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Innovation Economy

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A STOCK-FLOW ANALYSIS OF A SCHUMPETERIAN INNOVATION ECONOMY

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Abstract

Credit money plays a crucial role in Schumpeterian theoretical analysis of economic development. Nevertheless, it is not simple to propose an analytical framework which is able to clarify the meaning of credit creation considered as the monetary complement of innovation. This contribution aims to describe Schumpeterian economic development in a “monetary theory of production” framework. According to the Schumpeterian perspective, we propose to emphasize within the monetary circuit both the monetary nature and the qualitative change of the capitalist system (i.e. the innovative process). We will describe the different phases of Schumpeterian economic development by employing a set of accounting matrixes, which allows us to respect the condition of stock-flow consistency.

JEL Codes: B50; E51; O33

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1. Introduction

Credit money plays a crucial role in Schumpeterian theoretical analysis of economic development. Recollection of the famous passage in *The Theory of Economic Development* (Schumpeter, 1934, p. 74) should suffice:

The banker [...] is not so much primarily a middleman in the commodity ‘purchasing power’ as a producer of this commodity [...] He stands between those who wish to form new combinations and the possessors of productive means. He is essentially a phenomenon of development, though only when no central authority directs the social process. He makes possible the carrying out of new combinations, authorizes people, in the name of society as it were, to form them. He is the ephor of the exchange economy.

In other words – as Schumpeter wrote in his ambitious and unlucky *Business Cycles* - credit creation is the *monetary complement of innovation* (Schumpeter, 1964, p. 110):

The carrying into effect of an innovation involves, not primarily an increase in existing factors of production, but the shifting of existing factors from old to new uses. [...] If innovation is financed by credit creation, the shifting of the factors is effected not by the withdrawal of funds—“canceling the old order”—from the old firms, but by the reduction of the purchasing power of existing funds which are left with the old firms while newly created funds are put at the disposal of entrepreneurs: the new “order to the factors” comes, as it were, on top of the old one, which is not thereby canceled. (p. 110-111)

Nevertheless, economists do not seem to pay attention to the role of credit money in the process of innovation: many historians of economic analysis affirm that the Schumpeterian theory of economic development is centred on the role of entrepreneur rather than on the role of banks¹; innovation economists, who find their roots in Nelson and Winter’s research program, have seldom inquired about the reciprocal influence between the financial systems and innovative activity²; theorists of the *monetary circuit* are very close to Schumpeter’s theory of money, but they have not yet proposed an analytical framework able to clarify the meaning of credit creation considered as the monetary complement of innovation³. Notice that, according to Schumpeter himself, capitalism is characterized by the creation of credit money to finance innovative activity⁴.

This contribution aims to describe the Schumpeterian economic development in a “monetary theory of production” framework. According to a Schumpeterian perspective, we propose to emphasize within different monetary circuits both the monetary nature and the qualitative change of the capitalist system (i.e. the innovative process)⁵.

Each phase of the Schumpeterian process of cyclical development represents a different monetary circuit. The monetary circuit, as some scholars have demonstrated in the last decade (Lavoie 2004, Zezza 2004, Accoce and Mouakil 2007), may be formalized by making use of a stock-flow consistent framework – i.e. a method which has been advocated by Wynne Godley (1996) and which is based on a matrix presentation of transaction flows and financial stocks. Stock-flow

¹ Messori (2004, p. 193) quotes Augello (1990, pp. 21-24) who highlights that, taking into consideration 1916 works on Schumpeter, the works dedicated to “money” are largely lesser in number (170) than those concerning “development” and politics.

² The exploratory theoretical work by Dosi (1990), or the preliminary observations concerning the impact of monetary constraints on entrepreneurial activity in Fumagalli’s (2008) simulation dynamic process, remain exceptions. For a survey regarding the relationship between finance and innovation see O’Sullivan (2005) who notes that «empirical research has not kept pace with theoretical developments and the evidence that does exist, even on basic propositions, is often ambiguous» (p. 240). See also Perez (2007) and Dosi *et al* (2008).

³ For an interesting comparison between Schumpeter and monetary *circuitistes*, see Bossone (2000, pp. 12-14). See also Fumagalli and Lucarelli (2008).

⁴ We may say that Schumpeter’s approach is centered on innovative activity seen in its monetary temporality.

⁵ In this contribution, we refer to “monetary theory of production” as the line of research that, in contrast with mainstream economics, supports the thesis of money non-neutrality, whereas we use the notion of “monetary circuit” to intend a single production period in a pure credit economy with no government.

accounting matrixes are usually employed in order to ensure the internal consistency of a specific class of simulation models in which the behaviour of each sector of the economy (i.e. households, firms, and so on) is described by means of a set of simultaneous difference equations. These equations describe the way in which the economic sectors, represented by aggregate balance sheets, evolve through time (Michell 2011). In this contribution, we will use stock-flow consistent accounting in a different way: rather than constructing a fully-specified system of equations, we will use stock-flow matrixes in order to describe – for the first time – the different phases of Schumpeterian economic development. The outline of this article is the following. In the next section, a brief discussion on the relationship between Schumpeter’s theory of economic development and the so-called Italian *circuitist* approach will be presented. In the third section, the Schumpeterian circular flow (*Kreislauf*) will be recalled, discussed, divided in two sub-phases and presented in a simple stock-flow accounting matrix. In the fourth section, the process of innovation will be discussed, divided in two sub-phases and presented in a stock-flow accounting matrix. In the fifth section, again following the same approach, imitative firms are introduced. Some implications regarding monetary theory of production are drawn as we move along.

2. Schumpeter’s theory of development faced by the Italian theory of monetary circuit

In spite of the 1970s-1990s rediscovery of the Schumpeterian theory of innovation, development and cycles, surprisingly the part of Schumpeter’s contribution concerning the role of money and credit in economic evolution «seems to have escaped attention, except in relation to the modern theory of monetary circuit» (Bellofiore 1999, p. 1012). During 1970s-1980s some Italian scholars, especially those who follow the so-called Italian *circuitist* approach, have given importance to Schumpeter’s work on money and credit (Realfonzo 2006).

In his introduction to the Italian translation of *The Theory of Economic Development* (1971), Paolo Sylos Labini, who may be defined a precursor of the monetary theory of production (Graziani 2003, p. 4), did not neglect the importance of credit money in Schumpeter. Augusto Graziani, the founder father of the Italian circuit approach, clearly affirmed that «banks, in Schumpeter, do not intermediate savings to investment projects, but they create liquidity. [...] The purchasing power, made available to the entrepreneur, is the entrepreneurial capital» (Graziani 1977, p. 15, *our translation*).

The crucial role of credit money in Schumpeter analysis has also been recognized by Giorgio Gattei, although he proposed to describe it in terms of the old, and very disputed, Joplin’s “deposit multiplier” (1994, pp. 26-27). In 1825, the British banker Thomas Joplin presented all the elements found in modern treatments of the multiple expansion process: «Every banker [...] has therefore the power of creating bank money, and [...] there is no other limit to the exercise of this power than his own prudence. [...] I apprehend that bank money is always created by the bankers to the full extent that prudence will permit.» (Joplin 1825, quoted in Humphrey 1987, p. 7). The “deposit multiplier”, which claims that the increase in bank reserves had an impact on loans and money deposits through the interest rate channel, has been criticized harshly by Post-Keynesian and *circuitist* scholars. According to them, «loans may increase because the general fall in interest rates has induced an increase in borrowing: at the new interest rates, more projects are profitable. This has nothing to do with the deposit multiplier» (Lavoie 1992: 183). This is not the place to deal with the critique to the deposit multiplier⁶. What is important to note is that the formula “deposits make loans” is considered an old prejudice by Schumpeter himself (Graziani 2003: 82). The opposite conception – loans make deposits – may be described in the following words: «Banks could add to the existing means of payment by lending promises to pay, and entrepreneurs could have access to bank money by mortgaging goods which they would acquire with the borrowed purchasing

⁶ The 1900-1940 debate on this problem is discussed in Realfonzo 1998.

power. Thus, total credit could be greater than if it there were only fully covered credit» (Bossone 2000, p. 13).

De Vecchi (1995) argues that in Schumpeter's theory creating credit *ex novo* remains inevitably the basic method to finance innovative process: an entrepreneur can obtain the funds to pay for means of production and labour only from a bank. In this way, the entrepreneur, through the bank, becomes indebted to society as a whole. De Vecchi underlines two reasons to demonstrate the previous sentence: in the first place, «a relationship is created between the bank financing an entrepreneur and the other banks, and between the banking system and the institution issuing legal tender, whereby each decision taken by any one of these bodies is not independent of those taken by the others» (p. 28); in the second place, the bank determines whether or not to extend credit to the entrepreneur, but the entrepreneur becomes indebted to the institution which issues legal tender: «a claim to legal tender issued by a bank permits the user to do exactly what is done with legal tender» (p. 28). The credit system intervenes within discretionary powers allowed by the social institution which issues legal tender. De Vecchi is not a *circuitist* author, but his reading of Schumpeter may be very useful to the monetary circuit approach, especially regarding the supply of credit.

According to Graziani (2003, p. 151), the monetary theory of production is directly related to the Schumpeterian theory of the banker as the ultimate judge on the entrepreneur's plans⁷. However, Schumpeter cannot be considered only as a forerunner of monetary circuit. His theory of development also represents a future line of research able to solve some dilemmas of the monetary theory of production. In the first place, according to Zazzaro (2003), if the Schumpeterian process of creative destruction is introduced in the analysis of the monetary circuit, then the so-called paradox of monetary profits may be solved⁸. In the second place, as Bertocco (2006) has recently stressed, Schumpeter states that the diffusion of *fiat money* induces a radical change into the way in which the economic system works. This means that in Schumpeter bank credit acts as money-capital and, therefore, constitutes the necessary premise for the realization of the innovative processes planned by entrepreneurs. In this perspective Schumpeter's examination of the role of money capital aims to describe the cyclical evolution of the economic system (Messori 1987, 2004; Berti and Messori 1996). In other words, Schumpeter's theory of economic development implies a dynamic theory of money⁹.

3. The Schumpeterian Circular Flow

Schumpeter sees *circular flow*¹⁰ as a representation of a particular money economy (in which money is used as a unit of account), but also as a phase in the capitalist process (De Vecchi 1995, pp. 151-152). In the second case, it is defined as a situation in which an innovative process ends

⁷ See also Graziani (2001), pp.79-86.

⁸ The so-called paradox of monetary profits may be posed in the following terms: if in the economic system the only money existing is what the banks create in financing production, then the amount of money that entrepreneurs may hope to recover by selling their commodities is at most equal to the amount to which they have been financed by the banks. Once the principal has been returned, the possibility is ruled out that the class of entrepreneurs can realize their profits in money and then can pay interest owed to banks in money.

⁹ Notice that a dynamic theory of money implies a specific accounting system; according to Biondi: «the monetary process generated by the firm, prompts and sustains dynamic matching between costs and revenues (i.e. the economic process) that the accounting system, with limitations, represents. Following Schumpeter's reasoning, if money (and then capital-credit-money) shapes and affects the economic process, accounting too (and the firm as an entity) plays its own active role as a mode of shaping and affecting that process. Therefore, the accounting system is not simply a neutral technique, but, above all, an institutional device actively mobilized for coping with the dynamics and complexity of socio-economic reality.» (2008, p. 534)

¹⁰ *Circular flow* is the translation of the German word *Kreislauf*, the notion introduced by Schumpeter in his 1911 book. In the 1939 book, *Business Cycles*, Schumpeter uses the term *stationary flow*.

and, consequently, due to competitive pressures, entrepreneurial profits are nil¹¹. Schumpeterian profits are actually transitional phenomena to be traced back to cost differentials between different methods of production used simultaneously. The *circular flow* provides the best conditions for entrepreneurship¹². In this phase, which represents the starting point of a new cyclical development, there is neither credit for innovation nor interest on credit for innovation, but there is credit for normal production activity¹³. Because banks play a role that does not enable them to claim any remuneration, Schumpeter considers nil the rate of interest on credit for normal production activity¹⁴. Bank credits do not have effects on price level and money plays a non-essential role, it is a “veil”. In Schumpeter’s own words (1912, p. 112):

The process of production can always be repeated anew with the help of renewal of credit, although this is no longer ‘new enterprise’ within our meaning. The credit instruments thus not only have no further influence upon prices, but they even lose that which they originally exercised. Indeed, this is the most important of the ways in which bank credit forces its way into the circular flow, until it has so established itself there that analytical effort is necessary in order to recognize that its source is not there.

We may say that this kind of credit money is compatible with a process of simple reproduction, but not an expanded reproduction, of an economy¹⁵. In this kind of stationary state, with full employment, monetary flows are important for the sequence of exchange of produced commodities and productive services: each period is opened by the monetary demand for the services of waged workers (N) made by the managers of the productive units which realize routine activities¹⁶. Managers obtain from the banking system a quantity of money equal to the unchanging monetary income realized in the previous period¹⁷. This situation is very similar to the first step of the monetary circuit with private money, as the *circuitistes* say¹⁸. Thus in the first step of the circuit,

¹¹ Some Italian scholars observed that if the Schumpeterian circular flow is not intended as a Walrasian equilibrium but is represented as a circular process (according to the so-called surplus approach), it does not essentially require a nil rate of profit, but a constant rate of profit; on this point see Napoleoni (1976), pp. 150-153 and Cozzi (1971) quoted in Zanini (2000), p. 110. In our analysis of circular flow, we maintain the zero rate of profit hypothesis. This hypothesis is motivated by the attempt to simplify the discourse.

¹² See Bellofiore (1992).

¹³ We do not consider credit for consumption, which Schumpeter takes into account, in order to simplify our discourse.

¹⁴ Because *circular flow* may be also defined as a situation in which innovative process ends, banks could continue the practice of claiming interest on credit for consumption or for normal production activity, as if it were a *routine*. But there is no longer the prerequisite (i.e. the innovative process) for a positive interest. See De Vecchi (1995), pp. 152-153: «Schumpeter is not so obscure as he is made out to be, about why interest is nil in a circular flow. If he can be blamed for anything, it is for having extended his argumentation from this level, and in these terms, to the level – completely foreign for him – of equilibrium [Walrasian] models where interest is real and expresses a positive time preference. The question if and on what conditions the rate of interest can be zeroed in these models is completely irrelevant to understanding Schumpeter’s theory.» Notably Schumpeter’s theory of interest was criticized by Eugen von Böhm-Bawerk, on this point see De Vecchi (1983).

¹⁵ Simple and expanded reproduction are typical Marxian notions. For a comparison between Marx’s schemes of reproduction and Schumpeter’s circular flow and economic development see Sylos Labini (1954). As Bellofiore (1985) shows, there are some fundamental differences between Marx and Schumpeter: 1) Marxian innovation is generated by class struggle inside the labour process, whereas in Schumpeter’s model it emerges in intra-capitalist competition; 2) profits and interests are absent in Schumpeter’s circular flow, while surplus value is positive in Marxian equilibrium positions; 3) according to Schumpeter money is a symbol and not a commodity, whereas the Marxian theory of value, as explained in Book I of *Das Kapital*, is linked with commodity money. The real common point between Schumpeterian *Kreislauf* and Marxian simple reproduction scheme is the fact that money is a *numéraire*.

¹⁶ As Messori (2004, p. 195) noted, in Schumpeter the term “entrepreneur” is attributed to innovator. Hence in the stationary state the economic agents who manage firms are labeled “managers” or “administrators” of productive units.

¹⁷ As Messori (2004, p. 183) noted, if we consider Schumpeter’s circular flow as a logical representation of a particular money economy in which money is used as a unit of account, the concept of credit is excluded from the stationary state. In our approach the circular flow is intended as a historical phase of the capitalist process. Consequently, we maintain the role of banks as lenders. In this way, we can neglect the problem of the rise of the banking system: the banking system already exists before the innovation process.

¹⁸ See Godley and Lavoie 2007, pp. 47-49.

both the loans (ΔL) and the transactions deposits (ΔD_T) newly created by the banking system belong to the production sector. Notice that this kind of deposits does not imply savings: credit money in Schumpeterian circular flow is totally utilized as cash¹⁹. This initial step is shown in Table 1. A minus sign in the transaction matrix is associated with the use of funds, while a positive sign implies the source of funds. In Table 1, in the Banks column, the addition to cash is associated with a plus sign, while the addition to bank loans is associated to a minus sign. From a flow-of-funds standpoint, increased cash is thus a source of funds while increased loans are a use of funds for the banks. Firms produce both consumption goods (C) and investment goods (I_α), by utilizing a routine technology (α). Both the firms are described in the same column.

INSERT TABLE 1 HERE

Table 2 gives the balance sheet matrix of our postulated economy. Symbols with plus describe assets and negative signs indicate liabilities. The sum of every row is again zero.

INSERT TABLE 2 HERE

We consider an economy with two productive sectors: the first one produces consumption goods, the other one produces investment goods. Our choice to describe a two sector economy is not totally coherent with Schumpeter analysis but is necessary to describe the Schumpeterian circular flow in a stock-flow consistent framework²⁰.

Table 3, following Godley (1996), reveals the accounting structure of the model at the end of the circuit. Its key feature is that all columns and all rows sum to zero. Every row represents a monetary transaction and every column corresponds to a sector account which is fragmented in a current and a capital account. Sources of funds appear with positive signs and uses of funds with negative signs. ΔL is the flow of credit money that is necessary to activate the *routinized* production process. This kind of money is essential for financing the purchase of the productive services. Part of the deposits created in the initial step ($\alpha_1 \Delta D_T$) is directed from firms to households: it represents the flow of money that households, as workers, receive from firms. Households use it only for transactions in the consumption goods' market. In other words, $\alpha_1 \Delta D_T$ corresponds to the amount of workers' wages ($w_\alpha N_\alpha$), whereas $\alpha_2 \Delta D_T$ represents the specific monetary disposals ($W_{\alpha, M}$) that managers must use to purchase the investment goods ($I_\alpha p_{I\alpha}$) necessary to produce²¹. The total amount of investment goods is used during the production cycle.

¹⁹ We need to specify that for Schumpeter «the logical origin of money is in economic calculation and its essence may be easily traced – in a socialist economy as in a capitalist economy, as a unit of measurement of the *use value* of goods, besides their *exchange values*. Hence, it is the function of unit account which defines the essence of money, and not that of medium of exchange or means of payment. From this standpoint, therefore, Schumpeter must be considered as a sponsor of the credit nature of money, but only in the sense that behind every economic exchange, an underlying debt-credit relationship may be detected, and not in the sense, held by [*circuitistes*], that money may be logically represented only as liabilities issued by some third-party institution.» See Zazzaro (2003, pp. 221-22). Notice also that Schumpeter considers the Central Bank as part of the credit system, see chapter 3 in De Vecchi (1995). Schumpeter admits that the amount of legal tender acts as a restriction to bank creation of means of payment by regulating the reciprocal links amongst the individual competing banks and between each bank and the central bank (see Messori 1996).

²⁰ See Schumpeter (1956, p. 151): «The social product consists only of consumer goods. Means of production, too, are always being produced, but at the same time means of production previously produced are being taken over from the immediate past and converted into goods ready for consumption. Any part of the national productive forces which is not currently serving the production of consumer goods is thus replaced by the result of productive forces expended earlier, and the social product of an economic period contains productive forces which, while not originating in one economic period, are equal to the stock of productive forces which is at the disposal of the economy per economic period.»

²¹ The only role of fixed capital investment in a stationary system is to cover depreciation. We may assume that the depreciation rate of investment goods is constant and uniformly distributed. But, following Schumpeter, it cannot be intended as a real interest rate; in Schumpeter's model a real interest computable from physical goods does not exist.

Workers utilize the money income paid by firms ($w_\alpha N_\alpha$) for carrying out their unchanging purchase of final goods ($C p_C$). Each supply finds its own demand at the expected prices just covering money costs. At the end of the sequence firms are always able to pay their bank loans. In other words banks grant loans which are risk-free, consequently, as we said, the interest rate on loans is zero. Since the economic process is synchronized, there are no stores of money. At the end of the circular flow, over the course of the accounting period, both deposits and loans are zero (see Table 3). The essential circumstance for a positive rate of interest, i.e. entrepreneurship, is absent²².

INSERT TABLE 3 HERE

Table 4 gives the balance sheet matrix at the end of the Schumpeterian stationary state. Notice that there is no capital accumulation.

INSERT TABLE 4 HERE

Summing up: in the circular flow, loans are obtained initially by firms which are then used to employ labour and purchase – by means of managers – investment goods. The only role of fixed capital investment in a stationary system is to cover depreciation. Households then consume their income, which returns money balances to the firms and allows them to pay off their loans. Firms make no profits, and households consume all their income.

4.1. The process of innovation: the rise of innovative firms

Capitalist development is defined by Schumpeter as a discontinuous and qualitative change induced by innovation. Innovations are “new combinations” put forward by “new business men”, the entrepreneurs. In the *Theory of Economic Development* Schumpeter considers entrepreneurship as a break of the stationary state. Nevertheless, the process of innovation may emerge only when banks finance new firms promoted by entrepreneurs. Banks create *ex novo* new purchasing power (L_i), and each bank «will meet the demand for credit from those business men who are in a position to conduct transactions at the existing level of prices through opening credit» (Schumpeter 1912, p. 114). Money as purchasing power is the lever of qualitative change:

A different employment of the system’s productive power cannot be achieved *otherwise* than by disturbance in the relative purchasing power of individuals [...] We cannot get over this point [...] The capitalist credit system has grown out of and thrived on the financing of new combinations. (Schumpeter 1912, pp. 96, 69-71, also pp. 105-6.)

Schumpeter is a forerunner of the endogenous nature of money supply, that assumes a strong relevance in modern monetary theory of production²³: credit money is introduced into the economy in order to finance future production and it is mainly linked to an expected level of production and employment. Consequently money does not have a commodity nature, but is purely a symbol.

Entrepreneurs appear in swarms. Analogous to the productive units of the circular flow, the innovative firms (i.e. new enterprises that start to operate near the existing traditional firms), utilize both labour services and investment goods, but they also combine the productive factors in a new way. The entrepreneurs are creators of new firms where they organize a new process of production

²² See Schumpeter (1912, pp. 189-90).

²³ See Fontana and Realfonzo (2005). However, in Schumpeter’s view the endogenous supply of money is not completely demand driven. Although lending to innovation might theoretically be unlimited, the credit supply for innovation is necessarily limited: «The limit [to the creation of means of payment] is given by the condition that credit inflation in favor of new enterprises should be only temporary, or that there should be no inflation at all in the sense of permanently raising the price level. And the brake which guarantees the maintenance of this limit is the fact that any other conduct in the face of the rush of entrepreneurs seeking credit would mean a loss for the bank concerned» (Schumpeter 1912, pp. 196-198). See De Vecchi (1995, pp. 32-36).

by utilizing a new technology (i). In other words, by using the neo-Schumpeterian terminology, we limit our contribution to the so called Schumpeter Mark I technological regime²⁴. Before producing the final goods, each entrepreneur has to ultimate the organization of the new productive process. Schumpeter affirms that «the carrying into effect of an innovation involves, not primarily an increase in existing factors of production, but the shifting of existing factors from old to new uses» (1939, p. 110) and that the entrepreneur «withdraws, by his bids for producers' goods, the quantities of them he needs from the uses which they served before» (1939, p. 133). Consequently new firms withdraw part of the labour services previously employed in the traditional firms (N_α), and affect the demand for the investment goods (I_α) previously aimed at the non-innovative production organized by the managers of the existing productive units²⁵.

The phase of economic development may be divided in two sub-phases: we assume that in a first sub-phase entrepreneurs obtain loans (L_i) from the banks and organize the new combinations. Only in a second sub-phase entrepreneurs are ready to supply their final goods on the market, to realize profits and to pay interest to the banks which granted credit.

Although Schumpeter's theoretical analysis of the process of innovation is focused on the diffusion of innovative consumer goods, we will focus on the case of an innovative investment good (I_i)²⁶. A technological revolution begins after the diffusion of an innovative investment good in the economic system. In other words, innovative consumer goods appear as a consequence of the spread of the innovative producers' goods.

We assume that the new investment good has the following properties: the use of I_i in the productive process increases labour productivity and hence reduces production costs²⁷. But in the first sub-phase of economic development, the production of I_i may be obtained only by combining *traditional* investment goods (I_α) with labour services. A share (β_1) of the available investment goods will be utilized by the innovative firms, another share ($\beta_2 = 1 - \beta_1$) will be utilized by the traditional productive units. Traditional firms that operate in the sector of investment goods, having available raw materials, may produce investment goods for new firms. In general, the increasing demand for producers' goods determines increasing prices²⁸.

Entrepreneurs use credit money not only to buy traditional investment goods, but also to obtain labour services by offering higher wages than the wages paid by the traditional firms ($w_i > w_\alpha$)²⁹. Given the Schumpeterian hypothesis of full employment, in this phase the labour supply does not change ($N = N_\alpha + N_i$). Workers are redistributed amongst non-innovative firms (N_α) – including both firms producing consumer goods and firms producing investment goods – and innovative firms (N_i) – that given our assumption produce a new investment good. Wage earners can take decisions on how to distribute their new money incomes between consumption expenditure and/or bank deposits. In the first case, increasing wages will push up the prices of consumer goods. But

²⁴ Schumpeter Mark I is characterized by the key role played by new firms in innovative activities, i.e. creative destruction, whereas in the second one, Schumpeter Mark II (that is described by Schumpeter in his 1942 American book *Capitalism, Socialism and Democracy*), this key role is fulfilled by the large and established firms, i.e. creative accumulation. See Winter (1984).

²⁵ We may hypothesize that the increased demand for investment goods implies an extension of the production cycle necessary to meet the orders of the innovative firms.

²⁶ Our assumption – that is not explicit in Schumpeter's theoretical analysis – seems coherent with the historical case of the introduction of the power loom, which destroyed the hand-weaver's craft. Schumpeter himself considers this historical case important both in his 1912 book (Schumpeter 1912, p. 130) and 1939 book (Schumpeter 1939, p. 232 and p. 287). For an analytical treatment of the Schumpeterian process of innovation in the production of consumer goods see Messori (2004). See also Gattei (1993, pp. 22-30).

²⁷ We are introducing an assumption that is not explicit in Schumpeter.

²⁸ As De Vecchi (1995, p. 56) noted this circumstance «will not occur in the assumption of increasing returns to scale for firms which produce the goods demanded by innovators».

²⁹ The increase in wages is described by Schumpeter himself, see Schumpeter (1934, chapter 6). On this point, see also Messori (2004) We assume that workers engaged by the innovative firms come only from the sector that produces investment goods. In this way we give importance to heterogeneity in labour skills. This condition is not explicit in Schumpeter.

Schumpeter affirms (1912, p. 248) that at first the prices of consumer goods remain constant. A change in consumer decisions is possible only after an economic change. His hypothesis is coherent with the assumption that «consumers' initiative in changing their tastes - i.e., in changing that set of our data which general theory comprises in the concepts of "utility functions" or "indifference varieties" - is negligible and that all change in consumers' tastes is incident to, and brought about by, producers' action» (Schumpeter 1939, p. 66). Schumpeter stresses the importance of the second possible consequence of the increase in wages, i.e. the rise of households' savings that determine bank deposits (ΔD_s). As a consequence, it is the bank credit which mainly determines bank deposits and not *vice versa*, as affirmed in the standard neoclassical theory. Therefore, we find a typical result of the *circuitist* approach: loans make deposits (Graziani 2003, pp. 82-84).

Schumpeter does not consider the following circumstances: at the initial innovation phase, the creation of new money has diverted some resources away from the production of consumption goods towards accumulation of capital in the innovative sector, altering the composition of total output in favour of investment goods. This means that the supply of consumer goods and total real consumption are lower. In this case – given the households' demand – the scarcity of consumer goods will push their prices higher, thus those workers who are not employed in the innovative sector are now receiving less real income (due to the higher prices of consumption goods and fixed monetary wages). Thus workers in the traditional firms have had real wage cuts, while workers in the innovative firms are providing the forced savings corresponding to increased capital investment. This forced saving occurs in new bank deposits (D_s), that serve as a store of value.

This new scenario is described in Table 5, where a new column is added describing the innovative firms. The variables in square brackets represent the goods available at the end of the production process (in the second sub-phase).

INSERT TABLE 5 HERE

4.2. The process of innovation: the rise of profits

In this paragraph we will propose a personal reading of the innovative process, that is not considered to be an accurate copy of Schumpeter's descriptions; in particular we will introduce the notion of monopolistic power to formalize the price effects over the course of the economic cycle. The second sub-phase of the Schumpeterian process of innovation is characterized by the diffusion of the innovative final good in the market. It may be utilized in every production process and it substitutes the old investment good (I_a). New investment goods are able to cut production costs. In other words, if the innovation is adopted, then production cost per unit (x) depends on a labour productivity (π_i) that is greater than the past labour productivity (π_a).

We may express the general formula of production cost per unit as follows:

$$x = \frac{w}{\pi} + \frac{K}{Q} = \frac{w}{\pi} + \frac{K}{\pi N} \quad (1)$$

where w/π is the cost of labour per unit of output, K is the capital composed of investment goods and inventory, Q is the amount of final production. The latter is equal to the product between labour productivity (π) and the employment level (N). We may express the general formula of production cost per unit in the following alternative way:

$$x = \left(w + \frac{K}{N} \right) \frac{1}{\pi}, \text{ where } \frac{K}{N} \text{ represents the technical coefficient} \quad (1 \text{ bis})$$

Note that in Schumpeterian circular flow the prices of goods reflect the production costs. The new investment good is certainly demanded by firms that produce consumption goods (C). The use of I_i in the production process will reduce the production cost per unit (x_C).

We can define innovation also with reference to money cost. Total costs to individual firms must, in the absence of innovation and with constant prices of factors, monotonically increase in function of their output. Whenever a given quantity of output costs less to produce than the same or a smaller quantity did cost or would have cost before, we may be sure, if prices of factors have not fallen, that there has been innovation somewhere. (Schumpeter 1939, p. 89)

Consequently for the existing firms that sell consumption goods, profits will emerge (Π_α). They are expressed as follows:

$$\begin{cases} \Pi_\alpha = p_C C - x_C C > 0 \\ p_{C,t(0)} = p_{C,t(1)} = p_{C,t(2)} \\ x_{C,t(0)} > x_{C,t(1)} \end{cases} \quad (2)$$

where $t(i)$, with $i = 0, 1, 2$, respectively represent the circular flow, the first sub-phase and the second sub-phase of the economic development. Schumpeter considers profits as a phenomenon present only in a monetary economy of production where innovations are financed by money created by the banks. Only in this way do entrepreneurs obtain a monopolistic power that allows them to get a monetary surplus over costs. In other words, for the innovative entrepreneurs, profits may emerge (Π_i) because they are more efficient than the managers of the traditional productive units. Schumpeterian banks have to perform a screening activity about the expected efficiency of their own borrowers. The new firms that produce I_i obtain a decrease in production costs realized by the new combination of productive factors. The ability to combine the traditional inputs more efficiently than the competitors implies that costs decrease. According to the equation (1 bis) the production cost per unit decreases only if, after the innovation, labour productivity increases and/or the technical coefficient decreases, *coeteris paribus*.

Since wages offered by entrepreneurs are higher than wages offered by traditional firms ($w_i > w_\alpha$), we may justify the commercial success of the new investment good in the following way:

at first, $t(2.1)$, the new firms do not have a monopolistic power; they pay high wages to their workers, but their efficiency in combining factors of production determines lower production costs

than their competitors $\left(\frac{\pi_{I_i} - \pi_{I_\alpha}}{\pi_{I_\alpha}} > \frac{w_i - w_\alpha}{w_\alpha} \right)$.

To justify their commercial success we may assume that entrepreneurs obtain their first share of the market by selling their innovative product at a lower price than their competitors. This condition may be expressed as follows:

$$p_{I_i} < p_{I_\alpha} \Rightarrow \begin{cases} \frac{K_i}{\pi_{I_i} N_i} - \frac{w_i}{\pi_{I_i}} < \frac{K_\alpha}{\pi_{I_\alpha} N_{I_\alpha}} - \frac{w_\alpha}{\pi_{I_\alpha}} \\ \frac{\pi_{I_i} - \pi_{I_\alpha}}{\pi_{I_\alpha}} > \frac{w_i - w_\alpha}{w_\alpha} \end{cases} \quad (3)$$

Traditional firms in the sector of investment goods will experience difficulties because of their costs of production, that are greater than the costs of the new firms, and because of a decrease in the

demand towards I_α . As De Vecchi (1995, p. 112) noted the entrepreneurial competition envisaged by Schumpeter belongs to a process of change in production structure and has little in common with perfect competition that defines a state of the economy.

Entrepreneurs, focusing on the new technology and new demand, start to displace the incumbents. At this time, t(2.2), they obtain a monopolistic power and their profits increase further. In this situation, the prices of the new investment goods may be expressed as follows:

$$p_{I_i} = x_i(1 + \mu) = \left(\frac{w_i}{\pi_{I_i}} + \frac{K_i}{\pi_{I_i} N_i} \right) (1 + \mu) \quad (4)$$

where μ is the mark-up depending on temporarily monopolistic power for the innovators³⁰.

The profits realized by the innovative firms in the sector of investment goods are expressed as follows:

$$\begin{aligned} \Pi_i &= p_{I_i} I_i - x_i I_i > 0 \\ p_{I_i, t(2.1)} &< p_{I_i, t(2.2)} \end{aligned} \quad (5)$$

where t(2.1) and t(2.2) respectively represent two different periods of the second sub-phase of the economic development, only in the second period does the monopolistic power begin.

This is not the only novelty coming with economic development: as the following transactions matrix shows, interest shall accrue on the bank deposits of households ($i_{D(-1)} D_{S(-1)}$), and entrepreneurs must repay in money to bankers the principal of their debt and the interest on loans ($+i_{L(-1)} L_{i(-1)}$). Net profits of firms will be equal to:

$$\Pi_i^n = p_{I_i} I_i - x_i I_i - i_{L(-1)} L_{i(-1)} \quad (6)$$

According to Schumpeter interest on loans is therefore a “tax on profits” and a brake on development.

Banks apply a spread between the interest rate of loans and the interest rate on deposits in order to realize profits (Π_B):

$$\Pi_B = i_{L(-1)} L_{i(-1)} - i_{D(-1)} D_{S(-1)} \quad (7)$$

To facilitate the repayment of their debt, entrepreneurs will issue securities ($p_{E,i} \Delta E_i$); households, having increasing savings derived from other incomes generated by innovation, may purchase

³⁰ The monopolistic power is influenced by the elasticity of demand, i.e. moreover, in our case, by the elasticity of demand expressed by firms that produce consumer goods. In Winter’s model (1984) the mark-up formula is

$\frac{e + (1-s)\psi}{e - s + (1-s)\psi}$. Here e and s mean elasticity of demand and market share, under the given “Cournot Conjecture”

factor $\frac{1}{\psi}$ influenced by the elasticity of supply curve. In his simulation when s increases e decreases, in other words,

demand becomes more inelastic with the restrained entry. See also Takemura (2011). One could note that the use of mark-up leads to a neoclassical reading of Schumpeter: if the innovation is intended as “a jump into the unknown”, then the demand curve and consequently the elasticity of demand will be unknown. This is true, but we think that monopolistic power, even if it is not reducible to a deterministic variable, is an important feature of the Schumpeterian dynamic competition and depends on the entrepreneurs’ expectations on the control of consumers’ habits. The point represents an important problem that needs to be better investigated in our future research.

securities. Schumpeter affirms that, over time, the economic change stimulates social changes, consequently individuals use some of their income to share in the gains of development³¹.

A part of the households might also decide to improve their consumption. In this case, if the supply of consumer goods is given, prices of consumer goods will increase ($p_{C,t(2)} > p_{C,t(0)}$), and profits (Π_α) will increase. We prefer to discuss this case in the following paragraph, where we will describe a new phase of the economic development³².

This second phase of the process of innovation is described in Table 6 and Table 7.

INSERT TABLE 6 HERE

In Table 6, according to stock-flow accounting logic, banks' profits are all distributed to households, and these receipts together with the wage bill make up nominal personal disposable income. In order to achieve a realistic interpretation of this situation, we need to specify that in the above matrix we did not represent the Central Bank and the Government sector. In coherent stock-flow accounting (Godley 1996, Lavoie 2004, Accoce and Mouakil 2007) the Central Bank sets the benchmark monetary rate of interest and purchases Treasury bills to finance the deficit of the Government sector. In line with current practice, it is assumed that the Central Bank's profits are reverted to the Government sector. But this practice does not appear to be consistent with Schumpeter's analysis about the role of the banking system: banks should be independent agents³³.

This means, practically speaking, that banks and their officers must not have any stake in the gains of enterprise beyond what is implied by the loan contract. [...] But another kind of independence must be added to the list of requirements: banks must also be independent of politics. Subservience to government or to public opinion would obviously paralyze the function of that socialist board. It also paralyzes a banking system. This fact is so serious because the banker's function is essentially a critical, checking, admonitory one. Alike in this respect to economists, bankers are worth their salt only if they make themselves thoroughly unpopular with governments, politicians, and the public. (Schumpeter 1939, pp. 117-118)

The previous result therefore needs to be interpreted, with caution, as if the private banks' profits are all distributed to households. We should introduce a specific institutional analysis to describe the distribution of private banks' profits between different households, but that does not represent a research object of this article.

INSERT TABLE 7 HERE

³¹ In other words, households decide on the basis of their expected wealth. On this point, which is not dealt with here, see Accoce and Mouakil (2007).

³² We may also explain the variations in consumer prices by using the standard equations of a monetary circuit model, as presented in Lunghini and Bianchi (2004). The level of prices before the introduction of the innovation is expressed

as follows: $p_{C,t(0)} = (1 - s_{t(0)}) \frac{w_\alpha}{\pi_{C,t(0)}} \frac{N}{N_C}$, where s is the proportion of income that is saved, and N is equal to $N_C +$

N_i . After the introduction of the innovation the equation changes as follows: $p_{C,t(2)} = (1 - s_{t(2)}) \frac{w_\alpha N_\alpha + w_i N_i}{\pi_{C,t(2)}} \frac{1}{N_C}$,

where N_α is employment in non-innovative firms and N_i is employment in the innovative firms.

During the economic development period, prices of consumer goods will increase, i.e. $p_{C,t(0)} < p_{C,t(2)}$, if $s_{t(0)} < s_{t(2)}$ and/or

if $\frac{w_\alpha N}{\pi_{C,t(0)}} < \frac{w_\alpha N_\alpha + w_i N_i}{\pi_{C,t(2)}}$. Given s , the reduction of the inflation process may be possible if the increase in

productivity is not counterbalanced by the increase in the amount of wages.

³³ See De Vecchi (1995, p. 160).

An economic development process involves accumulation of capital³⁴. The net wealth of the firms (V_F) is obtained by subtracting the bank loans (L) from the capital. A similar logic explains the households' net wealth. The new scenario is principally characterized by the rise of innovative firms. Consequently, the capital may be split into two parts ($\beta_1 K_I, \beta_2 K_I$). Even the net wealth of the firms (V_F) will be divided into the traditional firms' part and the innovative firms' part. The households' net wealth amounts to money used for exchange ($D_{T,2}$), to the new bank deposits used as a store of value ($D_{S,2}$) and to securities issued by entrepreneurs ($p_{E,i} \Delta E_i$). Consequently securities appear with negative sign in the column of innovative firms. The banking system net wealth must be nil, by construction: the new purchasing power created *ex novo* must be balanced by the rise of new bank deposits ($L = L_\alpha + L_i = D_{T,2} + D_{S,2}$).

Summing up: new loans are obtained by new firms (innovative entrepreneurs) that withdraw part of the labour services previously employed in the traditional firms, and affect the demand for the investment goods previously aimed at the non-innovative production organized by the managers of the existing productive units. Entrepreneurs use credit money also to obtain labour services by offering higher wages than the wages paid by the traditional firms. The rise of households' savings determine bank deposits. New investment goods are able to cut production costs, then traditional firms that produce consumption goods, demand them to obtain profits. For the innovative entrepreneurs, profits emerge because they are more efficient than the traditional units that produce the non-innovative investment good. Entrepreneurs, focusing on the new technology and new demand, start to displace the incumbents, that may fail. Positive expectations about future profits may encourage entrepreneurs to issue securities. Households then may consume their income and purchase securities. At the end of the process innovative entrepreneurs pay interest to the banks which granted credit. The traditional firms that produce consumption goods pay off their loans.

5.1 The Imitators

The "prosperity" that we described is not perpetual: during economic development firms' results depend on the shifts in demand that will occur in consequence. There will be both gains and losses. If households decide to improve their consumption – a fact that, in economic development, must occur sooner or later – existing firms that produce non-innovative investment goods may benefit from the new orders necessary to increase production in the sector of consumer goods. In this way, a part of the traditional firms will obtain unexpected profits. They may decide to adopt the new investment good ($\beta_2 I_i$ in following Table 7 represents the share of I_i purchased by traditional firms) to restructure their manufacturing process and to produce an imitation of the innovative good (I_m) to gain market shares. As Schumpeter (1939, pp. 137-138) notes:

For some of the "old" firms new opportunities for expansion open up: the new methods or commodities create New Economic Space. But for others the emergence of the new methods means economic death; for still others, contraction and drifting into the background. Finally, there are firms and industries which are forced to undergo a difficult and painful process of modernization, rationalization and reconstruction.

A part of the imitative firms may also be founded by new managers of productive units. During the economic boom, banks create credit both in favour of the innovators and the imitators. The production of I_m may be obtained only by combining existing investment goods with labour services. We assume that imitators utilize innovative investment goods (I_i) and pay wages (w_m) that

³⁴ According to Schumpeter, capital is "abstract" purchasing power (see the chapter 3 in the 1911 book). Consequently Schumpeter's theory of capital is not traslatable in the above balance sheet matrices, where accumulated capital is composed of investment goods. The accumulation of new investment goods, described in table 7, reflects the role of fixed capital investment in the economic development: it is a driving force for economic growth. Note also that the diffusion of new technologies implies a depreciation of existing capital.

are both higher than the wages in a stationary state, and lower than the wages paid by innovative entrepreneurs ($w_\alpha < w_m < w_i$). In other words we are assuming that imitators copy the innovative product, but the imitation will be, in general, “less efficient” than the original innovation³⁵.

Bank financing of a given innovative process acts as a positive signal as regard to its expected profitability and, hence, it stimulates secondary innovations or imitative processes³⁶. In the historical part of his 1939 book, Schumpeter notices that in this phase credit may also be used for speculation, over-indebtedness and unproductive uses which leads to a high level of instability of the cycle³⁷.

Only in a second sub-phase are imitators ready to supply their final goods on the market, to realize profits and to pay interest to the banks which granted credit. Consequently, in this first sub-phase, the implementation of innovative and imitative processes determines an amount of purchasing power ($L_3 > L_2$) that, at the existing prices, exceeds the supply of final goods and leads to an increase in prices. This phenomenon is described by Schumpeter as follows:

The fact that the entrepreneurial demand appears *en masse* signifies a very substantial increase in purchasing power all over the business sphere. This starts a secondary boom, which spreads over the whole economics system and is the vehicle of the phenomenon of general prosperity [...] Only because new purchasing power goes in bulk from the hands of entrepreneurs to the owners of material means of production, to all producers of goods for ‘reproductive consumption’ [...] and to the workers, and then oozes into every economic channel, are all existing consumption goods finally sold at ever-rising prices. Retailers there upon place bigger orders, manufacturers extend operations, and for this purpose increasingly more unfavorable and often already abandoned means of production come into use again. (Schumpeter 1912, p. 226)

The new scenario is described in the following table (Table 8), where a new column is added, describing the imitative firms. The variables in square brackets represent the goods available at the end of the production process (in the second sub-phase).

INSERT TABLE 8 HERE

In the above table, entrepreneurs distribute parts of their profits to households that have securities ($p_{E,i} \Delta E_i$); we also assume that the traditional firms, financed by banks, will issue securities ($p_{E,\alpha} \Delta E_\alpha$) to facilitate the repayment of their debt.

5.2 Towards a new stationary state

The second sub-phase of the Schumpeterian process of innovation is characterized by the diffusion of the imitative final good in the market. It may be utilized in every production process and substitute the existing investment goods (I_α and I_i). We may assume that the imitative investment good is less efficient than the existing innovative good, and its price is lower than the existing price ($p_{Im} < p_{Ii}$), nevertheless imitative firms gain market share. The presence of imitative firms will open up competition that will reduce both the monopolistic power and the profits of the innovative firms in the sector of investment goods. Also, the profits realized by the firms in the sector of consumer goods will decrease: the fact that monetary demand, that has peaked, is met by more available

³⁵ Following the Neo-Schumpeterian scholars, in the case of a lock-in effect, less efficient imitative goods will have a higher success than the innovative goods. See Silverberg *et al* (1988).

³⁶ See Messori (1996, p. 12).

³⁷ See Schumpeter (1939, p. 215-218).

consumer goods confirms the decreasing trend in prices³⁸. In other words, when the new production combination yields results, prices must fall.

The following table describes the transactions during this process of competition that leads to a recession.

INSERT TABLE 9 HERE

In the above table, entrepreneurs distribute parts of their profits to households that have securities; we also assume that the imitative firms, financed by banks, will issue securities ($p_{E,\alpha}\Delta E_\alpha$) to facilitate the repayment of their debt. We may consider this increase in the amount of securities as a sign of speculative attitude, that is possible in the phase of euphoria of a new technological paradigm³⁹. This phenomenon will disappear with the fall of all profits towards zero.

INSERT TABLE 10 HERE

The new scenario is principally characterized by the rise of the imitative firms. Consequently, the capital, composed of the investment goods may be split into three parts ($\beta''_1K_3, \beta''_2K_3, \beta''_3K_3$). Also the net wealth of the firms (V_F) will be divided into the traditional firms' part, the innovative firms' part and the imitative firms' part. The households' net wealth amounts to money used for exchange ($D_{T,4}$), bank deposits ($D_{S,4}$) and securities issued by entrepreneurs and traditional firms that are restructuring their manufacturing process ($p_{E,i}\Delta E_i + p_{E,\alpha}\Delta E_\alpha + p_{E,m}E_m$). Consequently securities appear with a negative sign in the column of firms. The banking system net wealth must be nil, by construction: the new purchasing power created *ex novo* must be balanced by the rise of bank deposits ($L_4 = L_\alpha + L_i + L_m = D_{T,4} + D_{S,4}$).

The incoming recession is confirmed by the fact that deposits and loans in this phase are lower than the deposits and loans in the previous period.

Firms that survived during the process of creative destruction are able to pay their debts to banks. Following Schumpeter, this auto-deflation is a clear sign of the incoming recession:

Under our assumptions and with but minor qualifications, that sequence of phenomena leads up to a new neighborhood of equilibrium, in which enterprise will start again. This new neighborhood of equilibrium is characterized, as compared to the one that preceded it, by a "greater" social product of a different pattern, new production functions, equal sum total of money incomes, a minimum (strictly zero) rate of interest, zero profits, zero loans, a different system of prices and a lower level of prices, the fundamental expression of the fact that all the lasting achievements of the particular spurt of innovation have been handed to consumers in the shape of increased real incomes. (Schumpeter 1939, p. 141)

³⁸ We may also explain the variations in consumer prices by using the standard equations of a monetary circuit model, as presented above. The level of prices before the introduction of the imitation is expressed as follows:

$$p_{C,t(2)} = (1 - s_{t(2)}) \left(\frac{w_\alpha N_\alpha + w_i N_i}{\pi_C} \frac{1}{N_C} \right)_{t(2)}. \text{ During the imitative process, prices of consumer goods will}$$

$$\text{be } p_{C,t(3)} = (1 - s_{t(3)}) \left(\frac{w_\alpha N_\alpha + w_i N_i + w_m N_m}{\pi_C} \frac{1}{N_C} \right)_{t(3)}. \text{ Prices of consumer goods will decrease, i.e. } p_{C,t(3)} < p_{C,t(2)},$$

$$\text{if } s_{t(3)} < s_{t(2)} \text{ and/or if } \left(\frac{w_\alpha N_\alpha + w_i N_i + w_m N_m}{\pi_C} \right)_{t(3)} < \left(\frac{w_\alpha N_\alpha + w_i N_i}{\pi_C} \right)_{t(2)}, \text{ i.e. if productivity does not}$$

significantly change, we have a decrease in employment and/or in wages, that is confirmed in the text.

³⁹ See Perez (2007, p. 793): «[Financial capital] will now innovate in ways that turn the stock market into a casino decoupling from the real economy and building extraordinary paper mountains. It will speculate with whatever is at hand, from gold to real estate, and will also invent all sort of bonds and derivatives, inverted pyramids and even less legitimate schemes. High profit expectations will be kept alive by the financial wizards in a growing atmosphere of "irrational exuberance".»

Summing up, due to competitive pressures profits will in the long run be washed out and the system gravitate towards a new circular flow in which profits will again be uniform and equal to zero. All the entrepreneurs will be not innovative and will become traditional managers (although in a new scenario). In other words the economic system will be described as we did in Table 1.

6. Conclusion

The purpose of the present contribution was to show that a systematic use of transactions-flow matrices provides coherence and formalism to a monetary theory of production. This method, which ensures that nothing has been left out and that all interdependences have been taken into account, may also emphasize inside the monetary circuit not only the monetary nature of the capitalist system, but also its qualitative change in a Schumpeterian sense. There are great advantages, we believe, in developing this methodology to explain the meaning and the consequences of credit creation considered as the monetary complement of innovation. We described the different phases of Schumpeterian economic development by making use of six different transactions-flow matrices and four balance sheets matrices. We emphasized some important properties, that are obscured by the stationary state typical of the traditional monetary circuit framework, without losing the most important features of the monetary theory of production. In other words, we consistently described that “loans make deposits”, the endogenous nature of money supply, and the monetary nature of the interest rate but we also described the fluctuations in price dynamics, the temporarily monopolistic power of the innovative firms and the non-uniformity in profits. Our structure, that represents the first description of Schumpeterian analysis in the stock-flow accounting logic, may be a coherent basis for future research in macroeconomic modelling and simulating.

Capitalism is «that form of private property economy in which innovations are carried out by means of borrowed money» (Schumpeter 1939, p. 179); in other words capitalism is not only a monetary economy of production, it is also an economy that evolves technologically. A stock-flow analysis of Schumpeterian innovation economy may help us to better understand how effectively capitalism works.

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Table 1 The Transactions flow matrix of the Schumpeterian circular flow (beginning)

	Households		Traditional Firms		Banks	Σ
	Current	Capital	Current	Capital		
Consumption						0
Investment						0
Wages of Workers						0
Disposals of Managers						0
Profits of Firms						
Profits of banks						0
Interest on loans						0
Interest on bank deposits						0
Savings						0
Δ Securities						0
Δ loans			$+\Delta L_a$		$-\Delta L_a$	0
Δ transaction deposits			$-\Delta D_T$		$+\Delta D_T$	0
Δ bank deposits						0
Σ	0	0	0	0	0	0

Table 2 The Balance sheet matrix of the Schumpeterian circular flow (beginning)

	Households	Traditional Firms	Banks	Σ
Capital				0
Deposits used as cash	0	$+D_T$	$-D_T$	0
Securities				0
Bank deposits				0
Loans		$-L_a$	$+L_a$	0
Net wealth	0	0	0	0
Σ	0	0	0	0

Table 3 The Transactions flow matrix of the Schumpeterian circular flow (end)

	Households		Traditional Firms		Banks	Σ
	Current	Capital	Current	Capital		
Consumption	$-C p_C$		$+C p_C$			0
Investment			$+I_\alpha p_{I_\alpha}$	$-I_\alpha p_{I_\alpha}$		0
Wages of Workers	$+w_\alpha N_\alpha$		$-w_\alpha N_\alpha$			0
Disposals of Managers			$-W_{\alpha, M}$	$+W_{\alpha, M}$		0
Profits of Firms						
Profits of banks						0
Interest on loans						0
Interest on bank deposits						0
Savings						0
Δ Securities						0
Δ loans			$+ \Delta L_\alpha$ (=0)		$- \Delta L_\alpha$ (=0)	0
Δ transaction deposits	$- \alpha_1 \Delta D_T$ (=0)		$- \alpha_2 D_T$ (=0)		$+ \Delta D_T$ (=0)	0
Δ bank deposits						0
Σ	0	0	0	0	0	0

Table 4 The Balance sheet matrix of the Schumpeterian circular flow (end)

	Households	Traditional Firms	Banks	Σ
Capital		$+K (=0)$		$+K (=0)$
Deposits used as cash	$+D_T (=0)$		$-D_T (=0)$	0
Securities				0
Bank deposits				0
Loans		$-L_\alpha (=0)$	$+L_\alpha (=0)$	0
Net wealth	$-V_H (=0)$	$-V_F (=0)$	0	$-K (=0)$
Σ	0	0	0	0

Table 5 The Transactions flow matrix of the Schumpeterian process of innovation (first sub-phase)

	Households		Traditional Firms		Innovative Firms (investm. goods)		Banks	Σ
	Current	Capital	Current	Capital	Curr.	Capital		
Consum.	$[-C p_{C(t)}]$		$[+C p_{C(t)}]$					0
Investm.			$[+I_{\alpha} p_{I_{\alpha}}]$	$[-\beta_2 I_{\alpha} p_{I_{\alpha}}]$		$[-\beta_1 I_{\alpha} p_{I_{\alpha}}]$		0
Wages	$+w_{\alpha} N_{\alpha}$ $+w_i N_i$		$-w_{\alpha} N_{\alpha}$		$-w_i N_i$			
Disp. of Managers			$-W_{\alpha, M}$	$+W_{\alpha, M}$				0
Profits of Firms								0
Profits of banks								0
Interest on loans								0
Interest on bank deposits								0
Savings	$-S_I$	$+S_I$						
Δ Securit.								0
Δ loans			$+ \Delta L_{\alpha}$		$+ \Delta L_i$		$- \Delta L_{\alpha} - \Delta L_i$	0
Δ transact. Deposits	$- \alpha_1 \Delta D_{T,1}$		$- \alpha_2 \Delta D_{T,1}$				$+ \Delta D_{T,1}$	0
Δ bank deposits		$- \Delta D_{S,1}$					$+ \Delta D_{S,1}$	
Σ	0		0	0	0	0	0	0

Table 6 The Transactions flow matrix of the Schumpeterian process of innovation (second sub-phase)

	Households		Traditional Firms		Innovative Firms (investment goods)		Banks	Σ
	Current	Capital	Current	Capital	Current	Capital		
Consump.	$-C p_{Ct(2)}$		$+C p_{Ct(2)}$					0
Investm.			$+I_\alpha p_{I\alpha}$	$-I_\alpha p_{I\alpha}$ $-\beta_2 I_i p_{Ii}$	$+I_i p_{Ii}$	$-\beta_1 I_i p_{Ii}$		0
Wages	$+w_\alpha N_\alpha$ $+w_i N_i$		$-w_\alpha N_\alpha$		$-w_i N_i$			
Disp. Of Managers			$-W_{\alpha, M}$	$+W_{\alpha, M}$				0
Profits of Firms			$-\Pi_\alpha$	$+\Pi_\alpha$	$-\Pi_i$	$+\Pi_i$		0
Profits of banks	$+\Pi_B$						$-\Pi_B$	0
Interest on loans					$-i_L L_i (-1)$		$+i_L L_i (1)$	0
Interest on bank deposits	$+i_D D_{-1}$						$-i_D D_{-1}$	0
Savings	$-S_2$	$+S_2$						
Δ Securit.		$-p_{E,i} \Delta E_i$				$+p_{E,i} \Delta E_i$		0
Δ loans			$+\Delta L_\alpha$		$+\Delta L_i$		$-\Delta L_\alpha - \Delta L_i$	0
Δ transact. Deposits	$-\alpha_1 \Delta D_{T,2}$		$-\alpha_2 \Delta D_{T,2}$				$+\Delta D_{T,2}$	0
Δ bank deposits		$-\Delta D_{S,2}$					$+\Delta D_{S,2}$	
Σ	0		0	0	0	0	0	0

Table 7 The Balance sheet matrix of the Schumpeterian process of innovation (second sub-phase)

	Households	Traditional Firms	Innovative Firms	Banks	Σ
Capital		$+\beta'_2 K_2$	$+\beta'_1 K_2$		$+K_2$
Deposits used as cash	$+D_{T,2}$			$-D_{T,2}$	0
Securities	$+p_{E,i} E_i$		$-p_{E,i} E_i$		0
Bank deposits	$+D_{S,2}$			$-D_{S,2}$	0
Loans		$-L_\alpha$	$-L_i$	$+L_2$	0
Net wealth	$-V_H$	$-\beta'_2 V_F$	$-\beta'_1 V_F$	0	$-K_2$
Σ	0	0	0	0	0

Table 8 The Transactions flow matrix of the Schumpeterian process of imitation (first sub-phase)

	Households		Traditional Firms		Innovative Firms		Imitative Firms		Banks	Σ
	Current	Capital	Current	Capital	Current	Capital	Current	Capital		
C	$[-C p_{Ct(3)}]$		$[+C p_{Ct(3)}]$							0
I			$[+I_\alpha p_{I\alpha}]$	$[-I_\alpha p_{I\alpha} - \beta_2 I_i p_{I_i}]$	$[+I_i p_{I_i}]$	$[-\beta_1 I_i p_{I_i}]$		$[-\beta_3 I_i p_{I_i}]$		0
W	$+w_\alpha N_\alpha$ $+w_i N_i$ $+w_m N_m$		$-w_\alpha N_\alpha$		$-w_i N_i$			$-w_m N_m$		
W_M			$-W_{\alpha M}$	$+W_{\alpha M}$						0
Π	$+\Pi_{Di}$		$-\Pi_\alpha$	$+\Pi_\alpha$	$-\Pi_{Di}$	$+\Pi_{NDi}$				0
Π_B	$+\Pi_B$								$-\Pi_B$	0
i_L					$-i_L L_i (-1)$				$+i_L L_i (1)$	0
i_D	$+i_D$ D_{-1}								$-i_D D_{-1}$	0
S	$-S_3$	$+S_3$								
ΔE		$-p_{E,i} \Delta E_i$ $-p_{E,\alpha} E_\alpha$		$+p_{E,\alpha} E_\alpha$		$+p_{E,i} \Delta E_i$				0
ΔL			$+\Delta L_\alpha$		$+\Delta L_i$		$+\Delta L_m$		$-\Delta L_\alpha$ $-\Delta L_i$ $-\Delta L_m$	0
ΔD_T	$-\alpha_1 \Delta D_{T,3}$		$-\alpha_2 \Delta D_{T,3}$						$+\Delta D_{T,3}$	0
ΔD_S		$-\Delta D_{S,3}$							$+\Delta D_{S,3}$	
Σ	0		0	0	0	0	0	0	0	0

Table 9 The Transactions flow matrix of the Schumpeterian process of imitation (second sub-phase)

	Households		Traditional Firms		Innovative Firms		Imitative Firms		Banks	Σ
	Current	Capital	Current	Capital	Current	Capital	Current	Capital		
Con.	$-C p_{Ct(2)}$		$+C p_{Ct(2)}$							0
Inv.			$+I_\alpha p_{I\alpha}$	$-I_\alpha p_{I\alpha}$ $-\beta_2 I_i p_{Ii}$ $-\gamma_2 I_m p_{Im}$	$+I_i p_{Ii}$	$-\beta_1 I_i p_{Ii}$	$+I_m p_{Im}$	$-\gamma_1 I_m p_{Im}$		0
W	$+w_\alpha N_\alpha$ $+w_i N_i$ $+w_m N_m$		$-w_\alpha N_\alpha$		$-w_i N_i$		$-w_m N_m$			
W_M			$-W_{\alpha, M}$	$+W_{\alpha, M}$						0
Π	$+\Pi_{Di}$		$-\Pi_\alpha$	$+\Pi_\alpha$	$-\Pi_{Di}$	$+\Pi_{NDi}$	$-\Pi_m$	$+\Pi_m$		0
Π_B	$+\Pi_B$								$-\Pi_B$	0
i_L					$-i_L L_i (-1)$		$-i_L L_m (-1)$		$+i_L L_i (-1)$ $+i_L L_m (-1)$	0
i_D	$+i_{D(-1)}$ D_{-1}								$-i_{D(-1)} D_{-1}$	0
Sav.	$-S_4$	$+S_4$								
ΔE		$-p_{E,i} \Delta E_i$ $-p_{E,\alpha} \Delta E_\alpha$ $-p_{E,m} \Delta E_m$		$+p_{E,\alpha} \Delta E_\alpha$		$+p_{E,i} \Delta E_i$		$+p_{E,m} \Delta E_m$		0
ΔL			$+\Delta L_\alpha$		$+\Delta L_i$		$+\Delta L_m$		$-\Delta L_\alpha$ $-\Delta L_i$ $-\Delta L_m$	0
ΔD_T	$-\alpha_1 \Delta D_{T,4}$		$-\alpha_2 \Delta D_{T,4}$						$+\Delta D_{T,4}$	0
ΔD_S		$-\Delta D_{S,4}$							$+\Delta D_{S,4}$	
Σ	0		0	0	0	0	0	0	0	0

Table 10 The Balance sheet matrix of the Schumpeterian process of imitation (second sub-phase)

	Households	Traditional Firms	Innovative Firms	Imitative Firms	Banks	Σ
Capital		$+\beta''_1 K_4$	$+\beta''_2 K_4$	$+\beta''_3 K_4$		$+K_4$
Deposits used as cash	$+D_{T,4}$				$-D_{T,4}$	0
Securities	$+p_{E,\alpha} E_\alpha + p_{E,i} E_i + p_{E,m} E_m$	$-p_{E,\alpha} E_{ni}$	$-p_{E,i} E_i$	$-p_{E,m} E_m$		0
Bank deposits	$+D_{S,4}$				$-D_{S,4}$	0
Loans		$-L_\alpha$	$-L_i$	$-L_m$	$+L_4$	0
Net wealth	$-V_H$	$-\beta''_1 V_F$	$-\beta''_2 V_F$	$-\beta''_3 V_F$	0	$-K_4$
Σ	0	0	0	0	0	0

Legenda

Cp_C = monetary amount of consumption goods	p_Z = price of goods	$z = C, I$; C = consumption goods; I = investment goods
$I_j p_{Ij}$ = monetary amount of investment goods (j -type firms)		$j = \alpha, i, m$,
$W = w_j N_j$ = wages of workers (j -type firms)	w_j = rate of wage N_j = number of workers	α = routine technology => traditional firms; i = innovative technology => innovative firms; m = imitative technology => imitative firms
W_{iM} = disposals of managers		
Π_j = profits of firms		
Π_B = profits of banks		
i_L = interest on loans		
i_D = interest on bank deposits		
S = savings		
$p_{E,i} \Delta E$ = flow of securities (j -type firms)	$p_{E,i}$ = price of securities	
ΔL_i = flow of loans (j -type firms)		
ΔD_T = flow of transaction deposits		
ΔD_S = flow of bank deposits		
ΔD_S = flow of bank deposits		
$K_t = K_{t-1} + p^* \sum I_j$ = accumulated capital	$t = 1, 2, 3, 4$; $p^* = f(p_{I\alpha}; p_{Ii}; p_{Im})$	