

Stabilising an *unequal* economy?

Public debt, financial regulation, and income distribution

The monetary theory of disequilibrium dynamics

Supplementing the insights of *Macroeconomic methodology: a post-Keynesian perspective*

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1. Introduction

The starting point of this paper is the book recently written by Jesper Jespersen (2009), *Macroeconomic methodology: a post-Keynesian perspective*.

As suggested by its title, the book inquires about the principles that should underlie post-Keynesian macroeconomics. To this purpose, *Macroeconomic methodology* points out some flaws within the own principles of mainstream macroeconomics; then, it logically suggests structuring the principles of post-Keynesian macroeconomics so that these flaws are avoided. For instance, *Macroeconomic methodology* addresses the following principle: explaining (macro-)economic phenomena within mainstream economics means adopting the view of market-clearing equilibrium; however, we can show that the convergence to equilibrium is impossible without some assumptions that contradict uncertainty: full information, perfect foresight, rational expectations, and so on. Now, uncertainty belongs to the essential features of observable reality. Thus, *Macroeconomic methodology* suggests that post-Keynesian macroeconomic theories should avoid the use of the assumptions that contradict such a feature, and thus should not be based on market-clearing equilibrium. So, if the economy no longer gravitates around an equilibrium, the author suggests using the concepts of an economic *process* in a *constant change* which, in turn, depends on the path taken by the process, to wit, *path-dependency*. In a nutshell, path-dependent evolving tendencies should be used rather than equilibrium¹.

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1. In this framework, equilibrium can be re-introduced, but is no longer defined in the usual sense of the market-clearing, gravitational centre of the economy. It is a “standstill” situation, that is, a situation characterized by no change, in the same way as the *ceteris paribus* clause. According to Jespersen (2009), such a situation can be assumed for a practical purpose : it simplifies the analytical structure, but it should be removed later on in order to be closer to the idea of path-dependent evolving tendencies. For a short presentation of the book, see Stellan (2010).

Yet, in that book little is said about the choice between the *real* analysis of economic phenomena and the *monetary* analysis of them. This is puzzling. On the one hand, monetary analysis can be seen, to a large extent, as an essential principle that should be included in an alternative paradigm in general and in post-Keynesian economics in particular, following Keynes himself (1963 [1933]). On the other hand, real analysis is, to the contrary, an essential principle of mainstream economics. So, Jespersen (2009) could have asked: does the use of monetary analysis, instead of the real one, allow to avoid some flaws within mainstream economics?

Both analyses stem from two different conceptions of money. In real analysis, money is seen as a mere technical device, which just improves barter. So, the analysis of economic phenomena must be based on something else than money, namely, *goods*. Accordingly, following the path suggested by Debreu (1959), mainstream economics determines any equilibrium by the preferences of agents about goods, their initial endowments in goods, and the techniques of production (of goods). In monetary analysis, money is so defined that it becomes the basis upon which economic phenomena are understood, instead of goods. Although the definition of money within monetary analysis is not unique, we choose to put the emphasis on the following one: money is defined as both *unit of account* and *means of payment*, or, in the light of the *Treatise of Money* (Keynes, 1971 [1930]; see also Graziani, 1996), “money of account” and “money proper”. To our opinion, this twofold nature of money can be seen as the common denominator of most theories of money put forward by the proponents of monetary analysis in general and by post-Keynesian economics in particular.

1. As unit of account (euro, peso, dollar, and so on), the role of money is *to allow economic magnitudes* (prices, wages, taxes, and so on) *to be expressed*. The price of a given good is not expressed in terms of another, as in barter, e.g. the price of a given quantity of wheat is not a given quantity of iron (and reciprocally). This price is a given number of monetary units, say $\text{£}x$. In other words, within the framework of monetary analysis, there are not “real” magnitudes expressed in terms of a chosen good, the *numéraire*, and upon which a unit of account just adds “nominal” ones; there are only *monetary* magnitudes.
2. As means of payment, money consists in *debts* owed by *banks*, while these debts are transferred between agents in order *to settle the transactions involved by monetary magnitudes*. More precisely, these settlements are performed by transferring bank debts between agents. If a price amounts to $\text{£}x$, then the involved sale/purchase is settled by the transfer of a $\text{£}x$ bank debt (or several bank debts that amount to $\text{£}x$ together) from the purchaser to the seller. Similarly, if a wage amounts to $\text{£}y$, then the involved use of labour is settled by the transfer of a $\text{£}y$ bank debt from the related firm to the related household. These transfers are called *payments*. The role of money, as bank debts, is to be the mean through which payments are performed. In a nutshell, money acts as *means of payment*.

This twofold nature of money truly leads to the monetary analysis of economic phenomena. Notably, the conditions of creation, circulation and destruction of means of payments determine the framework within which economic magnitudes and transactions are set (see e.g. Ponsot & Rossi, 2009). To the contrary, when the focus is on goods themselves, as in real analysis, such a framework does not exist.

In this paper, we focus on a flaw of mainstream economics which is not dealt with by *Macroeconomic methodology*, and we show that the above definition of money avoids this flaw, thus leading to use monetary analysis. By doing so, we also supplement the inquiry undertaken by the book: we remedy to its “omission” of monetary analysis by using the same approach, namely, to focus on a flaw within mainstream economics and to elaborate on an alternative paradigm which avoids this flaw (and others).

This flaw is as follows: mainstream economics cannot appropriately account for *disequilibrium dynamics*. In this respect, let us first remark that equilibrium is not necessarily defined as a market-clearing situation. At the most fundamental level, it refers to the situation according to which agents' economic decisions (that is, decisions about production, consumption, and so on) are mutually compatible (Milgate, 1988; Kirman, 1995). *Market-clearing* equilibrium is a *specification* of this definition *once real analysis is given*. On the one hand, if agents' decisions are understood on the basis of goods, then they are understood as the supply of goods and the demand for them. On the other hand, when markets are cleared, that is, when aggregate demand equals aggregate supply on any market, then there are neither unsold stocks nor unsatisfied needs; as a result, market-clearing can account for a situation according to which agents' decisions are mutually compatible, to wit, equilibrium. Arrow & Hahn shed light on such a specification of equilibrium within real analysis: “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 demand for a good and its total supply”² (1971, p. 19).

Then, let us point out that, although *disequilibrium* has almost completely disappeared from economic theory, such a situation should be seen as an essential feature of modern economies. In other words, the latter are characterized by the fact that decisions are usually *not* mutually compatible. Whenever 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, whenever households tend not to find enough jobs, then the level of employment decided by firms is incompatible with the number of workers that households decided to make available to firms. Disequilibrium is truly unavoidable. This stems from the fact that modern economies are *market* economies, that is, economies wherein *prior coordination between agents tends to be absent* (De Vroey, 1987). Prior coordination means that some factors are common to all agents and create a framework which determine which decisions they can make and how, as if there is “an

2. In Stellan (2009), we propose a more detailed treatment of the concept of equilibrium and its specification depending on the choice between real analysis and monetary analysis.

overall plan in the unfolding of which they [i.e. agents] have pre-assigned roles” (Hahn, 1984 [1981], p. 209). In communist economies, prior coordination is predominant: it is the by-product of the state, for (economic) decisions to improve the wealth and the prestige of the nation. In “primitive” economies, prior coordination is also predominant, as the by-product of customs/traditions along with religion, for (economic) decisions to be in accordance with the willpower of divinities/ancestors, and with the prestige of the kingdom/community/family (see e.g. Polanyi *et al.*, 1957). However, within market economies, prior coordination does not occur (at least, it is reduced to a minimal component); neither the state nor customs/traditions nor religion tend to frame economic decisions (the latter are “disembedded” from the social system; see Polanyi, 1983 [1944]), so that the prior coordination induced by these factors tends to lack. Market is not only a “space” wherein some transactions are executed with respect to a given good. Before everything, it is a particular state of decision-making; the peculiarity is that decisions are made while prior coordination between agents tends to lack³ (Benetti & Cartelier, 2001). As a result, agents freely determine their decisions, according to their own objectives and constraints, outside any framework (at least within a “minimalist” framework). So, nothing implies that each decision will be compatible with each other, thus leading to disequilibrium (Cartelier, 1991).

Now, 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 tends 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 in the future; similarly, if households tend not to find enough jobs, then they may (decide to) accept part-time jobs, lower wages, or jobs for which they are over-skilled. Still, nothing implies that the newly-adjusted decisions will be mutually compatible, as prior coordination still tends to be absent. Thus, agents undertake new adjustments; and so on. As a result, disequilibria follow one another through time; here is defined the disequilibrium dynamics of market economies.

Now, on several occasions, mainstream economics has given a specific representation of disequilibrium dynamics: agents make decisions which belong to a specific set, the incompatibility of these decisions is assessed in a specific way, the adjustment of incompatible decisions is performed according to specific mechanisms, and so on. Actually, each time a specific representation is suggested, the latter stems from a *model* which tries to demonstrate (by means of a formal structure) the *convergence* to equilibrium. Accordingly, it should not be forgotten that such a convergence (which has to be proved) is the fact of disequilibrium dynamics themselves: in accordance with Smith's idea of the *invisible hand*, decisions would tend

3. In Jespersen's own words (2009), the lack of prior coordination is the most essential feature that we focus on, thanks to our “ontological reflection” about market economies.

to be mutually compatible as agents adjust them when they are not mutually compatible; equilibrium is said to be *stable* and, although prior coordination tends to be absent, the mutual compatibility of decisions remains possible (Ingrao & Israel, 1990). Thus, the underlying concepts, definitions and assumptions of the models logically lead to specify how disequilibrium dynamics develop.

Precisely, we show that the disequilibrium dynamics implied by the models are not satisfactory, as *they contradict the fact that, within market economies, agents act while prior coordination between them tends to be absent* (although disequilibrium dynamics are supposed to stem from the lack of prior coordination). Then, we suggest another representation of disequilibrium dynamics, in order to avoid the above contradiction. This representation relies on the definition of money that underlies monetary analysis. This *monetary theory of disequilibrium dynamics* thus leads to the use of monetary analysis.

First, we introduce the main specific representation of disequilibrium dynamics, which is given by the model so-called *tâtonnement*, and we show why it is affected by the above contradiction (2). Then, we introduce the *Edgeworth process* and the *Hahn process* (3), that is, two other models which give a representation of disequilibrium dynamics; again, we show that the above contradiction is still there (albeit in a different way). Finally, we suggest putting the emphasis on money, as unit of account and means of payment, in order to avoid such a contradiction, thus leading to the use of monetary analysis by means of this monetary theory of disequilibrium dynamics (4).

2. Disequilibrium dynamics and *tâtonnement*

The main specific representation of disequilibrium dynamics is given by the model known as *tâtonnement*, which first stems from Samuelson's pioneer paper⁴ (1941). As previously suggested, this model aims at showing the convergence to equilibrium. To this purpose, it relies 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 function⁵. So, this equation amounts to say that the variation of the price of a given good through 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

4. See also Samuelson (1961). The surveys of Negishi (1962), and thereafter of Arrow & Hahn (1971), give an overall picture about the works that use the *tâtonnement* model.

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

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. This amounts to say that any market is cleared, to wit, an equilibrium; conversely, if at least one excess demand does not equal zero, then disequilibrium occurs. 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, if at least one excess demand is negative. In this way, continuous variations of prices should lead to the convergence to zero of every excess demand, thus showing the convergence to equilibrium.

Now, such a convergence should be the result of disequilibrium dynamics. Thus, the latter is given a specific representation by *tâtonnement*:

1. First, each agent plans (individual) supplies of some goods and (individual) demands for some others⁶, 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

6. This focus on goods reminds the use of real analysis by mainstream economics in general and by *tâtonnement* in particular.

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 variations 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.

In a nutshell, according to *tâtonnement*, disequilibrium dynamics would consist in *continuous price variations with respect to the state of excess demands*. Let us remark that this model is unable to demonstrate the convergence to equilibrium: such a convergence cannot be the result of price variations, except for a few very specific cases, in virtue of the Sonnenschein-Mantel-Debreu theorem (see the appendix). Still, as previously suggested, we focus on the acceptability of the disequilibrium dynamics themselves, as suggested by *tâtonnement*. Now, on this ground, we would like to point out the following contradiction: these dynamics contradict the fact that, within market economies, prior coordination tends to be absent.

On the one hand, prior coordination means that some factors are common to all agents and create a framework which determine which decisions they can make and how. On the other hand, these factors are supposed to lack within market economies. However, *tâtonnement* implicitly introduces three factors within its representation of disequilibrium dynamics.

The first factor – which is the most famous one – is the *auctioneer*. One may wonder who/what is able to calculate excess demands and to make price variations, given the previous calculation. Actually, the disequilibrium dynamics implied by *tâtonnement* are effective only if agents are framed by an entity, called the “auctioneer”: on the one hand, the auctioneer announces some prices, while, in turn, the other agents have to communicate to the auctioneer their individual demands/supplies (which depend on the prices put forward); on the other hand, the auctioneer calculates every excess demand and announces new prices as long as every excess demand does not equal zero (Koopmans, 1957). However, within market economies, agents do not have to decide their individual demands/supplies within the framework of the auctioneer. In other words, neither they have to communicate their individual demands/supplies to the auctioneer, nor prices are set by the latter (in relation with excess demands). To the contrary, agents themselves set prices, according to their own objectives and constraints; this does not imply that agents set the prices they want to, but that price-setting is left to agents.

The second factor is a *predetermined list of goods*. Obviously, if some goods are not known by agents, then they cannot communicate with the auctioneer, so that the calculation of some excess demands would be impaired. So, agents' decisions (about their individual demands/supplies) must be made *only* for a predetermined list of goods (Benetti & Cartelier, 1980, 1990; Benetti, 2004). This is the reason why this list frames

agents' decisions. However, this is not the case within market economies: agents decide by themselves the goods they will produce, exchange and consume, but not according to a predetermined list. According to Hildenbrand & Kirman (1988, p. 53), this 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". Still, both authors forget that it would be impossible that *all* agents distinguish between the *same* goods (or "commodities"), unless they are framed by a predetermined list of them.

The third factor is the rule that may be called "nothing before equilibrium". Actually, agents do not to produce, consume or make transactions 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 demand depends neither on some production nor on some consumption nor on some transactions decided by agents meanwhile. Notwithstanding, 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 equilibrium; in turn, these decisions would influence excess demands, and the auctioneer then announces new prices; and so on, until price variations lead to equilibrium, while production, consumption and transactions would take place. Nevertheless, this is not the case. So, individual demands/supplies are just mere intentions communicated to the auctioneer, but are not effective. However, within market economies, agents do not have to wait for equilibrium (provided that the latter is truly achievable) in order to make their decisions effective. So, agents are truly framed by the rule according to which none of them make their decisions before equilibrium is reached (De Vroey, 1987; Fisher, 1989; Cartelier, 1991).

If the disequilibrium dynamics implied by *tâtonnement* introduces a threefold framework which contradicts the lack of prior coordination within market economies, then these dynamics (and thus *tâtonnement* itself) should be rejected⁷.

3. Disequilibrium dynamics, the Edgeworth process and the Hahn process⁸

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

7. Also, the third factor introduces another difficulty. If neither production nor consumption nor transactions are decided before equilibrium is reached, then disequilibrium dynamics are logically inconceivable. 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". Hence, "we know very little about how individuals do or ought to behave when equilibrium is not present" (*ibid.*). Finally, we can also add another difficulty: agents communicate their individual demands/supplies 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).

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

“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.

Thus, the Edgeworth process would be, at first sight, an improvement as compared with *tâtonnement*. As argued above, *tâtonnement* encounters a main difficulty as its subsequent disequilibrium dynamics imply three factors which frame decision-making as compared to market economies. Now, the prohibition of trading out of equilibrium is the result of this framework. So, if trading out of equilibrium is allowed, then a part of this framework is no longer necessary. As a result, the disequilibrium dynamics implied by the Edgeworth process would move closer to the absence of prior coordination than the own dynamics implied by *tâtonnement*. The former dynamics would thus be more satisfactory.

However, *tâtonnement* is still incorporated into the Edgeworth process. Simply, price variations according to excess demand functions are amended with equations which account for trading out of equilibrium⁹ (and for the subsequent improvement of agents' welfare). So, the related framework is lessened, but not removed. It is lessened as (all) agents are no longer framed by the rule according to which they have to wait the convergence to equilibrium for trade to occur. It is not removed as agents are still framed by the other factors: their individual supplies/demands are decided with respect to the auctioneer (first factor) and to the goods that will enter *tâtonnement* (second factor), while they still neither produce nor consume before equilibrium¹⁰ (third factor). Hence, the Edgeworth process remains unable to account for disequilibrium dynamics.

Moreover, the Edgeworth process implies that its subsequent disequilibrium dynamics are even farther from the lack of prior coordination, although it has previously moved (a little) closer with trading out of equilibrium. The explanation is as follows.

Firstly, like *tâtonnement*, the aim of the Edgeworth process is to demonstrate the convergence to equilibrium by means of price variations; but, as opposed to *tâtonnement*, convergence is also involved by trading out of equilibrium. Now, the model implies that, for convergence 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 welfare¹¹. 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”.

9. So, it may appear misleading to identify the Edgeworth process with a “non-*tâtonnement*” process, as found in the literature (see e.g. Negishi, 1962)

10. Also, if neither production nor consumption remain possible, then one may wonder how exchanges are possible. Actually, agents do not exchange goods themselves, but “trading tickets” that represent goods. Then, once equilibrium is reached, production/consumption take place and exchanges are executed according to the trading tickets previously traded.

11. Moreover, we can show that, contrary to *tâtonnement*, the Edgeworth process avoids the negative result of the Sonnenschein-Mantel-Debreu theorem. See Negishi (1962).

As a consequence (secondly), this trading rule implies prior coordination between agents. Indeed, it is a part of the framework which determine how exchanges are made. Moreover, if the only mutually advantageous trade involves several people (not to say “millions of people”), then any agent has to know who the other agents that could be involved in such a trade are. So, agents cannot exchange unless an “organization” disseminates this knowledge. This organisation extends the framework within which decisions are made. However, within market economies, neither the trading rule nor the underlying organization frame agents’ decisions about their exchanges. 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, without any rule that bind them to the only mutually advantageous exchanges. This is the reason why the disequilibrium dynamics implied by the Edgeworth process move farther from the absence of prior coordination than *tâtonnement*¹².

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: prior coordination is lessened, but not removed, as the other factors of the framework induced by *tâtonnement* remain. Nonetheless, the disequilibrium dynamics implied by the Hahn process would appear closer to the absence of prior coordination than the own dynamics of the Edgeworth process (and thus than the own dynamics of *tâtonnement*) as neither the above trading rule nor the underlying organization are introduced. The explanation would be as follows.

1. Like the Edgeworth Process, the aim of the model is to show the convergence to equilibrium, by means of price variations and of trading out of equilibrium. Now, let us recall that the above trading rule is necessary for the demonstration of convergence: thus, if the Hahn process does not rely on this rule, then it must introduce something else for such a demonstration. As a matter of fact, the solution is given the assumption of *orderly markets*: each market is sufficiently well organized so that, for each good, there are not simultaneously both unsatisfied demand and unsatisfied supply when trading out of equilibrium develops. Put differently, if supply is inferior to demand, then every supplier is supposed to trade (but an unsatisfied demand still remains); and conversely, if demand is inferior to supply.
2. Now, this assumption implies a much less severe prior coordination than implied by the trading rule (and the underlying organization) of the Edgeworth process: it only needs that agents use a common medium of exchanges, which is called “money” (Arrow & Hahn, 1971). To this purpose, suppose three goods, A, B and C;

12. 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.

then, without “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, each good is exchanged on two markets. So, it is possible that there is an unsatisfied demand of a given good on the first market (for instance, an unsatisfied demand of A in return for B), while there is an unsatisfied supply of the same good in the second market (an unsatisfied supply of A in return for C). So, these markets are not orderly ones. To the contrary, if “money” is introduced, then there are three other markets. Each of them is devoted to one good (A, B and C) which, in turn, is exchanged only in return for money. So, each good is exchanged only in a single market, so that there would not be simultaneously both an unsatisfied demand and an unsatisfied supply during exchanges.

As a final result, the disequilibrium dynamics implied by the Hahn process imply that exchanges out of equilibrium are possible, while they are solely framed by the use of “money”, but not by a trading rule and the underlying organization that give agents information about what can be traded and with whom. So, the Hahn process would be, at first sight, better able to account for disequilibrium dynamics than the Edgeworth process (and than *tâtonnement*)¹³. Still, as previously suggested, the remaining framework induced by *tâtonnement* is still there: individual supplies/demands are decided in relation with the auctioneer, and to a predetermined list of goods, while neither production nor consumption occur before equilibrium.

Moreover, the introduction of the medium of exchanges is flawed; so, the Hahn process is not better able to account with disequilibrium dynamics. The flaw stems from the introduction of an *ad hoc* assumption along with the introduction of the 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 might not be orderly ones (and the convergence to equilibrium cannot occur). As a final result, it appears indispensable to introduce the Positive cash assumption, but the latter is clearly unsatisfactory¹⁴.

13. 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.

14. Moreover, as agents behave as if equilibrium is already reached (i.e the Present action postulate; see the seventh footnote), the Positive cash assumption is even more problematic. 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).

4. Disequilibrium dynamics, money and monetary analysis

To sum up, if the aim is to appropriately account for disequilibrium dynamics, neither *tâtonnement* nor the Edgeworth process nor the Hahn process are useful¹⁵. We suggest putting the emphasis on the definition of money that leads to monetary analysis, that is, money as unit of account and means of payment, for an acceptable treatment of disequilibrium dynamics; monetary analysis is thus implied by this monetary theory of disequilibrium dynamics.

To this purpose, we first deal with disequilibrium itself. The above models always deal with disequilibrium by means of excess demands, with at least one of them differing from zero. Nevertheless, instead of excess demands, disequilibrium can be assessed by means of *the non-respect of budgetary constraints*. Indeed, disequilibrium implies that some agents are unable to sell their goods as expected (and to get jobs as expected), so that they have purchased goods that amount for more than the goods that they have sold (and more than the wages that they have earned). This difference between receipts (income) and purchases, due to disequilibrium, is nothing but the non-respect of budgetary constraints.

Still, in the previous models, *agents spontaneously respect their budgetary constraints*. First, this is due to the fact that agents are supposed to decide their individual demands/supplies so that their budgetary constraints are respected *ex ante*. Notwithstanding, this is also due to the fact that, once equilibrium is reached, *exchanges are executed like barter*. The explanation is as follows. On the one hand, any good is supposed to be exchanged for another one (and all these goods belong to a predetermined list, as mentioned above), to wit, barter. Even if money is introduced, the former is also a good (be it “dematerialized” 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). On the other hand, however, 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* price (the latter being expressed in terms of one of them, to wit, the *numéraire*). So, within the framework of barter, the equivalence principle implies that agents cannot purchase more than what they sell, so that *they spontaneously respect their budgetary constraints during trade*.

15. 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.

Thus, if disequilibrium can be characterized by the fact some agents do *not* respect their budgetary constraints (instead of focusing on excess demands), then *we can reject barter for disequilibrium to be accounted for.*

Thereafter, the rejection of barter has two immediate consequences. First, prices cannot be “real” prices, that is, prices expressed as quantities of a chosen good (as goods are exchanged for other goods). To the contrary, prices must be expressed by a unit which does not identify with goods. Precisely, this unit can be a *monetary* unit, say, euro. Clearly, agents cannot “produce” or “consume” euros in the same as they produce and consume any good. In other words, the monetary unit is purely *nominal*, as it is not defined in terms of a chosen good which acts as such a benchmark for prices to be expressed (the so-called *numéraire*).

Secondly, 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*); and if ii) the price of goods are expressed according to a monetary unit. Precisely, money as means of payment is a solution. If a price amounts to £ x , then the involved sale/purchase is executed by the transfer of a £ x bank debt from the purchaser to the seller¹⁶. In turn, bank debts are not goods. Agents cannot produce or consume bank debts in the same way as they produce and consume goods.

As a result of these two consequence, *the rejection of barter leads to the definition of money that underlies monetary analysis.*

It therefore remains to inquire about how agents might not respect their budgetary constraints, in order to account for disequilibrium (and then for disequilibrium dynamics). Here, the process which makes means of payment available to agents enters the picture. This process 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 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 constraint.* However, as decisions are made while prior coordination tends to lack, then nothing implies that each lender recovers enough means of payments. Lenders can only make expectations about the payments they will benefit from, but the lack of prior coordination implies that these expectations may not be fulfilled. This is the reason why the budgetary constraint might not be respected, that is, the whole credit is not reimbursed. As the non-respect of budgetary constraints amounts to disequilibrium, then the latter is given an even more specific meaning once monetary analysis is given: disequilibrium identifies with *the non-reimbursement of every bank credit*, which in turn identifies with *the non-fulfilment of agents' expectations with respect to the means of payments that are recovered from their circulation.* In turn, equilibrium would amount to the whole reimbursement of

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

credits and thus to fulfilment of agent's expectations with respect to monetary circulation¹⁷. Also, let us remark that some operations have to settle the non-reimbursed credits: bankruptcies, leverage buy outs, 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. In other words, the circulation of means of payment does not correspond to an overall plan according to which any credit will be reimbursed. 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*¹⁸. Thereafter, new payments are made, which also lead some credits not be reimbursed, as prior coordination still tends to lack; and so on.

Let us remark that this characterization of disequilibrium dynamics is very close to *the theory of the monetary circuit* (Graziani, 1990). Indeed, disequilibrium dynamics include the twofold process that defines the monetary circuit. First, the opening of the circuit is the creation of means of payment by a bank credit, essentially for a firm to finance its production costs. Secondly, the closure of the circuit is the reflux of means of payment to banks, as the lender reimburses its credit once it has benefited from payments at the occasion of its relations with other agents. Actually, disequilibrium dynamics can be seen as a complex of monetary circuits *with some of them facing closing problems, the subsequent operations to settle the non-reimbursed credits, and the reassessment of creditworthiness due to these closing problems*. To the contrary, when any monetary circuit closes, that is, when any credit is reimbursed, then equilibrium occurs (see Graziani, 1990).

Finally, by introducing money as unit of account and means of payment in order to give a specific representation of disequilibrium dynamics, we are therefore led to a monetary theory of these dynamics. Now, *this theory is far more closer to the absence*

17. In Stellian (2009), we suggest the same meanings of equilibrium and disequilibrium, but in a different way. We first start from monetary analysis; then we suggest the meaning of equilibrium once given such an analysis; and then we deduce the own meaning of disequilibrium, as the latter is the opposite of equilibrium. Here, we first start from disequilibrium; then we introduce monetary analysis for an acceptable treatment of disequilibrium, which leads to the suggested meaning of disequilibrium within this analysis; and then we deduce the own meaning of equilibrium, as the latter is the opposite of disequilibrium.

18. Also, this path-dependency outside equilibrium reminds the path-dependent evolving tendencies put forward by Jespersen (2009).

of prior coordination than those of any model of mainstream economics. Indeed, agents' decisions are just framed by three factors: i) a common monetary unit; ii) the use of means of payment; and iii) the existence of a banking system according to which the creation, circulation and destruction of means of payments are possible. These three factors amount to a “minimalist” framework. Indeed, agents do no longer have to make decisions in accordance with the auctioneer, with a predetermined list of goods or with any trading rule and the underlying organization that disseminate information about the potential trading partners. Similarly, they do not have to wait for the achievement of equilibrium (provided that the latter exists and is truly achievable) before making their decisions effective. All of these elements are left outside of the monetary theory of disequilibrium dynamics, which make this theory far more satisfactory. At the same time, it leads to to use of monetary analysis.

5. Conclusion

The aim of this paper is to shed light on the need for monetary analysis. On the one hand, we show that the disequilibrium dynamics implied by the main models of mainstream economics are flawed, in the sense that they contradict the definitional feature of market economies, that is, the lack of prior coordination between agents. On the other hand, we show that, on the basis of the definition of money that implies monetary analysis, then we can have a representation of disequilibrium dynamics which avoids such a contradiction, thus leading to the use of this kind of analysis.

We would like to end this paper with three remarks. First, let us remind that the above models of mainstream economics attempt to show that disequilibrium dynamics converge to equilibrium. So, the proponents of monetary analysis may ask: does such a convergence occur when disequilibrium dynamics develops through money? According to Jespersen (2009), the answer is clearly negative (due to the refusal to use the assumptions needed for the convergence to equilibrium, as these assumptions contradict uncertainty). So, *the economy would always be in disequilibrium.*

Secondly, if disequilibrium dynamics does not converge to equilibrium, then we may ask if *any* disequilibrium dynamics are acceptable? To our opinion, the answer is also negative. Indeed, some disequilibrium dynamics may lead to *economic crisis*. If some disequilibrium dynamics are associated with a widespread failure of monetary circuits, then banks undertake a widespread degradation of the creditworthiness of their customers; as a result, firms are less able to borrow, so that production itself has to be reduced, thus leading to crisis. This suggests that we have to find which disequilibrium dynamics ensure economic stability. In other words, we have to inquire about the foundations for economics stability in relation with disequilibrium dynamics¹⁹.

19. So, if the economy is always in disequilibrium, then we deal with disequilibrium economics; and if the aim is to find the foundations for economic stability with respect to disequilibrium dynamics, then the aim is to find *the disequilibrium foundations of disequilibrium economics* (Stellian, 2009).

Thirdly, from the two remarks above, we suggest a tool which can be used in order to assess the influence of some empirical phenomena on the economy, *instead of the usual comparative statics*. The latter amounts to compare different equilibria in order to deduce this influence; for instance, two equilibria are calculated, depending on the existence or not of a given economic policy, and then we compare the properties of each equilibrium in order to deduce the consequences of the policy at issue. Now, if the economy is always in disequilibrium, then comparative statics cannot be used. Thereafter, if any disequilibrium dynamics are not acceptable with respect to economic stability, then we can assess the influence of a given empirical phenomenon as follows: we inquire to what extent this phenomenon can restrict the number of disequilibrium dynamics that are compatible with economic stability. Following Cartelier (1998), such an inquiry is undertaken in terms of *viability* (and not of comparative statics). This kind of inquiry may help the proponents of an alternative paradigm to mainstream economics, as they can use another tool than comparative statics.

As a matter of fact, there still remains to give more content to viability. So, a lot of works remains to be done, and will contribute to the elaboration of monetary analysis of market economies, that is, economies which develop through disequilibrium dynamics.

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Appendix: *Tâtonnement* and the convergence to equilibrium

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 demand are first positive, each rise in prices is expected to reduce individual demands and to increase individual supplies (as suggested above), so that the difference between the sum of individual demand functions and the sum of individual supply functions, that is, excess demand function, decreases. 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 the 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 of the 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, 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.

Actually, Scarf (1960) already provides some counter-examples of different excess demand functions that do not converge to zero. 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 behaviour 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 (i.e. individual demand functions who prevent income effects from occurring). This property is the famous gross substitutes property, according to which a rise in the price of any good increases the aggregate demand of every other but not of the former good itself (see Fisher, 1972).