Chapter 5

An Agent-Based Model to Forecast the Inflation Rate in the Eurozone: Incorporating Microfoundations into Complex Behavioral Models

Juan Luis Santos  
University of Alcalá, Spain

Jagoda Anna Kaszowska  
Cracow University of Economics, Poland

Tomás Mancha Navarro  
University of Alcalá, Spain

ABSTRACT

The aim of the agent-based model presented in this chapter is to explain the determinants of inflation and to forecast the inflation rate in the Eurozone for the next five years. The behaviors of agents and their expectations are interrelated and explained by macroeconomic models applied to heterogeneous agents of three classes: individuals, companies and financial institutions. In addition, the behavior of public sector and central bank is also modeled with a single agent of each kind. Once the quantitative easing policy is implemented, the quantitative theory of money expects higher inflation rates in the long run. Inflation should remain low taking into account the Phillips-Curve. Last, according to the Aggregated Supply and Demand as well as to the Money Market equilibrium, the behaviors modeled allow forecasting low inflation. However, an external shock, as it would be an increase in the price of important commodities, can alter the inflation rate to a great extent.
INTRODUCTION

Agent-based models are increasingly applied to macroeconomic forecasting. However, they require high amounts of information of agents in terms of microdata and behavioral rules and they have only recently been used successfully thanks to several European Commission funded projects such as Eurace (Cincotti, Raberto & Teglio, 2012) and Mosips (Pablo-Martí et al., 2013; 2014). The aim of these initiatives is to improve the state of the art and they created massive agent-based models with millions of heterogeneous agents of different classes. The frameworks of these projects are the ones used as building blocks to develop the agent-based model presented in this chapter.

In the background section previous related research it is studied. The main flaw of past approaches is the lack of agents’ variety with respect to classes (individuals, corporations, financial institutions, etc) and behavioral rules variety. Behavioral rules are a key point to the validity of an agent-based model and in Economics they tend to be selected from Microeconomic Theory. However, since 1970s Macroeconomic Theory incorporates microfoundations. These models have important drawbacks and should be replaced for agent-based models because their assumptions made them unable to predict disruptive changes in the economic growth such as the recent financial crisis (Colander et al., 2008) and also because the equational models have important flaws that can be solved with algorithmic models (Velupillai & Zambelli, 2015). However, they allow explaining macroeconomic variables such as Gross Domestic Product (GDP) growth. Therefore, they can be included in the set of behavioral rules of agents. In the chapter it is explained how it can be performed in an agent-based model aimed to forecast the inflation rate.

In the third section, the three macroeconomic theories that aim to explain inflation performance are explained. They are the quantitative theory of money, the Phillips curve and the aggregated supply and demand as well as to the money market equilibrium. In general, they forecast low inflation except in the case of the quantitative theory of money that allows forecasting a high inflation rate in the long run under some assumptions about the behavior of agents.

In the fourth section, the agent-based model is presented following Dahlem guidelines. It makes it possible to arrive to a set of scenarios that incorporate different assumptions to the model in order to assess how they would impact on the inflation rate in the Eurozone for the next five years.

The agent-based model is built in order to cope with the main objective of the chapter: to study how behavioral rules impact on the level of prices. The most important transactions in the economy are modeled and their results modify the subsequent states and behavior of agents in the economy. The central bank is explicitly modeled and its decisions are also taken into account. Imports and exports are also incorporated as they modify the performance of companies. In addition to the actual inflation rate simulated in every period in the baseline scenario that aims to replicate the actual economy, it is possible to introduce shocks in the model in order to measure how agents react to different scenarios. Three conditions are tested: inflationary tensions, deflationary tensions and an oil shock. The agent-based model developed allows the implementation of counterfactual analysis useful for monetary policy.

BACKGROUND

Complex agent-based macroeconomics is a research field recent that has benefited of the increasing availability of big amounts of available data, new systems that allow computing at a higher speed and the inadequacy of the previous paradigm, dynamic stochastic general equilibrium (DSGE) models. These