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# An economic model for the interpretation of business cycles and the efficiency of monetary policy

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ABSTRACT

This paper attempts to investigate business cycles, assuming that both national income and the interest rate on loans are determined jointly in the product market and the banking sector. For this reason, a second order accelerator model in discrete time is combined with a two-stage Cournot game with scope economies for the oligopolistic banking sector. The presence of scope economies increases liquidity and hence, the destabilizing influence of the financial sector, affecting in turn the effectiveness of monetary policy. In addition, the model is calibrated to assess the ability of our system to interpret the cyclical path of national income over time and the possibility of the latter's convergence towards its steady-state. Performing a simulation process, we present the implications of different permanent shocks of monetary policy on national income diachronically.



## 1. Introduction

The present paper establishes a model for the interpretation of business cycles, concentrating on the assumption of the simultaneous determination of national income and the interest rate on loans in both the product market and the banking sector. To begin with the product market, we extend the Samuelson's (1939) multiplier-accelerator model, incorporating the second order accelerator for fixed investment (Hillinger, 1992, 2005) in discrete time in it. This mechanism provides a pure explanation of the endogenous origination of business cycles and complies with the stylized facts,[2] which imply a major role for investment in the fluctuations of economic activity. On the other hand, the banking sector is described by a two-stage Cournot model with scope economies. The intuition behind the introduction of scope economies is that their presence increases liquidity and thereby the destabilizing influence of the financial sector, affecting subsequently the effectiveness of monetary policy. Our purpose is the investigation of the effects of different shocks of monetary policy on the time path of national income.

Business cycles are eminently dynamic phenomena to which many different definitions have attributed. Generally, they are considered as the periodic but irregular movement in economic activity, measured in terms of GDP or other macroeconomic variables. The first attempt to modeling business cycles was done by Tinbergen (1931), who built a model of industrial investment cycle. Assuming a time lag between the inception and the completion of an investment project in

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[2] A discussion on the business cycles stylized facts is given in Hillinger and Sebold-Bender (1992), Hillinger (1988), A' Hearn and Woitek (2001).

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shipping industry, in fact this model introduced the time to build approach. Frisch (1933) emphasized on the macroeconomic aspect of business cycles. He claimed that random shocks are able to disturb economic activity.

Theories of business cycles can be divided into five schools (Arnold, 2002a), namely *Keynesian Economics, Monetarism*, *New Classical Economics*, *Real Business Cycles* and *New Keynesian Economics. Keynesian Economics* involves models that interpret economic disturbances from the aspect of aggregate demand. The centerpiece in such theories is the notion of the accelerator. Keynes (1936) explains the occurrence of business cycles via disturbances in private consumption and private investment. Samuelson (1939) constructs a multiplier-accelerator model of income determination. This model constitutes the inception of several recent researches (Westerhoff (2006); Dassios, Zimbidis, & Kontzalis (2014); Dassios and Zimbidis (2014); Jones, 2012). Moreover, Puu, Gardini, and Sushko (2005) propose a Hicksian type (Hicks, 1950) model that concentrates on the "floor" of income and omits the "ceiling". This model interprets the existence of business cycles with increasing amplitude. Puu (2007) extends the previous model, introducing the "ceiling" of income as well. Hillinger (1992, 2005) derives a second order accelerator model for fixed investment and inventories in continuous time. Hillinger and Weser (1988) and Weser (1992) use this model to study the aggregation problem in business cycles theory.

From the other schools of business cycles, *Monetarism*, *New Classical Economics* and *Real Business Cycles* argue that there is no need for governmental intervention as the economy is inherently stable. More specifically, according to *Monetarism*, the disturbances in economic activity are triggered by random shocks (Laidler, 1976). On the other hand, both the supporters of *New Classical Economics* and the supporters of *Real Business Cycles* adopt the assumption of rational expectations. The difference between these approaches is that the former emphasizes on the importance of monetary shocks (Lucas, 1975) while the latter (Kydland & Prescott, 1982) argues that real shocks are more significant. Finally, *New Keynesian Economics* concentrates on the microfoundation of macroeconomic models (Greenwald and Stiglitz, 1993; Arnold, 2002b).

Moving now into the banking sector, several researches adopt the Industrial Organization approach to banking, treating banks as firms that attempt to maximize their profits. The Klein-Monti model (1971) was the first to introduce this concept. Dalla and Varelas (2013) examine the effects of monetary policy on the optimal behavior of a monopolistic bank. Under the assumptions of symmetric costs and symmetric conduct, Freixas and Rochet (2008) show that, in the context of a Cournot game with finite number of banks, an increase in the interbank rate results in an increase in both the optimal interest rate on loans and deposits. In addition, Toolsema and Schoonbeek (1999) apply a similar model for the cases of asymmetry in the cost function (Cournot game) and asymmetry in the banking conduct (Stackelberg game). Yamazaki & Miyamoto model (2004) constitutes an extension of the above models, introducing the notion of scope economies in a two-stage Cournot game. Applying this model and assuming an overlapping generation model, Varelas (2007) analyzes the effects of monetary policy via the interbank rate on the bank clients' consumption. In the same manner, Dalla, Karpetis, and Varelas (2014) emphasize on the effects of monetary policy via the minimum reserve requirements on the interest rate spread.

The existence of scope economies in the banking sector has been also addressed by the empirical literature in the field. Indeed, recent empirical research shows evidence for the existence of scope economies at least in the European banking sector. For instance, Cavallo and Rossi (2001) suggest the existence of scope economies for 6 European banking systems (French, German, Italian, Spanish, British and Dutch) for all production levels over the period 1992–1997. Rime and Stiroh (2003) demonstrate weak evidence on economies of scope for the largest Swiss banks from 1996 to 1999. Valverde & Fernandez (2005) find economies of scope in the Spanish banking sector during the period from 1993 to 1999. Dijkstra (2013) estimates scope economies in the banking sector for 12 European countries over the period 2002–2011. He concludes in the presence of scope economies for all years in all countries.

Our paper is structured as follows. Section 2 presents the theoretical model while Section 3 provides the solution. Section 4 and Section 5 include the calibration and the simulation process respectively. Section 6 examines the efficiency and the implications of monetary policy on the time path of national income. Section 7 concludes.

## 2. The theoretical model

Our structural model consists of (15) equations. Relations (1)–(7) describe the product market. In particular, they compose a second order accelerator model in discrete time for the case of a closed economy. The price level is assumed stable over time. On the other hand, the oligopolistic banking sector is determined by equations (8)–(15). In fact, this is a two stage Cournot game with scope economies, assuming that there are just two banks, bank 1 and bank 2, that operate both on the markets for loans and deposits. We continue, presenting this structural model.

$$I_t - I_{t-1} = c\left(I_t^* - I_{t-1}\right), \quad 0 < c < 1 \tag{1}$$

$$I_t^* = b(K_t^* - K_{t-1}) + dr_{Lt} \quad b > 0,\ d < 0 \tag{2}$$

$$I_t = K_t - K_{t-1} \tag{3}$$

$$C_t = a_0 + a_1 Y_{t-1}, \quad a_0 > 0,\ 0 < a_1 < 1 \tag{4}$$

$$Y_t = AK_t, \quad A > 0 \tag{5}$$

$$Y_t = C_t + I_t + \Delta_t \tag{6}$$

$$\Delta_t = \delta K_{t-1}, \quad \delta > 0 \tag{7}$$

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