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Assessing Brazilian macroeconomic dynamics using a Markov-switching DSGE model

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Abstract

The goal of this paper is to evaluate the behavior of the main parameters of the Brazilian economy through the estimation of an open-economy dynamic stochastic general equilibrium (DSGE) model using Bayesian methods and allowing for Markov switching of certain parameters. Using the DSGE model developed by Justiniano and Preston (2010) and the solution method of the Markov switching DSGE (MS-DSGE) model proposed by Farmer et al. (2008), this paper found a superior fit in the data of Markov switching models, rejecting the hypothesis of constant parameters in DSGE models for the Brazilian economy.

JEL classification: C51; E32; C11

Keywords: DSGE model; Markov switching; MS-DSGE

Resumo

O objetivo deste trabalho é avaliar o comportamento dos principais parâmetros da economia brasileira através da estimação de um modelo DSGE (*Dynamic Stochastic General Equilibrium*) de economia aberta usando métodos bayesianos e permitindo mudanças de regime markovianas de determinados parâmetros. Utilizando o modelo DSGE desenvolvido por Justiniano e Preston (2010) e o método de solução do modelo Markov *Switching* DSGE (MS-DSGE) proposto por Farmer et al. (2008), este trabalho encontrou superioridade nos ajustes dos dados dos modelos que incorporaram mudanças markovianas, rejeitando a hipótese de parâmetros constantes em modelos DSGE para a economia brasileira.

Palavras-chave: Modelo DSGE; Markov *Switching*; MS-DSGE

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1. Introduction

This paper assesses the behavior of the major Brazilian economic parameters after the Real Plan using the Markov switching-dynamic stochastic general equilibrium (MS-DSGE) model.

Dynamic stochastic general equilibrium (DSGE) models have become a standard tool for macroeconomic analysis. The advancements made since the first real business cycle approach have provided models with an increasingly higher capacity of capturing the characteristics of macroeconomic series. Theoretically, new features have been added to DSGE models, such as currency, international trade, real and nominal price rigidity, wages, and several shocks. This has enabled a more in-depth analysis of the relationships between aggregate variables and the effects of economic policies.

In practice, the theoretical and empirical progress of DSGE models has aroused the interest of central banks, as monetary authorities need a tool upon which policy decisions can be hinged. Fukac and Pagan (2006) described the historical path of DSGE models and highlighted their use mainly by central banks in developed countries.

Studies conducted for Brazil on DSGE model estimations suffer from a major drawback: the assumption that Brazilian economic parameters are constant.[1]

Nonetheless, it is known that parameters related to the central bank's reactions to key macroeconomic variables, such as inflation, output, or exchange rate, for example, may oscillate over time. To follow these movements closely, one can use Markov switching models to check for possible changes in the parameters of interest. However, the use of Markov models is restricted to reduced-form structural models.

Therefore, the combination of both approaches – DSGE and Markov switching models – best known as Markov switching DSGE (MS-DSGE) models, blazes a trail in the analysis of macroeconomic models, as it contemplates parameter changes over time in a more complex model.

In the international literature, several works deal with MS-DSGE models and with the solutions of Markov switching rational expectations (MSRE)[2] models. The debate was sparked off after uncertainties about the parameters of microfounded models came up and eventually evolved by the introduction of Markov switching into DSGE models.

The main differences between studies on MS-DSGE models lie in the parameters believed to vary according to the Markov process, in the basic theoretical model and in the solution method.

Initially, studies considered Markov regime shifts only in volatility shocks (Justiniano and Primiceri, 2008). Later, there was avid interest in monetary policy parameters such as inflation target (Schorfheide, 2005; Ireland, 2007; Liu et al., 2011), or in Taylor rule parameters (Bianchi, 2013; Foerster, 2013). Besides the parameters mentioned earlier, other ones from DSGE models with variation in the Markov switching regime (MS-DSGE models) were analyzed, such as technological growth rate and nominal price rigidity, Phillips curve parameters such as indexation rate or exchange rate pass-through effect or only the price rigidity parameter.[3]

In regard to the theoretical models that allow certain parameters to vary according to the Markov regime, we highlight those DSGE models proposed by Lubik and Schorfheide (2004), Christiano et al. (2005), Gali and Monacelli (2005), An and Schorfheide (2007), Smets and Wouters (2003) and Justiniano and Preston (2010), among others.

With respect to MS-DSGE solution models, studies have basically used the method put forward by Farmer et al. (2008) or that suggested by Davig and Leeper (2007), or a variant of these. In addition, most of these studies have employed Bayesian estimation methods. Recently, Foerster et al. (2013) have proposed a new method that utilizes perturbations to make approximations to MS-DSGE solutions.

In general, results have been positive. Liu et al. (2011) tested several models with different numbers of regimes for the U.S. economy and found that Markov regime switching models outperform those with constant parameters. Moreover, results were better in the presence of two regime shifts. Liu and Mumtaz (2011) estimated the first open-economy MS-DSGE model for the UK and their results showed the presence of large parameter changes.

This paper contributes toward the discussion about parameter changes in the Brazilian economy and is the first, to our knowledge, to use the DSGE model with parameter changes in Markov switching regimes. Additionally, the

[1] See, for instance, Silveira (2008), Carvalho and Valli (2010), Vereda and Cavalcanti (2010) and Castro (2011).

[2] See, for example, Davig and Leeper (2007), Farmer et al. (2008), Liu et al. (2011), Eo (2009), Cho (2011), Liu and Mumtaz (2011) and Bianchi (2013).

[3] See, for instance, Eo (2009), Liu and Mumtaz (2011) and Chen and Macdonald (2012).