

# PRICE THEORY AND MONEY COUPLED: SOME REMARKS ON THE AYRES-MARTINÁS THEORY

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## ABSTRACT

The main concern of economic science is to explain the Wealth of Nations. This tradition implies on the one hand, that wealth must be evaluated i.e.: economic science must elaborate a price theory; on the other hand, money should be integrated in economic theories because prices are expressed in monetary terms. Mainstream economic theory succeeds in price determination (with some limits) but fails on money integration, while non-mainstream monetary models succeed on money integration but fail on price determination. In this paper I argue that the Ayres-Martinás theoretical framework is a promising tentative to cope with this challenge of economic science.

## KEY WORDS

microeconomic foundations, macroeconomics

## CLASSIFICATION

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## INTRODUCTION

General equilibrium theory, though facing serious flaws, still constitutes the core of economic thinking. The ideological reason – or explication in terms of paradigms [1] – is clear as also summarised by Soros [2]: “In the absence of equilibrium, the contention that free markets lead to the optimum allocation of resources loses its justification. The supposedly scientific theory that has been used to validate it turns out to be an axiomatic structure whose conclusions are contained in its assumptions and are not necessarily supported by the empirical evidence. The resemblance to Marxism, which also claimed scientific status for its tenets, is too close for comfort.”

If ideological aspects are ignored, one should admit that the general equilibrium theory is a “theory of the determination of prices” [3]. Hence, general equilibrium theory responds one of the core questions of the inquiry into the Wealth of Nations [4]. Probably, this is the reason why it is so popular in spite of the fact that out of equilibrium states clearly spoil the price adjustment convergence to the predetermined equilibrium price: “If the supply and demand curves are not independently given, how are market prices determined? If we look at the behavior of financial markets, we find that instead of tending toward equilibrium, prices continue to fluctuate relative to the expectations of buyers and sellers. There are prolonged periods when prices are moving away from any theoretical equilibrium. Even if they eventually show a tendency to return, the equilibrium is not the same as it would have been without the intervening period. Yet the concept of equilibrium endures. It is easy to see why: without it, economics could not say how prices are determined” [2].

Connected to this price adjustment problem, a coherent adjustment process is unimaginable without money. From practical considerations, a theory without money for economic policy has very limited scope: “... the condition that supply and demand are independently given cannot be reconciled with reality, at least as far as the financial markets are concerned – and financial markets play a crucial role in the allocation of resources ...” [2]. Unfortunately, proper integration of money into the general equilibrium theory is not yet solved.

The empirical evidence on the importance of money led non mainstream monetary economists to break with the starting point of the general equilibrium theory in favour of a departure from money. Though these models capture monetary flows, they fail on the proper determination of prices.

Schematically the present state of the art is as follows. We have a price theory but no money, or vice versa we have money but no determination of prices. Consequently, the core problem is to construct a macroeconomic theory (include money) with micro-foundations (price determination).

In this paper I examine the Ayres-Martinás theoretical framework [5] as a promising tentative to solve this problem of constructing a coherent micro-founded model with money.

In the first point, I discuss some problems hindering the proper integration of money into the general equilibrium framework in a perspective to determine minimal conditions for the integration of money. In the second point, I briefly discuss some of the major properties of non mainstream monetary models in the perspective of defining the minimal conditions of useful model of money. At the same time I explain why one should go further and cannot stop at the non mainstream monetary models. Finally, I show that the Ayres-Martinás theoretical framework is compatible with these minimal requirements.

## **LESSONS FROM THE GENERAL EQUILIBRIUM THEORY: SOME PREREQUISITES FOR THE INTEGRATION OF MONEY**

The main idea of the general equilibrium theory is that economic agents exchange commodities with each other at will on the markets. An exchange can suffer from technical or informational difficulties. The technical difficulty is simply that the double coincidence of wants does not hold. The informational difficulty is that economic agents have no knowledge on the state of the overall economy, that is to say they do not know at which price markets clear. These two difficulties are evacuated by the fictive agent of the “Walrasian auctioneer”. But the fable of the Walrasian auctioneer takes us far from the description of a decentralised market economy (unless there is no fundamental difference between a centralised and a decentralised economy). If the Walrasian auctioneer is eliminated, the coherence of the general equilibrium theory is also ruined:

- 1) if agents do not know when prices are at their equilibrium level, then they may make exchanges at non equilibrium prices. As a consequence, the equilibrium also changes [6]. Hence, the adjustment mechanism between two states cannot be omitted, which is equivalent to the abandon of the equilibrium analysis,
- 2) connected to the previous problem of the convergence to the predetermined equilibrium, there is no insurance that the way of the realisation of exchanges does not influence this price adjustment path. That is to say, if exchanges are not realised by the help of the Walrasian auctioneer, but by the help of money, it is possible that the equilibrium state changes. For standard monetary theory, the problem of money is hence simply a problem of selection between equilibrium states [7]. However, the Hahn problem [8, 9] shows that one cannot stop at this point for a coherent model: in fact, the variable called money can have zero price in equilibrium. That is to say this variable cannot fulfil any functions of money: it is not money. Inversely the question can be raised: even if this variable has positive price, is it money? Thus, the coherent integration of money is equivalent to the identification of money in the model. For more than half century, this integration into the general equilibrium theory has failed. The major problems causing the inconsistencies were the following:
  - stock-flow problem. The original problem is the incoherence of the Walrasian period with any detailed representation of exchanges [9]. The need for the detailed representation comes from the standard function attributed to money – it is a means of exchange (one can make exchanges within the period by the help of money). This function is clearly incompatible with the notion of the period: a period is an interval of time between two instant during which none of the actions are represented, including exchanges. Let put aside this aspect of the problem. In order to get to the main point, this stock-flow problem should be considered from another perspective: the term “commodity” in modern economics stands for stock and flow variables at the same time. I note that Walras’ original theory is free of this fundamental confusion (nevertheless it was him who gave rise to this confusion): in his theory a commodity should be considered as a flow (service of a thing) and capital is a stock (thing itself). Hence, it is not surprising that the stock-flow problem appears in monetary theory. The assumptions that hid this problem are: one period models and the existence of exclusively perishable goods. In order to face the problem of integration of money these assumptions must be abandoned [10].
  - the utility concept is intended to evaluate commodities. A commodity is a useful thing. Things can be characterised by physical properties, that is to say a commodity derives its utility from the physical properties of the thing. In that sense, a financial asset is not a

thing: the fact that for example money is printed on gold, on a piece of paper, or it is not printed at all does not change the usefulness of it. Hence, we cannot use the utility concept for the evaluation of financial assets (including money). The problem is harsher if we think of financial liabilities (for example a debt) as counter-part of a financial asset: is a liability also a commodity? As a result, financial assets are excluded from the decisional problem of the economic agent: they are calculated as residual variables (overall balance at the end of period).

## **LESSONS DRAWN FROM NON MAINSTREAM MONETARY MODELS**

Let us put aside debates on the essence of money as integral part of a proper theory of money [11, 12], and let us focus only on practical considerations. In that case the difference between models aiming at properly integrating money into theories in order to describe the functioning of our modern monetary economies can be reduced simply to differences in mathematical constraints.

In that sense, the core question of adequate modelling is the following: What kind of constraints characterise at best monetary economies?

Not surprisingly, adepts of non-mainstream monetary models believe that financial constraints characterise at best monetary economies; in other terms they believe that financial constraints have decisive effect on the evolution path of our economies (see e.g. [13]).

The obvious question follows: Do financial constraints have other nature than natural constraints?

The general answer is positive: Money creation does not obey to the conservation law of physical objects. Loosely speaking money is created ex nihilo.

To continue this line of thought, the next question is: Why these financial constraints are not simply added to the natural constraints? In other terms, why financial constraints are not formulated analogously to the balance equations of real things? In brief, why the whole story becomes an issue?

The reason why the integration of these financial constraints into the general equilibrium analysis is not obvious is the following: the general equilibrium analysis uses demand and supply functions derived from the utility and the profit maximisation programs when formulates the balance equations. The problem is that the excess demand function of any financial asset (as well as money) cannot be deduced from these maximisation programs. As already mentioned, this is because on the one hand, financial assets cannot enter into the utility function and on the other hand these assets cannot enter into the profit maximisation program. They are simply calculated as residual variables (overall balance at the end of period).

Non-mainstream monetary models do not solve this problem. They simply avoid it: without micro-foundations there is no need and obligation to formulate the underlying individual behaviour.

The final question can be raised: If at the end the individual constraints sum up to an overall constraint and if this overall constraint is correct, then why should we bother ourselves with the micro-foundations?

The answer lies in the core problem of economic theory, from the perspective of the Wealth of Nations. In spite of its inconsistencies, the general equilibrium analysis provides a price theory – a theory on the determination of (relative) prices. But non mainstream monetary models fail on this point. Thus, from theoretical point of view we should have micro-foundations in order to have a complete theory; from practical considerations to avoid the limited scope of possible investigations.

Hence, in the next point I examine whether there is any promising attempt that can solve the coherent integration of money and price theory at the same time.

## THE AYRES-MARTINÁS THEORETICAL FRAMEWORK – A BRIEF DISCUSSION

In the previous point I concluded that the present state of art is as follows: either we have a price theory without proper integration of money or vice versa. I remembered that from theoretical point of view, the omission of money underlies the mainstream price theory because money can affect prices. From practical considerations, the omission of either money (general equilibrium theory) or of price theory (non mainstream monetary models) restraints the possible scope of economic investigations. That is why it is important to construct a micro-founded theory which is compatible with money.

In the followings I argue that the Ayres-Martinás model is a promising framework in that sense. Naturally, further research will say the last verdict.

The basic idea of the Ayres-Martinás theoretical framework is the same as the basic idea of the mainstream economic theory (economic agents are free to make exchanges on the market). In order to focus on the main elements elucidated in the previous points and in order to compare the two theoretical structures, let us consider a simple pure exchange economy in a given period with consumable things and money.

Let us consider the temporary equilibrium version of the general equilibrium theory with external money as being the only durable commodity where agents live just two periods. The problem of the consumer in this setting is to maximise its utility under the budget constraint:

$$\begin{aligned} \text{Max } U(x_t, x_{t+1}), \\ p_t x_t + m_t &= p_t e_t + e_m, \\ p_{t+1}^e x_{t+1} &= p_{t+1}^e e_{t+1} + m_t, \end{aligned}$$

where  $x_t$  is the consumption in period  $t$  (commodity: stock or flow),  $m_t$  is money stock hold at the end of period  $t$ ,  $e_t$  is the initial endowment in period  $t$ ,  $p_t$  is the price in period  $t$  and  $p_{t+1}^e$  is the price in period  $t + 1$  as expected by the agent in period  $t$  (supposed to be the same for all agents).

The solution of this program is the demand functions as a function of prices, i.e.:

$$x_t(p_t, p_{t+1}^e).$$

Prices are determined from the equilibrium condition when demand equals supply for each period  $t$ :

$$\sum_i x_t^i(p_t, p_{t+1}^e) = \sum_i e_t^i,$$

The problem of an economic agent in the Ayres-Martinás theoretical framework can be written as:

$$dZ(X_t, m_t) \geq 0,$$

where  $X_t$  is stock (let us call also commodity). The solution of this program using the identity that of buying for money:  $p_t dX_t = -dm_t$  is:

$$dX_t = L(v_t - p_t), \quad v_t = \frac{\partial Z}{\partial X_t} \left( \frac{\partial Z}{\partial m_t} \right)^{-1},$$

with  $L$  taken to be a constant, for the sake of simplicity. Prices are determined by the help of the balance equation that

$$\sum_i dX_t^i = 0.$$

Let us discuss the Ayres-Martinás theoretical framework on the basis of the minimal requirements determined in the previous points:

- 1) the first obvious observation is that the Ayres-Martinás theoretical framework, like the general equilibrium theory, can determine prices. Hence, it provides a price theory,
- 2) as to the limits of the general equilibrium price determination, the second obvious observation is that the Ayres-Martinás theoretical framework does not require convergence to any predetermined state furthermore it does not require any convergence at all as opposed to the general equilibrium theory. In fact, the Ayres-Martinás theoretical framework is a non-equilibrium model and economic agents do not maximise (they accept just better offers). This formal difference follows simply from the fact, that the formalism of the Ayres-Martinás theoretical framework is inspired by the non-equilibrium thermodynamics in physics, while the formalism of the general equilibrium analysis is inspired by the equilibrium thermodynamics [14]. It also follows that the price determination of the general equilibrium theory is just a special case of the Ayres-Martinás theoretical framework,
- 3) the third obvious observation is that time is not necessarily divided into periods in the Ayres-Martinás model, thus the problem of the realisation of exchange can be represented. This leads us to the problem of money,
- 4) the fourth observation is that in the Ayres-Martinás model money is put in nominal terms into the evaluation function while in the general equilibrium theory it cannot be integrated into the utility function. Grandmont shows [15]: the integration of money in real terms into the utility function is equivalent to the non-integration of money into the utility function if budget constraints are correctly modified. This treatment of money is the result of some very fundamental differences between the two theories,
- 5) the utility function's arguments are commodities. The utility function shows the utility that consumption represents for the agent. The consumption means the consumption of the services of stocks. Thus, the arguments of the utility function are flows. In most of the time there is a definite relationship between the stock of thing (one piece of apple) and the flow of service of the stock of thing (delicious fruit which satisfies for some time the consumer who eats it up). I mean on definite relationship that the amount of the service does not depend on prices; and the amount of stock determines the amount of flow. Hence, the stock of thing put directly into the utility function is an acceptable simplification. That is why one can see stocks (peace of apple) and flows (hair cut) at the same time in the utility function. When there is no definite relationship between the thing itself and the service of this thing, one must distinguish between the stocks and flows. If one considers not just perishable goods the whole story becomes more complex, but it is not the point here. All I wanted to emphasise is that the lack of definite relationship is the reason why money in nominal terms cannot be put into the utility function. The service of the stock of money (flow) depends on the exchange value of the money stock.

The fact that money in nominal terms is put into the evaluation function of the agent in the Ayres-Martinás theoretical framework clearly shows that this evaluation function is:

- not the utility function. That is why it is better to denote it not by  $U(\cdot)$  but rather by another letter, let us say  $Z(\cdot)$ .
- the arguments of  $Z(\cdot)$  are stocks. Hence, there is no confusion between stocks and flows. That is why I denoted the commodity with  $X$  (stock) instead of  $x$  (stock or flow?).

- the nature of the evaluation function leads us to philosophical considerations. The philosophical considerations and possible interpretations require a thorough analysis. The work on this fundamental point is not finished [16]. Nevertheless, I firmly believe that this work cannot end up in failure. The reason is the following: all economists depart implicitly from the axiom that evaluation of wealth exist in some form, because economists want to make an inquiry into the causes of wealth of nations. In order to say which nation or agent is richer, one should be able to compare different set of wealth. That is to say, agents must have some ordering on wealth. The utility concept is one possible ordering. But I do believe that it is not the only possible evaluation concept.

This brief discussion shows that the Ayres-Martinás theoretical framework fulfils the minimal requirements that we have fixed for the proper integration of money into a price theory:

- 1) it is a non-equilibrium theory, hence out of equilibrium states are represented;
- 2) there is no confusion between stocks and flows; the arguments of the evaluation function of the agents are stocks;
- 3) the evaluation concept is not the utility concept. Hence all stocks (including money) can enter into the decision problem of the agents;

We can conclude that the Ayres-Martinás theoretical framework is not based on the concepts of the general equilibrium theory; it can be considered as a new theoretical framework. The purpose of this paper was not and couldn't be to give a detailed proof on each point. Much work is needed to arrive to the level of sophistic elaboration of the general equilibrium theory. As an excuse, I remember that it took a couple of decades to elaborate the general equilibrium theory, too.

## **CONCLUSIONS**

The main concern of economic science in the Smithian tradition is to explain the Wealth of Nations. This tradition implies two fundamental tasks of economic science. On the one hand, wealth must be expressed in a one dimension variable in order to make possible the comparison of wealth; i.e.: economic science must elaborate a price theory. On the other hand, money should be integrated in economic theories because prices are expressed in monetary terms. Mainstream economic theory succeeds in price determination (with some limits) but fails on money integration, while non-mainstream monetary models succeed on money integration but fail on price determination.

In this paper I argued that the Ayres-Martinás theoretical framework is a promising tentative to cope with this challenge of economic science. At first glance, the fundamental concepts of the Ayres-Martinás theoretical framework do not exclude the integration of money into a price theory as opposed to the mainstream economic theory. Because the arguments of the evaluation function of the economic agents are stocks (including money) and out of equilibrium states are represented.

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## VEZA TEORIJE CIJENA I NOVCA: NAPOMENE O TEORIJI AYRES-MARTINÁS

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Sveučilište zapadne Mađarske  
Šopron, Mađarska

### SAŽETAK

Glavni zadatak ekonomske znanosti je objašnjenje bogatstva naroda. S jedne strane ta tradicija podrazumijeva da bogatstvo treba izvrijedniti, tj. ekonomske znanosti trebaju razraditi teoriju cijena. S druge strane, novac treba integrirati u ekonomsku teoriju jer su cijene izražene u novčanim terminima. Glavna ekonomska teorija uspjela je u određivanju cijena (uz određena ograničenja) ali nije uspjela u integraciji novca, dok je ostala ekonomska teorija uspjela integrirati novac ali ne i odrediti cijene. U ovom radu zastupam stav da je Ayres-Martinás teorijski okvir perspektivni pristup bavljenja ovim izazovom ekonomske znanosti.

### KLJUČNE RIJEČI

temelji mikroekonomije, makroekonomija