_{it} \ldots \varepsilon_{is}] = 0$ for all i, t and s.

Given these assumptions about the error structure, and the fact that all five explanatory variables are, by definition, exogenous, the model [2] can be estimated using Ordinary Least Squares (OLS).

The goal of this exercise is to test the significance of the various policy instruments employed by students in their efforts to achieve their declared targets. As such, the estimated coefficients of equation [2] can be interpreted as (pseudo) multipliers associated with each policy variable.[3]

The results of the fixed effects panel estimation are reported in Table 4.

Table 4: Panel Estimation (Fixed Effects, Equation [2])

Independent Variables	Income Growth Rate	Unemployment Rate	Inflation Rate	Government Deficit
Government Transfers (IRd)	1.172*** (0.288)	-0.117 (0.108)	0.272 (0.215)	-0.068 (0.070)
Investment Tax Credit (Cti)	-0.303 (0.329)	-0.097 (0.123)	0.233 (0.245)	0.003 (0.080)
Export Tax Credit (Ctx_exp)	1.067** (0.512)	0.591*** (0.192)	-0.989** (0.381)	-0.725*** (0.124)
Real Money Supply (dM)	-0.195*** (0.031)	0.096*** (0.011)	-0.411*** (0.023)	-0.067*** (0.007)
Public Spending (dG)	0.775*** (0.278)	-0.032 (0.104)	-0.442** (0.207)	-0.313*** (0.067)
Constant	-13.150*** (3.361)	5.151*** (1.259)	5.003** (2.502)	4.238 (0.813)

Note: Standard errors are shown in parentheses; ***, ** indicate significance at the 1% and 5% levels, respectively.

Time dummies: Yes (all models)

F-test:

- Income Growth Rate: F (14, 130) = 8.60***
- Unemployment Rate: F (14, 130) = 12.14***
- Inflation Rate: F (14, 130) = 42.10***

[3] Multipliers are combinations of the structural parameters of the model that link exogenous variables to endogenous ones. In our case, the estimated coefficients do not correspond exactly to the true multipliers of each exogenous variable, since these variables enter the original model in levels, but appear in equation [2] as percentage changes. For this reason, the coefficients are referred to in the text as "*pseudo-multipliers*". Equation [2] was also estimated using level variables; however, the results did not differ significantly.

- Government Deficit: F (14, 130) = 22.58***

Number of observations: 160 (all models)
Number of students: 16

Overall, the estimation results are satisfactory when evaluated using the F-test, which is highly significant in all four models. However, an analysis of the estimated coefficients reveals the presence of some signs that are contrary to theoretical expectations.

In the income growth equation, while the investment tax credit instrument does not appear to play any role in determining the growth rate of income, the coefficients for government transfers, the export tax credit, and the growth rate of public spending all have the expected positive sign and are statistically significant.

Also, statistically significant – but with an unexpected negative sign – is the coefficient for the growth rate of the real money supply (see Table 4). Based on the available information, it is difficult to explain this result; even when excluding Student 4, who shows an anomalous standard deviation for the growth rate of real money supply (see Figure 9), the results remain unchanged.

In the case of the unemployment rate equation, the only statistically significant coefficients are those of the export tax credit and the real money supply, but in both cases the sign is opposite to what theory would suggest.

Similarly, the estimation of the inflation rate equation yields results that are hard to reconcile with established economic theory. For instance, the estimated coefficients imply that an increase in the growth rate of real money supply and public spending is associated with a decrease in the inflation rate (see Table 4).

Finally, the results from the government deficit-to-income ratio equation are generally difficult to interpret, except for the coefficient for the growth rate of public spending.

The negative value suggests that an expansionary fiscal policy leads to an increase in tax revenues that outweighs the rise in expenditures, thereby reducing the deficit-to-income ratio (see Table 4).[4]

In this study, we described the functioning of a role-playing simulation – MultiCountry – and analysed the simulation results, consisting of the players' decision-making and the accounting data for each individual economy.

Students clearly demonstrated a learning process in understanding how their respective economies operate and respond to interactions with other players.

Less satisfactory, however, was the attempt to identify the multipliers of the five exogenous variables through the estimation of a simple linear model, in which the exogenous variables are the policy instruments under each student's control, and the endogenous variables are the declared targets.

In several cases, the estimated multipliers were either statistically insignificant or had signs contrary to theoretical expectations.

[4] However, this result is consistent with the finding that an increase in the growth rate of the real money supply leads to a reduction in the income growth rate and an increase in the unemployment rate.

3. Conclusion and future work

Future efforts will primarily focus on improving the software component, particularly in the following areas:

1. Implement automation for `mcsolver.exe`
2. Introduce a ranking system based on the Loss Function
3. Apply a fuzzy logic approach to the selection of policy instruments available to players
4. Further decouple the model architecture to enable internet access and use by external users
5. Deliver output reports to instructors via web.

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