“Macroeconomic forecasting with ABM. Prediction and simulation of the impact of public policies on SMEs”

Federico Pablo-Martí, Antonio García-Tabuenca, Juan Luis Santos, María Teresa Gallo, María Teresa del Val, Tomás Mancha

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Summary

1. Introduction
2. Overview: rationale and relationships
3. Policy design in MOSIPS model:
   - The Small Business Act
   - The MOSIPS specific policy domains
4. Main conclusion
1. Introduction (1)

• Over the past decades, several models have been developed for assessing the costs and effects of implementing public policies.

• These approaches (with a representative agent) neglect that the economy is a complex system made up of heterogeneous interacting agents (Wolf et al., 2011, a), and present major shortcomings:

  – the interactions between the agents,
  – endogenous aspects as fixed variables.
  – if they provide a general view -DSGE models-, refer to global rather than local areas.
  – when they include various types of individuals, they do not capture the differences (Colander et. al, 2008).
  – controversial assumptions of rationality and perfect information (Kirman, 2010).
  – reveal difficulties to forecast bubbles and crises (Committee on Science and Technology, 2010). Are not able to represent a significant deviation from the equilibrium growth path predicted.
1. Introduction (2) [ABM]

- These justify to use a new approach to study and forecast the effects that economic policies have on the business sector.
- Consequently, **agent-based models** (ABM) have increased their importance in Economics:
  - The ABM approach is **bottom-up**, starting with the specification of the agents involved in the economy.
  - Multi-agent models have been used to study economic systems in several ways:
    - **conceptual works** on agent-based economic models, (Tesoatsion and Judd, 2006)
    - focused on a **part of the economy**, for example, financial markets (Samanidou et al. (2007), Farmer and Foley 2009).
    - considering **the economy as a whole** are infrequent, but examples: (Gintis, 2006; Dosi et al., 2008; Mandel et al. 2009; and the EURACE model by Dawid et al., 2011).
1. Introduction (3) [MOSIPS Project]

- This paper presents the MOSIPS project, that focuses on simulating and evaluating policies for SMEs in a local or regional environment and according to different socio-economic scenarios.
- The results allow citizens and stakeholders know how the measures affect and enable them to interact in the decision-making process.

MOSIPS Project, Modeling and Simulation of the Impact of Public Policies on SMEs, is funded by the 7th Framework Programme of the European Commission. It is a 36 months project started on September 1st, 2011.

- The paper’s structure is inspired in the guide recommendations of the Dahlem Conference, and takes the multi-agent Lagom Regio model as a methodological guide (Wolf et al., 2011).
1. Introduction (4) [MOSIPS Project]

- The model includes a number of features of the previous referred models, but it represents the economy making the emphasis in actions and interactions in the process of **two basic types of agents**:
  - individuals and firms (SMEs basically),
  - and some other entities: the public sector, the financial system, and external sector).
- Therefore, at the **micro-level**, the model provides these agents and entities, and also determines **rules** for actions and interactions.
- Simulation on variables and parameters used lead to the analysis and forecast at the **macroeconomic-level**.
- The trajectories of the agents offer a dynamic standpoint that **overcomes the standard equilibrium models**.
- And the flexibility of simulations generate complex models, even **long term** (Wolf et al. 2011, b).
The MOSIPS model: main differential characteristics

- Big Data driven model
- Fine spatial resolution: complete geolocation of agents
- Based on the ‘proximity’ concept: mainly spatial but not only
- ‘Real’ bottom-up approach: from the individual to the institutions (family, enterprise, financial system...)
- Links and networks: double selection process (pairing, labor market, credit market...)
- Asymmetric evaluation of human capital
- Explicit consideration of entrepreneurial phenomena
- Model focused on the evaluation of policies for SMEs, involving citizens and stakeholders
Data bases of the MOSIPS Model

- POPULATION CENSUS
  - LABOUR FORCE SURVEY
  - MOBILITY SURVEYS
  - GLOBAL ENTREPRENEURSHIP MONITOR

- BUSINESS DIRECTORY
  - AMADEUS
  - PITEC
  - SURVEY ON ACCESS TO FINANCE

- INDIVIDUALS
  - HOUSEHOLD BUDGET SURVEY
  - INCOME TAX PANEL

- FIRMS
  - ESTABLISHMENT DIRECTORY

- HOUSEHOLDS

- ESTABLISHMENTS

- RASTER OF LOCATIONS
  - MACROECONOMIC VARIABLES
  - INCOME AND WEALTH DENSITY
  - PUBLIC FACILITIES
  - PRODUCTION DENSITY
  - POPULATION DENSITY
  - USES OF LAND / CORINE
  - TRANSPORT NETWORKS
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2. Overview

2.1 Rationale, and Agents and other components

Rationale:

a. MOSIPS model represents the dynamics and interactions of agents. It forecasts the evolution of an economic system over a time horizon of one quarter to several years.

b. It is based on a multi-agent approach at the micro-economic level. It can be used to model macro-economic features of a system.

c. Allows focusing in a specific part of the economy, at sector and spatial level.

d. Taking into account the firms and individuals’ characteristics, the model evaluates the effects of policies at a local level over them.
General Structure and data bases of the MOSIPS Model

Establishments
- FIRM LOCATION
- INNOVATION
- PRODUCTION

Firm Location
- LABOUR DEMAND
  - LABOUR MARKET
  - LABOUR SUPPLY

Firm Location
- MERGERS & ACQUISITIONS
  - FIRM DEMOGRAPHY
  - ADULTS

Firm Location
- ENTREPRENEURSHIP
  - GOODS AND SERVICES MARKET
  - FINANCIAL MARKET

Productive firms
- FIRM GROWTH

Individuals
- LIVING (AGEING, & DEATH)
  - CHILDREN
  - EDUCATION

Immigrants
- PAIRING
  - MIGRATION & MOBILITY
  - BIRTHS
  - NEWBORNS

Households
- CONSUMPTION ANS SAVINGS
  - MACROECONOMIC ENVIRONMENT
  - PUBLIC POLICIES

Financial firms
- CONSUMPTION ANS SAVINGS

Public Sector

External sector
Agents:

a) **INDIVIDUALS**: people in the place under study the previous period.

b) **IMMIGRANTS**: people arriving in period t, to the place under study.

c) **HOUSEHOLDS**: groups of individuals of the same family living together.

- The model uses information about them (number, location, work place, education...). They are taken into account as a kind of agent:
  - owners of the firms,
  - workers,
  - and the final purchasers of goods and services produced by enterprises.
  - located in the territory (residence and their workplace)

d) **PRODUCTIVE FIRMS**: owned by individuals.

e) **ESTABLISHMENTS**: the place where firms develop their activity.

- They are the key agent in MOSIPS system: the **effect of public policies** over them.
- MOSIPS uses information relative to the activity level (surplus, location, R&D ...)

**Agents’ properties**: reactivity, proactivity, social skills and autonomy.
Other entities

- In addition to these two basic types of agents, other complementary entities:
  a) **FINANCIAL FIRMS**, mail role to facilitate funding to whichever agents.
  b) **PUBLIC SECTOR**, the different authorities.
  c) **EXTERNAL SECTOR**, the aggregation of firms and individuals not located in the place under study.

- They do not make decisions directly, but the evolution of their behaviours impacts on the creation of the expectations and decisions of firms.

Markets

- Where agents and other entities relate to each other:
  a) **LABOR,**
  b) **FINANCIAL,**
  c) **GOODS AND SERVICES MARKET.**
Other components

- Agents, other entities and markets are affected by:
  
  a) The MACROECONOMIC ENVIRONMENT
  
  b) PUBLIC POLICIES

-The macroeconomic environment and public policies have a lot of influences over the decisions of the individuals and enterprises.

-The model uses a high number of macroeconomic information in order to create agents’ expectations.
3. Public Policies

3.1 Small Business Act and MOSIPS policy domains

- The SBA forms the ‘enabling framework’ of the EU for improved SME performance (EC, 2008). **Ten principles:**
  1. Create an appropriate environment for entrepreneurs.
  2. Ensure that entrepreneurs that face bankruptcy get a second chance.
  3. Design rules according to the “Think Small First” principle.
  .../
  10. Encourage and support SMEs to benefit from the growth of markets.

- The MOSIPS project takes the SBA as the core area for analysis and modeling.
- We identify the **ten policy domains** according to the rationale of MOSIPS model.
Ten Policy domains of MOSIPS model implementation-oriented

- Macroeconomic environment
- Entrepreneurial activity
- Infrastructure
- Innovation
- Internal managing
- Inter-firm relations
- Labor market
- Funding
- Regulation and red tape
- Environment

Cost function
- Data
- Behavior
SBA principles

- Entrepreneurship
- Second chance
- Think small first
- Responsive administration
- State aid & Public procurement
- Access to finance
- Single market
- Skills and innovation
- Environment
- Internationalization

MOSIPS domains

- 2. Innovation
- 4. Environment
- 5. Entrepreneurial activity
- 7. Funding
- 10. Regulation & red tape
3.2 Design of policy in MOSIPS model

- To illustrate how these ten policy domains are included in the model, it is presenting one of the modules of MOSIPS model: Firm demography.

- The main operational assumptions for firm demography are:

  - Entrepreneurs who have no firm trying to create it.
  - Entrepreneurs who have at least one firm are businessmen.
  - Businessmen may own more of a business.
  - Entrepreneurs determine the desirable characteristics of their new firms before creating them.
  - If they have funding so they create them.
  - To create a firm is mainly a legal issue. It’s possible a firm without establishments.
  - If the performance of firms is too low then they close. The establishments of the closed firms become free.
Firm demography

Does the entrepreneur have any firms?

Determines the characteristics of the new company

Evaluates if the businessman wants another firm

Does the businessman wants to create another firm?

Evaluates the performance of their firms

Does the individual want to close any firms?

End

Does it get funding?

End

Does it get licenses?

The entrepreneur creates the firm

The entrepreneur -> Firm

Does the individual have any remaining firms?

Stops being an businessman

End

Entrepreneur

Entrepreneur (Firm owner)

Entrepreneur

Entrepreneur (Firm owner)
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5. Conclusion and outlook

1. This work discusses the policy design in an agent-based model (ABM), in a 7FP (EU) project called MOSIPS,

2. It is aimed at the simulation and evaluation of policies for small and medium enterprises in a local or regional environment.

3. By contrast to traditional models, which give a partial view of the economic reality, and to the DSGE models, this approach focuses on the actions and interactions of the agents: firms and individuals.

4. The model includes ten policy domains, based on the ten principles of the SBA:
   - Every domain can affect the behavior of the agents, the data or the cost function of each establishment.
   - The model will allow the citizens and stakeholders participation, through the social networks.
THANKS FOR YOUR ATTENTION!