# Modelling the central bank repo rate in a dynamic general equilibrium framework ☆

## Emanuel R. Leao[a],*, Pedro R. Leao[b]

[a] *Department of Economics, Instituto Superior de Ciencias do Trabalho e da Empresa and Dinamia, Avenida das Forcas Armadas, 1649-026 Lisboa, Portugal*
[b] *Department of Economics, Instituto Superior de Economia e Gestao, Technical University of Lisbon and UECE, Rua Miguel Lupi, No 20, 1200 Lisboa, Portugal*

## Abstract

This paper incorporates two components of a modern monetary system into a standard real business cycle model: a central bank which lends reserves to commercial banks and charges a *repo* interest rate; and banks which make loans under a fractional reserve system and thereby create money.

We examine the response of our model to shocks in the monetary base, in the currency–deposits ratio and in the required reserve ratio. Our main finding is that all these monetary shocks lead to changes in the composition of total investment between the banking and the non-banking sectors.
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## 1. Introduction

Modern monetary systems have two important features. First, there is a central bank which lends reserves to commercial banks and charges a *repo* interest rate (e.g., the "main refinancing

rate" of the European Central Bank). Second, there are banks which make loans under a fractional reserve system and thereby create money. This paper is an attempt to incorporate these elements into a standard Real Business Cycle (RBC) model.

RBC models were launched by Kydland and Prescott (1982) and Long and Plosser (1983), and were later given a more consistent framework by Hansen (1985) and King, Plosser and Rebelo (1988). These were dynamic general equilibrium models with a productive sector, intertemporal optimization under rational expectations and perfectly flexible prices — but without money. Later research added new dimensions to the basic model. Cooley and Hansen (1989) first incorporated money into RBC models by using a cash-in-advance constraint to derive the demand for money and assuming that money was supplied through lump-sum transfers from a monetary authority. Fuerst (1992) and Christiano and Eichenbaum (1992, 1995) made further extensions by introducing a banking system which receives cash injections from the central bank and lends money to the economy. However, unlike in the real world, the cash injections received from the monetary authority in their models are costless lump-sum transfers, and banks do not operate under a fractional reserve system.

By contrast, this paper extends the standard RBC model by explicitly including (i) a central bank that lends reserves to banks and charges a *repo* interest rate; and (ii) banks which make loans under a fractional reserve system and thereby *create money*. This extended framework will allow us to look at the impact of monetary shocks which have not so far been considered in the RBC literature. In particular, we will study how the economy and the banking system are affected by changes in the *repo* rate and by changes in the money multiplier (arising from variations in the currency–deposits ratio and/or in the required reserve ratio).

It should be acknowledged that other work has already modelled the central bank *repo* rate in a dynamic general equilibrium framework. Notable examples are the flexible-price models of Calvo and Vegh (1990, 1995) and Lahiri and Vegh (2003), and the sticky-price models of Clarida, Gali and Gertler (1999) and McCallum and Nelson (1999). However, unlike the present paper, these models do not include a fractional reserve banking system, nor a productive sector with endogenous capital accumulation. Additionally, the present paper goes beyond the qualitative comparison between the properties of the model and the stylized facts. In the RBC vein, we calibrate our model and then use it to generate artificial data that can be compared with actual data. In this way, the present paper attempts to meet the challenge set forth by Lucas (1980) when he wrote that one of the functions of theoretical economics is to provide fully articulate, artificial economic systems that can serve as laboratories for macro-economic analysis.[1]

We start by modelling the typical behaviour of households, firms and banks. The first order conditions of these agents' decision problems, together with the market clearing conditions, define the competitive equilibrium of the economy. Next, this system is log–linearized around the steady-state values of its variables and then calibrated using Postwar U.S. data. Finally, we examine the response of the model to shocks in the monetary base, in the currency–deposits ratio and in the required reserve ratio. Our main finding is that *all these monetary shocks lead to changes in the composition of investment between the banking sector and the non-banking sector*. More specifically, an increase in reserves by the central bank which is seen as temporary leads to a strong increase in investment by banks at the expense of investment by non-bank firms. In contrast, an increase in either the currency–deposits ratio or

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[1] On this issue, see Rebelo (2005) and King and Rebelo (1999).