



# Short-run and long-run effects of monetary policy in a general equilibrium model with bank reserves<sup>☆</sup>

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## Abstract

This paper presents a dynamic general equilibrium model that allows the distinct short-run and long-run effects of monetary policy to be explained. There are two main features of the model. The first is the consideration of a financial intermediary that must use money to meet legal reserve requirements. The second is the monetary policy mechanism: The increase in the quantity of money goes first to the financial intermediaries, which can lend the new amount of money to firms since the legal reserve requirements have been fulfilled and there are no new deposits. The increasing investment of firms is accompanied by higher production and consumption, which constitute the short-run effects of monetary policy. As time passes, the additional quantity of money reaches the consumers, which then increases their deposits. The reserves therefore rise, the real short-run effects disappear, and the price level becomes higher as a result of the greater amount of money.

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## 1. Introduction

Over the last 50 years, the economic literature has produced a large amount of work exploring the role that money plays in an economy. This fact is in part a consequence of the unsatisfactory

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state of the modern monetary theory, which involves some problems that have been pointed out by, among others, Samuelson (1968), Hahn (1993), Lucas (1993) and Wallace (1997, 1998).

One of the more fundamental problems is the failure of the general equilibrium theory to incorporate money into its standard models in a sound way, able to explain the disparate long-run and short-run effects of changes in the quantity of money. As noted by Lucas (1996) and Wallace (1997), a great part of the research effort made in macroeconomics since the 1920s has been an attempt to explain these distinct effects. As is well known, the long-run effects of changes in the quantity of money are mainly nominal, while the short-run effects are predominantly real.

In particular and as has been documented among many others by McCandless and Weber (1995),<sup>1</sup> Leeper et al. (1997), King and Watson (1997) and Monadjemi and Huh (1998), there is empirical evidence showing that, in the long-run, there is a high positive correlation between the growth rate of the money supply and inflation, and that, on the contrary, there is no long-run correlation between the growth rates of money and real output. However, when the short-run is analyzed, the quantity of money appears as an important variable positively correlated with output.

Together with these dichotomy between nominal and real effects, changes in the quantity of money also imply two seemingly contradictory facts in the interest rates, likewise linked to the long- and short-run. On the one hand, in the long-run, there is empirical evidence that supports a positive relation between money and interest rates, in the line of that present in the Fisher equation. On the other hand, in the short-run, the empirical evidence shows that money and interest rates are negatively related, which is consistent with the interaction of money supply and demand and the so-called *liquidity effect*. This empirical evidence on the relationship between money and interest rates has been recently commented on and reviewed by Bernanke and Mihov (1998), Christiano, Eichenbaum and Evans (1999) and Monnet and Weber (2001).<sup>2</sup>

As commented above, the observation of all these disparate long-run and short-run effects of changes in the quantity of money is, even today, challenging. Contributing to this research issue, this paper presents a dynamic general equilibrium model that can explain both the long-run and the short-run effects of monetary policy. There are two main features of the proposed model. The first is the consideration of a financial intermediary, that plays a role in facilitating production and capital accumulation, and that must use money to meet legal reserve requirements. The second feature is simplicity. The model is a representative agent model with no aggregate uncertainty and complete markets, where the production and financial sectors are integrated. Indeed, the resulting model is almost identical to a basic optimal growth model where the use of money is motivated by a cash-in-advance constraint. These two characteristics allow the real and nominal effects of distinct monetary policies to be studied from a simple, clear and intuitive perspective.

The closest reference for this paper is that by Chari, Jones, and Manuelli (1995). These authors also study the real effects of monetary policy in a general equilibrium model with banks required to hold reserves. However, they focus exclusively in the long-run, make use of more sophisticated models, and explain the real effects of the monetary policy in a different way. In particular, Chari, Jones, and Manuelli (1995) consider a model with two types of capital, one of them intermediated through the banking system. The existence of a reserve requirement ratio creates a wedge between the marginal products of the two types of capital in the economy, which, in turn, distorts the capital mix. Therefore, in the Chari, Jones and Manuelli model, changes in the reserve

<sup>1</sup> See also the numerous references provided by these authors.

<sup>2</sup> On this point see also Mishkin (1992) and Million (2003), who analyze the relationship between prices and interest rates.

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