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Money and the disequilibrium dynamics of market economies

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This paper is a preliminary essay in relation with my PhD Dissertation in progress. The latter aims at pointing out the potential causality from the process generally called "financialization" – the increasing role of financial markets with respect to the overall workings of modern market economies (see Epstein, 2005) – to macroeconomic instability. Notably, a model is elaborated in order to deal with the causality at issue. Hence, the model should be elaborated so that its hypotheses, definitions and assumptions abide by some "essential" features of the workings of market economies (Baumol, 1966). This paper argues the very first of of these features is *money*. In other words, money should be seen as the basis of the workings of market economies. As a result, the model to be elaborated in our PhD Dissertation should reflect this monetary theory of market economies, in order to abide by this essential feature.

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To our opinion, such a theory deserves attention, because it amounts to elaborate on an alternative paradigm in economics. Indeed, mainstream economics thinks of market economies as “real” economies, that is, economies whose workings are based on *goods*. Notably, as put by Debreu (1959), any market-clearing equilibrium is determined by the preferences of agents about goods, their initial endowments (in goods), and the techniques of production (of goods). Within this framework, money is just a technical device added to a pre-existent real economy, in order to execute the transactions associated with the equilibrium that has been previously determined independently of money (Iwai, 2001). Money is supposed to be a technique of transaction more suitable than barter, as the latter is restricted by the double coincidence of wants (as already argued by Menger, 2005 [1892]). In turn, money is supposed not to influence (at least in the long run) the properties of equilibrium (except the general level of prices in the short run). Money is said to be *neutral*.

In order to deal with money as the basis of the workings of market economies (which precludes the notion of neutrality), the starting point is the aforesaid property of every model: the latter always has logical implications about the theorizing of real-world economies (Baumol, 1966). For instance, whenever a utility/production function is used, it has the following logical implication: the goods that enter the function can be described before everything, as if they are the starting point of economic activity (Benetti & Cartelier, 1980; Benetti, 2004). However, to think about goods as such a starting point is not a necessity. To the contrary, goods can be seen as the ongoing result of the economic activity, instead of being thought of as its starting point. Notably, this is the case in a Schumpeterian perspective. Bank credit is the main source of financing for production, while credit relations between banks and firms thus determine which goods are produced (Schumpeter, 1961); but goods are not given *ex ante*, as implied by utility/production functions.

This property applies to a particular set of models, which can be seen as the “core” models of modern mainstream economics, namely, those models that attempt to demonstrate the *stability* of *equilibrium*. The latter is a situation according to which agents' decisions (about production, consumption, transactions, and so on) are mutually compatible; conversely, *dis*equilibrium is a situation according to which agents' decisions are *not* mutually compatible. For instance, if a firm does not manage to sell its (consumption) goods to households, then the decision (by the firm) about production is incompatible with the decisions (by households) about consumption. Similarly, if households tend not to find enough jobs, then the number of jobs decided by firms is incompatible with the number of workers that households decided to submit to firms (Milgate, 1989; Kirman, 1995). Disequilibrium is unavoidable in market economies. Indeed, the latter are characterized by the fact that prior coordination between agents tends to be absent[1], whereas prior coordination (whether by the state, by religion or by customs/traditions; see e.g. Polanyi *et al.*, 1957) obviously implies that agents would be

1. Said differently, agents are *separated* and make *decentralized* decisions (Benetti & Cartelier, 1980; De Vroey, 1987).

more able to make decisions which are mutually compatible (Cartelier, 1991). As put by Hahn (1984 [1981], p. 209), there is not “an overall plan in the unfolding of which they [i.e. agents] have pre-assigned roles”. Thus, as prior coordination tends to be absent, nothing implies that any decision will be compatible one with each other, thus leading to disequilibrium.

Equilibrium is stable if there is a convergence from *disequilibrium dynamics* to equilibrium. By “disequilibrium dynamics”, we mean a process made of several situations of disequilibrium, each of them following one another through time. The explanation is as follows. As previously suggested, if prior coordination tend to be absent, then a disequilibrium may almost certainly occur. Now, given that agents are aware of disequilibrium, they will adjust their decisions in order to avoid the related incompatibility of decisions: if a firm does not manage to sell its (consumption) goods to households, then its decision about production is so adjusted that it will not lead to unsold stocks; similarly, if households tend not to find enough jobs, then they may (decide to) accept part-time jobs, lower wages, or jobs which do not correspond to their skills. Still, nothing implies that the newly-adjusted decisions will be compatible, as prior coordination still tends to be absent. Thus, agents undertake new adjustments; and so on. As a result, disequilibrium situations follow one another through time; here is defined the disequilibrium dynamics of market economies. Notwithstanding, some models attempt to show that decisions would tend to be mutually compatible as agents adjust them during disequilibrium dynamics; this would stem from the fact that agents are supposed to learn from their past experience in the market. As a result, there would be a convergence from disequilibrium dynamics to equilibrium. In other words, equilibrium would be stable (Ingrao & Israel, 1990).

Hence, one can wonder if these models are acceptable or not with respect to their logical implications. Accordingly, the hypotheses, definitions and concepts of the models lead to a specific representation of disequilibrium dynamics. Thus, we should inquire if the representation given by any model related with the demonstration of stability is acceptable or not. *This paper is devoted to such an inquiry*. Our argument is twofold. First, we argue that the disequilibrium dynamics implied by the models contradict the lack of prior coordination which is supposed to prevail in market economies. Then, we argue that thinking of market economies as monetary economies avoids this contradiction; in this perspective, money is seen as a *set of rules*, but no longer as a mere technical device, while this set implies to be far closer to the absence of prior coordination than with mainstream economics (through its models of stability). As a final result, we are more able to account for disequilibrium dynamics, while the economic modeling of market economies – whether to inquire about financialization or other topics – should reflect this monetary theory of market economies.

First, we introduce the main model which aims at demonstrating stability, and we show why it encounters the above contradiction. This model is known as *tâtonnement*. Then, we introduce the *Edgeworth process* and the *Hahn process*, which also aim at demonstrating stability; again, we show that the above contradiction is still there.

Finally, we suggest putting the emphasis on money in order to avoid such a contradiction, and thus thinking of any market economy as a monetary economy.

I. **Disequilibrium dynamics and *tâtonnement***

The first model known as *tâtonnement* (Samuelson, 1941; see also Samuelson, 1961; Arrow & Hahn, 1971). According to the latter, the stability of equilibrium is due to price variations. The model is based on the following equation:

$$\left(\frac{\partial p_i}{\partial t}\right)=H_i[Z_i(p)]$$

where p_i is the price of the *i*-th good; *t* is (continuous) time; $Z_i(p)$ is the excess demand of *i*-th good, that is, the difference between the sum of the individual demands for this good and the sum of the individual supplies of it; the excess demand is set as a (continuous) function of every price, to wit, the price vector *p*. Finally, H_i is a sign-preserving function[2]. So, this equation amounts to say that the variation of the price of a given good trough time depends on the excess demand of this good, in accordance with the H_i function. For instance, if we set $H_i[Z_i(p)]=Z_i(p)$ (which is sign-preserving), then the variation of p_i equals the value of the excess demand and is of the same sign: if $Z_i(p)>0$ then the variation of p_i is also positive; and the variation is negative if, conversely, $Z_i(p)<0.$

Then, *tâtonnement* characterizes individual demands/supplies, in order to characterize excess demands themselves (see Arrow & Hahn, 1971). Here, it is sufficient to point out the following: if excess demands are (continuous) functions of prices, and if excess demands are the difference between the sum of individual demands and the sum of individual supplies, then these individual demands/supplies are logically set as (continuous) functions of prices likewise. Indeed, if the price of a given good increases, then one can expect that the related good is less demanded (as it is more expensive) and more supplied (as its sale implies more profit); and conversely, if the price decreases. Also, one can expect that, if the price of a given good increases, the goods that are more or less substitutes for the former are more demanded, and that the goods whose sale may imply less profit than the sale of the former are less supplied (everything else being equal). And conversely, if the price decreases, then the opposite effects apply.

On the basis of *n* equations like the previous one (that is, *n* goods), with the underlying individual demand/supply functions of *m* agents, the demonstration of convergence to equilibrium amounts to show that every excess demand converges to zero due to the variations of prices. The explanation is as follows. On the one hand, if excess demand equals zero for any good, then any aggregate supply logically equals the related aggregate demand. In turn, this equality implies that there are neither unsold stocks (supply>demand) neither unsatisfied needs (supply<demand). Thus, this

2. Let $sign(Z)$ be the (positive or negative) sign of the *Z* function. Then *H* is sign-preserving if (and only if) $sign[H(Z)]=sign(Z).$

equality can be seen as the expression of a situation according to which agents' decisions are mutually compatible, to wit, a situation of equilibrium. As put by Arrow & Hahn (1971, p. 19), “market equilibrium is concerned with the compatibility of the decisions of the different firms and households, and therefore we are interested in the difference between the total demand for a good and its total supply”. On the other hand, as put by the equation, if at least one excess demand is positive, then the related prices increase (that is, price variation is positive like the related excess demands), which in turn should lead individual demands to decrease and individual supplies to increase: as a consequence, excess demands are closer to zero. And conversely, for any negative excess demand. In this way, continuous variations of prices should lead to the convergence to zero of every excess demand, thus showing the convergence to equilibrium.

As suggested in the introduction, such a convergence should be the result of disequilibrium dynamics. Thus, the latter is given a specific representation by the *tâtonnement* model:

1. First, each agent plans (individual) supplies of some goods and (individual) demands for some others, in accordance with specific objectives (to maximize utility for households, to maximize profit for firms) and constraints (initial endowments, input-output coefficients, and so on).
2. For each good, the excess demand is calculated. Each time at least one excess demand does not equal zero, then prices change. Indeed, these changes are supposed to lead agents themselves to change their individual supplies/demands (as the latter are set as functions of prices), so that the subsequent excess demands also change.
3. Precisely, the aim of these price changes is to lead any excess demand to equal zero, to wit, equilibrium. However, if at least one excess demand still differs from zero despite some price variations, then a second disequilibrium follows the first one. Price thus change again. And so on, until it would lead any excess demand to equal zero.

As suggested above, this model is unable to demonstrate the stability of equilibrium. On the one hand, at the heart of demonstration, we have to prove that excess demand functions are specific. Their first specificity is that they (monotonically) *decrease* due to price variations. More precisely, assuming that excess demands are first positive, each rise in prices is expected to reduce individual demands and to increase individual supplies (as suggested above), so that excess demand functions decrease. Secondly, as price variations follow one another, excess demand functions gradually decrease, until they reach zero, where they must not decrease any more; thus, the second specificity of excess demand functions is that they are *bounded below* while zero *is a rest point* (Uzawa, 1961). On the other hand, however, according to the so-called Sonnenschein-Mantel-Debreu theorem, nothing implies that excess demand functions behaves in this specific manner (Sonnenschein, 1972, 1973; Mantel, 1974, 1976;

Debreu, 1974; for surveys of these and other related works, see Shafer & Sonnenschein, 1982; Kirman, 1999; Ackerman, 2004).

Generally speaking, this theorem is based on the following result: if we start with *any* function of prices, then we can show that this function can be set as the difference between the sum of a given number of individual demand functions and the sum of a given number of supply functions, thus leading to include the former function within the class of excess demand functions (provided that this function abide by the minimal properties of this class, namely, homogeneity of degree zero and Walras' Law; see the already mentioned references). The fact that excess demand functions can thus be any function is due to *income effects*: if the price of a given good increases, then some producers earn more income (in the form of profit), so that they increase their demand of certain goods, and this increase may also concern the former good whose price has previously risen; to sum up, an increase of the price of a given good may lead agents to increase their demand for this good *via* income effects, but not to reduce it. As a result, the individual demand functions could be any function, thus leading the excess demand functions to be also any function[3].

Still, as previously suggested, we are interested with the acceptability of the disequilibrium dynamics themselves, as implied by *tâtonnement.* Now, on this ground, *tâtonnement* is also unacceptable. We would like to point out the following difficulty: the disequilibrium dynamics of *tâtonnement* contradict the lack of prior coordination within market economies. Actually, there is such a contradiction because the disequilibrium dynamics of *tâtonnement* imply an *agreement* between *all* agents *before* they make decisions, as if, precisely, prior coordination were not so absent. In other words, there is an overall preliminary agreement ("overall" points out that all agents are concerned with this agreement; "preliminary" points out that the latter takes place before they make decisions). This overall preliminary agreement is threefold:

1. Firstly, (all) agents (beforehand) agree that one of them (then called "auctioneer"), or a subgroup of them, announces some prices, while, in turn, the other agents have to give information about their individual demands/supplies (which depend on the prices put forward). Still in virtue of this first agreement, the first (group of) agent(s) then calculates every excess demand (as the latter is the difference between aggregate demand and aggregate supply, and thus is the difference between the sum of individual demands and the sum of individual supplies), and announces new prices as long as at least one excess demand does not equal zero[4] (Koopmans, 1957).
2. Secondly, agents agree on a predetermined list of goods, which would be produced, exchanged and consumed (Benetti & Cartelier, 1980, 1990; Benetti,

3. Actually, Scarf (1960) already provides some examples of non-stability. And, the demonstrations of stability by Arrow & Hurwicz (1958) and Arrow, Block & Hurwicz (1959) are possible only because they add an additional property which restricts the behavior of excess demand functions. Thus, it restricts the proof of stability to the individual demand functions whose sum implies this property at the level of excess demand functions. This property is the famous gross substitutes property See Fisher (1972) .

4. Also, we can show that the agent(s) that is the auctioneer must do it for free (Deleplace, 2007). Obviously, this could undermine the agreement if the latter should be reached by self-interest agents.

2004). Obviously, if some goods are not known by agents, they would not be able to formulate an individual demand/supply, so that the calculation of some excess demands would be impaired, thus leading the process to be inefficient. This is the reason why agents have to agree on a predetermined list of goods (*nomenclature*). According to Hildenbrand & Kirman (1988, p. 53), this predetermined list "does not impose any real restriction, since all that we are assuming is that the agents in an economy are only capable of distinguishing between a finite number of commodities". However, both authors forget that it would be impossible that *all* agents distinguish between the *same* goods (or "commodities"), except if agents previously agree on those goods that will enter the *tâtonnement* process.

3. Thirdly, agents agree not to produce, consume or to trade before every excess demand equals zero, i.e. before equilibrium is reached. This is due to the following reason. On the one hand, within the *tâtonnement* system of equations, price variations depend on excess demands, which in turn depend only on the prices put forward by the auctioneer; on the other hand, however, excess demands depend neither on some production nor on some consumption nor on some transactions decided by agents meanwhile. Still, once the auctioneer has announced a set of prices, agents might decide to produce, to consume and to trade even if these prices do not achieve an equilibrium; in turn, these decisions would influence excess demands, and the auctioneer then announces a new set of prices; and so on, until price variations lead to equilibrium while production, consumption and transactions take place. So, agents really have to agree that they decide nothing before equilibrium is reached; their individual demands/supplies are just mere intentions communicated to the auctioneer (De Vroey, 1987; Fisher, 1989; Cartelier, 1991).

Now, if the disequilibrium dynamics implied by *tâtonnement* contradict the lack of prior coordination, due to an overall preliminary agreement between agents, then these dynamics should be rejected.

In addition, the third part of the agreement introduces another difficulty. If neither production nor production nor transactions are decided before equilibrium is reached, then disequilibrium dynamics are logically inconceivable. Put differently, *tâtonnement* only leaves room for equilibrium. As put by Fisher (1989, p. 21), "the difficulty arises directly with the price-adjustment equation used. It has nothing to do with the question of whether or not trade, consumption, or production takes place out of equilibrium". Definitely, *tâtonnement* should be rejected if the aim is to deal appropriately with disequilibrium dynamics[5].

5. Finally, we can also add another difficulty: agents communicate their individual demands/supply as if equilibrium is already reached, although the latter is only the final result of *tâtonnement*. This is called the *Present action postulate* (Fisher, 1989).

II. Disequilibrium dynamics, the Edgeworth process and the Hahn process[6]

Another model is the *Edgeworth trading process*, or, more simply, "Edgeworth process" (so named and undertaken by Uzawa, 1962; see also Hahn, 1962; and, for a brief presentation, see Negishi, 1962). As compared with *tâtonnement*, the Edgeworth process leaves room for exchanges before equilibrium is reached (hence the words "trading process"); to this purpose, it introduces some equations that account for the execution of exchanges, in relation with the welfare gains that agents would benefit from these exchanges.

At first sight, the Edgeworth process would seem to be an improvement as compared with *tâtonnement*. As argued above, *tâtonnement* encounters a main difficulty as the subsequent disequilibrium dynamics imply an overall preliminary agreement between agents, although the latter are supposed to act while prior coordination between them tends to be absent. Now, the prohibition of trading out of equilibrium is a part of this agreement. So, if trading out of equilibrium is not forbidden, then this part of this agreement is no longer necessary. As a result, the Edgeworth process would move closer than *tâtonnement* to the absence of prior coordination, and thus and would the implied disequilibrium dynamics is more satisfactory.

However, *tâtonnement* is incorporated into the Edgeworth process. Simply, the price variations according to excess demand functions are amended with equations which account for trading out of equilibrium[7] (and for the subsequent improvement of agents' welfare). So, the preliminary threefold agreement is lessened, but not removed. It is lessened as (all) agents no longer (beforehand) agree not to trade before equilibrium is reached (third part of the agreement). It is not removed as agents still agree on the auctioneer (first part), on the goods that will enter *tâtonnement* (second part), and agree not to undertake consumption or production before equilibrium is reached (third part). Hence, the Edgeworth process remains too far from the absence of prior coordination, and thus remains unable to suggest a suitable representation of disequilibrium dynamics.

In addition, let us remind that *tâtonnement* is also unable to account for an effective situation of disequilibrium, as neither production nor consumption nor trade take place out of equilibrium. Now, as the Edgeworth process incorporates *tâtonnement*, it encounters the same difficulty, albeit to a lesser degree. Indeed, although trade is possible before equilibrium is reached, neither production nor consumption remain possible. However, this is necessary if the aim is to account for disequilibrium dynamics. As put by Fisher (1989, p. 30), "the Edgeworth process does not appear to lend itself readily to the important extension of allowing production and consumption to take place out of equilibrium".

6. Throughout this section, we rely on Fisher (1989).

7. So, It may appear misleading to identify the Edgeworth process with a "non-*tâtonnement*" process (Fisher, 1989), as found in the literature (see e.g. Negishi, 1962)

Moreover, the Edgeworth process implies that we move even farther from the absence of prior coordination, although we have previously moved (a little more) closer to it by means of trading out of equilibrium. The explanation is as follows.

1. Like *tâtonnement*, the aim of the Edgeworth process is to demonstrate the stability of equilibrium by means of formal analysis; but, as opposed to *tâtonnement*, stability is also involved by trading out of equilibrium. Now, the related formal analysis implies that, for stability to occur, trading out of equilibrium must follow a specific rule: trade takes place if (and only if) the latter implies that at least one agent gains welfare (i.e. is made better off) and if no agent loses welfare[8]. Put differently, trade occurs if the latter is advantageous for a set of agents (this set is called a "coalition"). However, as put by Fisher (1989, pp. 29-30), "it is possible that there is no mutually advantageous bilateral or trilateral or quadrilateral trade and that the only mutually advantageous trade involves a very complicated swapping of commodities among millions of people".
2. As a consequence, this trading rule implies prior coordination between agents. Indeed, if the only mutually advantageous trade involves several people (not to say "millions of people"), then any agent have to know who the other agents that could be involved in such a trade are. Hence, agents must (previously) agree on an "organization" which disseminate this knowledge, and thus extend the overall preliminary agreement related to *tâtonnement.* This is the reason why the Edgeworth process moves farther from the absence of prior coordination. Still, such an organization does not exist. Agents *lack* of prior coordination, and they have to act on the market in order to know by themselves who might be trading partners and what can be traded.

Finally, another difficulty is introduced by the trading rule. As a consequence of the latter, agents only gain welfare in virtue of their exchanges. However, disequilibrium implies that some decisions are not compatible one with each other, so that some exchanges may not be possible, so that *in fine* agents may *not* gain welfare. Definitely, the Edgeworth process is unsuitable with regard to disequilibrium dynamics.

Maybe a solution is given by the third model, namely, the *Hahn trading process*, or, more simply, "Hahn process" (so named by Negishi, 1962; see Hahn & Negishi, 1962). Actually, it follows the same path as the Edgeworth process: the *tâtonnement* system of equations is amended with other equations which account for trading out of equilibrium. So, the Hahn process encounters the same difficulty: again, the overall preliminary agreement is lessened, but not removed. Similarly, as the Hahn process incorporates *tâtonnement* (like the Edgeworth process), it is also unable to account for an effective situation of disequilibrium, albeit to a lesser degree. Indeed, although trade is possible before equilibrium is reached, neither production nor consumption remain possible.

8. More precisely, the formal analysis within the framework of the Edgeworth process consists in the use of the so-called *Lyapounov's second method*, which is also used to demonstrate stability within the framework of *tâtonnement*. More on this can be found in Fisher (1989).

Nonetheless, the Hahn process would appear closer to the absence of prior coordination than the Edgeworth process (and thus than *tâtonnement*). The explanation is as follows.

1. The Hahn process does not rely on the above trading rule (trade occurs if the latter is advantageous for a set of agents). Now, for the trading rule to be effective, agents beforehand agree on an organization that make them known what can be traded and with whom; the Edgeworth process thus moves farther from the absence of prior coordination. So, if the Hahn process does not introduce the above trading rule, then we do no longer need to assume that agents agree on the related organization. This is the reason why, within the framework of the Hahn process, we do not move farther to the absence of prior coordination because of the trading rule.
2. Actually, the Hahn process also imply to move farther from the absence of prior coordination, but such a move is far more smaller than the one involved by the organization that is responsible for the trading rule within the Edgeworth process. Let us recall that the above trading rule is necessary for the demonstration of stability: thus, for stability to occur, the Hahn process must introduce something else if it does not rely on such a rule. As a matter of fact, the solution is given the assumption of *orderly markets*: each market is sufficiently well organized that there are not simultaneously both unsatisfied demand and unsatisfied demand.
3. Now, this assumption implies a much less severe prior coordination than implied by the trading rule: it only needs that agents agree on a medium of exchanges, which is called “money” (Arrow & Hahn, 1971). To this purpose, suppose three goods, A, B and C; then, without this “money”, there are three markets: one where A is exchanged for B, one where A is exchanged for C, and one where B is exchanged for C. Thus, A is exchanged within two markets, so that it is possible that there is an unsatisfied demand of A in return for B (first market), while there is an unsatisfied supply of A in return for C (second market). So, these markets are not orderly ones. To the contrary, if “money” is introduced, then there are three other markets, and each of them is devoted to one good (A, B and C) as the latter is exchanged only in return for money. So, each good is exchanged only in a single market, so that there cannot be simultaneously both an unsatisfied demand for and an unsatisfied supply.

As a final result, within the framework of the Edgeworth process, agents beforehand agree on an organization that make them known what can be traded and with whom, whereas, within the framework of the Hahn process, agents simply beforehand agree on a medium of exchanges. So, the Hahn process clearly is closer to the absence of prior coordination than the Edgeworth process, and thus is better able to appropriately account for disequilibrium dynamics.

This would be confirmed as the Hahn process avoids the other difficulty encountered by the Edgeworth process: on the one hand, the trading rule implies that

agents only gain welfare in virtue of their exchanges; on the other hand, however, disequilibrium implies that some decisions are not compatible one with each other, so that some exchanges may not be possible, so that *in fine* agents may *not* gain welfare. Precisely, as the Hahn process leaves room for unsatisfied demands and unsatisfied supplies (but not simultaneously both on a single market), some exchanges are not made; this amounts to say that not all decisions are compatible, as in disequilibrium dynamics.

Nonetheless, the introduction of the medium of exchanges is flawed; so, the Hahn process is not necessarily closer to the absence of prior coordination than the Edgeworth process, and thus is not necessarily better able to appropriately deal with disequilibrium dynamics. The flaw stems from the introduction of an *ad hoc* assumption along with the introduction of a medium of exchanges, that is, the "Positive cash assumption": no agent runs out of money. Suppose that some agents demand a given good, but that they do not have enough money in order to buy this good. Consequently, there is an unsatisfied demand and simultaneously, as suppliers do not sell the good, there is an unsatisfied supply; so, even with a medium of exchanges, markets are not orderly ones (and stability cannot occur). As a final result, it appears indispensable to introduce the Positive cash assumption, but the latter is clearly unsatisfactory[9].

III. Disequilibrium dynamics and money

To sum up, if the aim is to appropriately account for disequilibrium dynamics, neither *tâtonnement* nor the Edgeworth process nor the Hahn process are useful[10]. To this purpose, we suggest putting the emphasis on the path followed by a set of works,where money is something more than a mere technical device (Benetti & Cartelier, 1980, 1990; Cartelier, 1991, 1996).

Indeed, each model mentioned above implies that the economy is a *real* economy, that is, an economy whose workings are based on goods. Notably, this implies that exchanges are executed like barter: any good is exchanged for another good (and all these goods belong to a predetermined list, as already argued). Even if money is introduced (as in the Hahn process), the latter is also a good (be it "dematerialized"

9. Moreover, since agents behave as if equilibrium is already reached (i.e the Present action postulate; see the fifth footnote), the Positive cash assumption is even more problematic, as we can show that no agent wants to hold money. Indeed, if trade ceases at equilibrium (as in Arrow & Hahn, 1971), and if agents believe that equilibrium is already reached, then they do not have any reason to hold money; however, in virtue of the Positive cash assumption, they are supposed not to run out of money. See Fisher (1989).

10. Maybe there would remain the « true model » elaborated by Fisher (1989), wherein the auctioneer is removed, and wherein production, consumption and trade take place out of equilibrium. However, there still remains the predetermined list of goods, that is, the second part of the framework induced by *tâtonnement*. Now, when goods are given *a priori*, the model is already characterized by a high level of complexity. Thus, we wonder if the removal of the predetermined list is feasible. Nevertheless, even if theoretical complexity is not an obstacle, the model remains unsatisfactory, as its demonstration of stability relies on an *ad hoc* assumption, called *No favorable surprise*. According to the latter, agents cease to perceive some opportunities of profit on markets. In other words, any unforeseen technological change, any modification of preferences or any discovery of new sources of raw materials is supposed not to occur. Otherwise, the convergence to equilibrium is always delayed. This assumption is unsatisfactory not for its lack of "realism", but for its negation of uncertainty, although the latter is an ontological feature of the observable facts, namely, uncertainty. Indeed, the latter implies that favorable surprises do exist.

and/or “useless”, as in the case of fiat-money), so that exchanges are still between goods themselves; money just makes barter less cumbersome (and may also help to demonstrate the stability of equilibrium, as suggested by the Hahn process), with respect to the double coincidence of wants (Benetti, 2004). Still, outside this technical role, money is not necessary for the understanding of market economies.

Now, barter is executed according to the following principle, which may be called the *Condition of barter* (Negishi, 1962), or the *No swindling* principle (Fisher, 1989), or even the *equivalence* principle (Benetti, 2004): any good is exchanged for another good of the *same* value. So, within the framework of barter, *agents spontaneously respect their budgetary constraints*: agents cannot purchase more than what they sell. However, if decisions are not compatible as in disequilibrium, then we need that, from a theoretical perspective, some agents do *not* respect their budgetary constraints. Indeed, in virtue of a disequilibrium, some agents may be unable to sell their goods as expected (and to get jobs as expected), while they have purchased goods that amounts for more than the goods that they have sold; thus, in disequilibrium, budgetary constraints are not always respected. Still, barter ensures that agents spontaneously respect their budgetary constraints. As a final result, we clearly have to exclude barter if the aim is to appropriately account for disequilibrium (dynamics).

This has the following consequence: if we reject barter, then prices cannot be “real” prices, that is, prices expressed as quantities of different goods (as goods are exchanged for other goods). To the contrary, prices must be expressed by a unit which does not identify with (quantities of) goods. Precisely, this unit can be a *monetary* unit: euro, peso, dollar, and so on. All of these monetary units are *not* goods. Clearly, agents cannot “produce” or “consume” euros as they produce and consume goods.

Also, one can wonder how the purchase/sale of goods are executed if i) an agent does not sell a good by purchasing another good (and *vice versa*), to wit, barter; and if ii) the price of goods are expressed by means of a monetary unit. To this purpose, we have to introduce *means of payment*, notably *bank debts*. If a price amounts to £*x*, then the involved sale/purchase is executed by the transfer of a £*x* bank debt (or several bank debts that amount to £*x* together) from the purchaser to the seller[11]. These transfers are called *payments*, and bank debts, as the means through which payments are performed, are called *means of* payment[12]. Contrary to mainstream economics, neither goods are transferred in return for other goods (on the basis of their “real” prices), nor money is a technical device which makes these transfers more convenient. Goods are only transferred in return for means of payment.

The process which makes means of payment available to agents is *bank credit.* Indeed, when banks grant credits, they truly issue debts on themselves, while these debts are then lent to agents (first of all firms) as means of payment. Now, any credit must be reimbursed. This amounts to say that the lender must recover means of

11. This implies that bank debts are used as means of payment only if agents do not ask for their settlement. See Cartelier (1991, 1996).

12. We can also imagine a minting process, besides bank debts. Actually, there should not be any confusion with mainstream economics. See Cartelier (1991, 1996).

payment up to the amount of means of payment that has been borrowed (plus interest charges). In other words, lenders must benefit from payments up to the payments made by themselves thanks to credit. *This condition is nothing but the respect of the budgetary constraints*. Precisely, as agents decide of their payments outside prior coordination, then some credits are not reimbursed, thus leading some budgetary constraints not to be respected. It thereafter remains to settle the bank credits that are not reimbursed, to wit, to restore budgetary constraints. As a matter of fact, several solutions exist: bankruptcies, LBOs, financial operations, and so on.

The following representation of disequilibrium dynamics would thus be elaborated.

1. Agents borrow means of payments from the banking system, and perform payments for their transactions to be executed; notably, these transactions are necessary for production to be achieved, as firms need to pay other firms in return for capital goods and households in return for their labour services.
2. Still, as agents make their payments while prior coordination between them tends to lack, then payments are not decided so that they ensure the reimbursement of every bank credit. So, a first disequilibrium occurs. In turn, this disequilibrium implies some operations in order settle those credits that are not reimbursed.
3. Then, given these non-reimbursements, banks adjust their assessment of the creditworthiness of lenders, *so that the amount of means of payment lent to agents depend on the previous disequilibrium*. Thereafter, new payments are made, which also lead some credits not be reimbursed, as prior coordination still tends to lack; and so on.

This representation of disequilibrium dynamics imply that agents must beforehand agree on three rules: prices are expressed according to a given monetary unit, purchases/sales are executed according to the transfer of some means of payment, and some operations restore budgetary constraints. These three rules can be called *money.* Now, if agents just beforehand agree on these three rules, then this overall preliminary agreement is far more important than the one implied by *tâtonnement*, or by the Edgeworth process, or by the Hahn process. Nothings prevents agents from consuming, producing or trading during disequilibrium dynamics, while neither an auctioneer nor a *nomenclature* are needed. Said differently, if money is seen as something more than a mere technical device, it may help to move closer to the absence of prior coordination, and thus it may help for appropriately account for disequilibrium dynamics. As a result, the economy would no longer be a real economy, but a *monetary* economy, that is, an economy whose workings (including disequilibrium dynamics) cannot be dissociated from money.

Conclusion

Three conclusions can be made. Firstly, if the aim is to appropriately account for disequilibrium dynamics, then we have to use an alternative paradigm wherein money

is not reduced to an afterthought, to wit, an alternative paradigm which leads to think of any market economy as a monetary economy. Secondly, once one chooses to use this alternative paradigm, then economic modeling should thus be in accordance with it, otherwise disequilibrium dynamics cannot be appropriately dealt with. Put differently, whenever a macroeconomic model is elaborated, then we have to check if some assumptions, even if they are a convenient way for the closure of the model, are compatible with a monetary theory of market economies. Thirdly, economists have still to inquire about the result of disequilibrium dynamics when the latter develops through money. In other words, is equilibrium stable when disequilibrium dynamics develops within monetary economies? Notably, if this is performed by means of a model, then we also have to check if the latter will not encounter the same difficulty as the previous ones, that is, to re-introduce some prior coordination. As a matter of fact, there still remains to give an answer to this question. So, a lot of works remains to be done, and will contribute to the elaboration of the alternative paradigm of monetary economies[13].

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13. See Cartelier (1998) for elaboration on that.

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