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An elementary model of money circulation

Vladimir N. Pokrovskii [a,*], Christophe Schinckus [b]

[a] Moscow State University of Economics, Statistics and Informatics, Moscow, 119501, Russia
[b] University of Leicester, UK

HIGHLIGHTS

- A set of equation for money circulation in the production system is formulated.
- The contribution to Gross Domestic Product from the bank system is defined.
- The relation of 'the quantity theory of money' is justified.

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ABSTRACT

This paper investigates money circulation for a system, consisting of a production system, the government, a central bank, commercial banks and many customers of the commercial banks. A set of equations for the system is written; the theory determines the main features of interaction between production and money circulation. Investigation of the equations in a steady-state situation reveals some relationship among output of the production system and monetary variables. The relation of quantity theory of money is confirmed, whereas a new concept of the efficiency of the system is introduced.

1. Introduction

There is no doubt that the real and the financial sides of the economy are closely connected with each other, which give a base to design a monetary macroeconomic models that incorporate banks, debt and money in such a way, as, for example, described in many details by Godley and Lavoie [1]. The literature dedicated to the link between production and money circulation is huge and includes a variety of approaches [2,3]. It is out of our scope to review and discuss numerous books and papers devoted to the problem; a tremendous list of literature can be found in the already cited monograph [1]. An extra view on the money problem gives econophysics, but it restricts itself mainly to discussion of microeconomic problems of distribution wealth and money, as can be read in reviews [4,5]. We are going to follow the macroeconomic line of Godley and Lavoie, aiming to formulate and investigate a system of equations for the simplest system, consisting of the government and many customers of commercial banks—producers and consumers, but trying to approach to the problem from the other side, beginning with presentation of a simple three sector production subsystem running in the money environment, created by the central and commercial banks (see Fig. 1).

The core of the system is a production subsystem, which creates real wealth of the society and is considered as an originator of value. It is assumed, that the production subsystem consists of three sectors: the first sector creates basic

* Corresponding author.
E-mail address: vpok@comtv.ru (V.N. Pokrovskii).

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production equipment (K—production capital), the second one creates non-material intermediate products (S), consumed by the other two sectors and stored in warehouses and depositories for the future production and non-production consumption, and the third sector creates products for direct consumption by humans (C) in accordance with earlier description [6]. Due to the input–output theory of Leontiev [7], one knows that the output of each sector is needed to maintain production of, generally speaking, all other sectors, so that the gross outputs X_K, X_S or X_C, are generally distributed among three sectors, and the balance relation for the products can be written as

$$\begin{aligned} X_K &= X_{KK} + X_{KS} + X_{KC} + I, \\ X_S &= X_{SK} + X_{SS} + X_{SC} + G, \\ X_C &= C, \end{aligned} \tag{1}$$

where I, G and C are components of final output, planned for sale beyond the intermediate production usage; these quantities are estimation of value (in money units) of created commodities: the quantity $I = I_K + I_S + I_C$ is estimation of the value of the investment products, distributed over the three sectors; the quantity G is estimation (in money units) of results of all long-lasting projects (investment in human capital, R&D, infrastructure and so on); we consider this quantity is equal to the government spending. For simplicity, it is assumed that the product of the third sector in the amount C is completely consumed. It is known that the sum of these quantities comprises Gross Domestic Product: $Y = I + G + C$, which is the final result of activity of production subsystem. All quantities in Eqs. (1) are measured in value (money) units.

Eqs. (1) describe motion of products between sectors, which, as we know, is accompanied with motion of money that is moving in the opposite direction. There is a correspondence between fluxes of money and fluxes of products, and also as production subsystem creates real value, the bank subsystem generates corresponding amount of money. But there is no sign of the activity of bank subsystem in balance equations (1), which are written on the assumption that the money is moving without any expenses, and the banks, if present, acts free. There is no sign of money also in the expression for Gross Domestic Product. Our first task to fulfill is to make fluxes of money explicit, that is in line with the product circulation, write equations for money circulation. It allows to generalize the expression for the Gross Domestic Product and gives a solid base to understand interaction between the real and the financial sides of the economy.

In the next section, the main relations for a system, consisting of the government, a central bank, commercial banks and many customers of the commercial banks, will be formulated. We shall be urged to aggregate the variables and introduce some simplifying assumptions to make the results more transparent. Following to a work of one of the predecessor [8], we use the symbols D and B with different indexes for the amounts of deposits and debts of different customers. In accordance with the works of Keen [8,9], we will treat debt as a data record rather than a negative money. This specific assumption is very important since it implies that money used to repay debts goes into a debt account which negates an equivalent sum of debt.[1] An expression for Gross Domestic Product is formulated and discussed in Section 3. The final equations, discussed in Section 4, contain only seven variables describing money system, while it is assumed that trajectory of production output is given. The comparison with known results will be given in Conclusion.

2. The architecture of the finance system

The social production system, which is needed to maintain the existence of the human society, is considered here to be immersed in the money system that is organized and managed by a central bank and commercial banks. The situation is shown schematically in Fig. 1.

Although the money system contains many commercial banks, each with many customers, for simplicity, we consider all commercial banks together, as the only commercial bank: further, instead of many customers, we consider four groups of consumers. One can separate all accounts in the commercial banks into groups: a group of producers of main production equipment (K), a group of producers of non-material intermediate products (S), a group of producers of products for immediate consumption (C) and a group of final consumers (L). In a sense, our model is in line with a Neo-Kaleckian circuit of money, according to a classification of circuitist models by Parguez [11]. Economic actors interact with each other using money as a tool for purchase of resources, both for consumption and for production. One can assume an elementary diagram of monetary fluxes, in which only banks are accumulators of incomes and sources of expenses.

2.1. The customers of the commercial banks

At any time, when the clients of commercial banks need money, they should determine whether a financial source of possible expenses should be money from its own account or a loan from a commercial bank. The customers of commercial banks create demand for credit money, and they appear to be the basic movers of the progress of the economic system.

[1] A number of authors in the circuitist literature often assume that the repayment of debts destroys money, see Graziani [10] or Keen [8] for further information on that point.