Proceedings of the 2017 Winter Simulation Conference
W. K. V. Chan, A. D'Ambrogio, G. Zacharewicz, N. Mustafee, G. Wainer, and E. Page, eds.

DEVS MODELING AND SIMULATION BASED ON MARKOV DECISION PROCESS OF FINANCIAL LEVERAGE EFFECT IN THE EU DEVELOPMENT PROGRAMS

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ABSTRACT

The evaluation of development programs has become essential to verify their success. Indeed, it is necessary to develop prediction tools of the still-planned programs, in a special phase called ex-ante phase, to simulate the effects of fictitious programs or changes in the existing program structure in order to predict the level of leverage of a program from its design stage as well as during the project. The proposed paper consists of the definition of a DEVS-based Markov Decision Process model which, after simulation, may constitute an ex-ante evaluation of a development program. First promising simulation results are presented and seems to confirm the right way of the proposed approach.

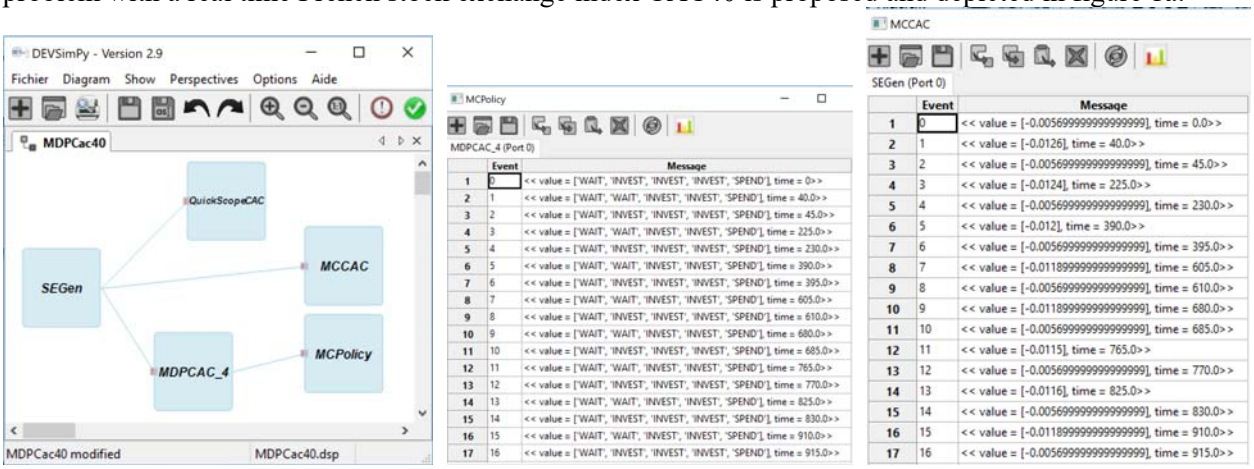
1 INTRODUCTION

The evaluation of development programs (and particularly rural economic development programs (RDPs)) has become essential to verify their success. Indeed, it is necessary to develop high-level prediction tools of the still-planned programs that are traditionally called ex-ante evaluation methods such as SWOT or Computable General Equilibrium Models (Leite 2011). This method simulates the effects of fictitious programs or changes in the existing program structure in order to predict the level of leverage of a program from its design stage as well as during the project. The ex-ante model is then validated from the spending review which analyzes the impacts of a program using the data from a survey carried out after the implementation of the program (Ahrweiler 2015).
Ex-ante control are therefore to estimate a behavioral model of development of a program using data collected prior to its implementation. Then, program changes are simulated (variation of program components) in order to visualize the impacts of the changes. One of the difficulties raised by ex ante evaluations is the identification of the causal effects of the action variables of a program. Some work considers ex post evaluation as a benchmark to compare the results of an ex-ante evaluation in order to assess the quality of the ex-ante evaluation. Behavioral development models (of a development program) are usually sets of equations linking action variables (economic). They can be static or dynamic and can use least squares or Markov chains. At present, there is a lack of behavioral model of dynamic development based on high-level modeling to assess the leverage effects of a development program in the course of a project.

The proposed poster consists of the definition of a Markov Decision Process (MDP) (Bertsekas 1987, Puterman 1994) model which, after simulation, may constitute an ex-ante evaluation of a development program. Modeling and simulation will be carried out using the DEVS (Discrete EVent system Specification) (Zeigler 2000) formalism known to be used to model complex systems with a modular and hierarchical way. We use the DEVSimPy (Python DEVS simulator) framework (Capocchi 2011) to implement the proposed model and give the first simulation results.

2 FIRST SIMULATION RESULTS

Thanks to the DEVS formalism, we can model and simulate the ex-ante phase of this set of processes as an interconnection of atomic models. Indeed, in accordance with the DEVS formalism, each atomic model will activate its internal transition function to unfold the process as planned by the ex-ante phase. The interest of our approach based on the use of the DEVS formalism lies in the use of the external transition functions to represent the stimuli (events) representative of the perturbations identified by the previous spending review. The DEVSimPy modeling of the financial leverage effect management problem with a real time French stock exchange index CAC40 is proposed and depicted in figure 1a.



(a) (b) (c)

Figure 1: (a) Financial leverage effect management modeling of the French stock exchange index CAC40 modeling into DEVSimPy; (b) Policy simulation results ; (c) CAC40 real time evolution.

Figures 1b and 1c show the first simulation results obtained with the MCPolicy atomic model that display the policy proposed by the MDPCAC_4 atomic model depending on the CAC40 evolution (generated by the SEGen atomic model in Figure 1a). The three states (WAIT, INVEST and SPEND) change depending on the CAC40 values in order to select the policy that leads to the best financial leverage effect. We can point out that the CAC40 is negative in this case but positive values can be considered by the model.

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