Carl Menger's "Money" and the Current Neoclassical Models of Money

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The paper analyzes three neoclassical models of money with emphasis on the equilibrium concepts employed. It is argued that the neoclassical theories fail to analyze the emergence of the social institution of money. Instead, they focus on the consistency of individual decisions regarding the rational acceptability of intrinsically worthless objects given the social institution of money and the Pareto superiority of the allocations in monetary vis-à-vis barter economies. The equilibrium concepts employed by neoclassical theories are not suitable for the study of the emergence of new electronic payment systems. Instead, a theory of the emergence of social institutions, of institutional change is required: the Mengerian method of institutional analysis.

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The following paper briefly summarizes the current neoclassical models of money and contrasts them with Menger's institutional approach[1]. The models were motivated by an attempt to reconcile Walrasian value theory with monetary theory. In a frictionless market where agents trade multilaterally and simultaneously based on equilibrium prices there is no 'absence of a double coincidence of wants' constraint to barter. Consequently, there is no role for money as a medium of exchange.[2] In order to explain why rational agents exchange goods for intrinsically worthless money, various frictions have to be introduced in the models. The

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[1] For a discussion of Menger's institutional approach see the introduction and Streissler's contribution to this volume. For a recent survey of New Institutional Economics (NIE) see Williamson 2000.

Mengerian approach is contrasted with current neoclassical models of money in order to point out the narrow scope of the latter in particular with regard to their treatment of the social institution[3] of money.

The selection of current neoclassical models is restricted to those that satisfy Wallace's (1998) "Dictum for Monetary Theory": As examples of the eligible models I discuss Kiyotaki, Wright's (1992) search model, Samuelson's (1958) overlapping generations model, and Townsend's (1980) spatial separation model. To satisfy the dictum, a theory has to specify assets by their physical properties (i.e. their explicit payoffs) and embed the economy in an environment in which the asset's role in exchange is determined endogenously. I will briefly describe the three models, although the main focus is on the equilibrium concepts employed and their suitability to study the fundamental questions in the theory of the origin of money.

> *"That a good is given up by its possessor in exchange for another one more useful to him is an occurrence plausible even to the meanest intelligence. But that among all somewhat civilized peoples every economic agent should be willing, indeed eager, to trade away his goods intended for exchange for small metal disks that seem useless in themselves or for documents representing these: this is an occurrence so contrary to the ordinary course of things that we must not be*

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[2] See Hellwig 1993. For a historical account of attempts to reconcile value and monetary theory see Hoover 1988.

[3] Menger interprets money as a social institution, i.e. a system of norms, expectations, and conventions that influence the decisions of the participants (e.g. financial intermediaries, firms, households etc.). In particular, the mutual consistency of expectations that other individuals accept money as the generally accepted medium of exchange with near certainty is the result of a complex learning, co-ordination, and development process (for a discussion see Furubotn, Richter 1997).

surprised if it seems downright "mysterious". [...] How did money come about?" (Menger 1909, pp. 3)

Menger emphasizes two questions: (*i*) the individual rationality of accepting intrinsically worthless objects in exchange for goods,[4] and (*ii*) the emergence of the social institution of money. I will argue that the three models discussed in the paper focus only on the question of individual rationality and its welfare implications taking the social institution of money as given. Moreover, they are static in the sense that the expectations of the agents in the economies concerning the acceptability of money are constant over time and determined exogenously. Therefore, the models do not address the question of how the social institution of money came about or why agents prefer monetary exchange to indirect barter.

In addition, the paper argues that the Mengerian method of institutional analysis is suitable to investigate current institutional change in the monetary system due to the emergence of new electronic payment systems.

Due to the exogeneity of expectations, the use of static equilibrium concepts and the neglect of the evolution of the institution of money, the models are of limited use in the analysis of new electronic payment systems. An understanding of the formation of expectations is crucial for the analysis of new electronic payments systems. Positive irreversible fixed costs (such as terminals, acquisition of technology competence etc.) are frequently associated with joining a new electronic payment system. Furthermore, the realized marginal utility due to transaction cost savings associated with an individual transaction is relatively low. Consequently, the decision to join a new electronic payment system can be interpreted as an investment decision. The expected return on investment is influenced by the individuals' expectations

[4] Hellwig (1993) refers to the same question as the Hahn problem.

with regard to the acceptability of the new medium of exchange (e.g. some form of electronic money).[5]

The emergence of new electronic payment systems is an instant of institutional change in the financial system. Current neoclassical models of money assume the institutional setup (including the social institution of money) to be exogenously given. In order to analyze the emergence of new electronic payment systems a different method is required – the Mengerian method of institutional analysis.

Moreover, a very short translation of Menger's "Money"[6] is one of the most quoted early papers in the theory of the origin of money. A critical assessment of the models from a Mengerian viewpoint thus sheds light on the differences in economic approaches to the role of money.

The paper is structured along the following lines: First, the three current neoclassical models of money are briefly described – search models, overlapping generations models, and spatial separations models. Secondly, their common methodological characteristics are contrasted with the Mengerian method of institutional analysis. The final section provides a conclusion and summary.

[5] See Osterberg, Thomson 1998 and Sheehan 1998. The demand curve for a good exhibiting network externalities (e.g. joining a payment system) still slopes downward but it is shifted outwards if its expected number of units sold (e.g. its expected acceptability) increases (see Economides 1995 and 1996).

[6] See Menger 1892. Goodhart (1998, p. 408) calls the theorists who base their explanation of the positive value of intrinsically worthless money on individually rational decisions to overcome the costs of an absence of double coincidence of wants Mengerians.

1. Search models

Search models base the argument for the origin of money on the absence of a double coincidence of wants. Due to specialization of production and preferences that do not allow agents to consume their own product, trade is necessary to consumption. The absence of a centralized market imposes high search costs on the agents. The mutual acceptance of a medium of exchange can overcome some of the restrictions imposed by the trading technology and the economic environment by reducing search costs. A double coincidence of wants is no longer necessary. The following description of a search model follows Kiyotaki, Wright (1992). Other examples include Kiyotaki, Wright (1989, 1991) and Wallace (1997).

Table 1: Assumptions of a typical search model of money (Kiyotaki, Wright 1992)

The Economy ➢ A very large number of agents all of whom live indefinitely[7] and maximize discounted utility *U*. ➢ Agents discount expected future consumption at a constant rate $0 < \beta < 1$ or $1/(1 + r)$ where *r* is the real rate of interest. ➢ There is a large number of goods that are indivisible and storable at no cost. ➢ Furthermore, the agents do not know the economy's full history of transactions (see Kocherlakota 1998a, b) nor can they commit to future actions (see Wallace 1997).
Consumption ➢ All goods are consumed by a fraction *x* of all agents. ➢ Each agent consumes the fraction *x* of all goods.[8] ➢ No agent consumes the good he produces. ➢ Utility derived from the consumption of one unit of a consumption good is *u*.
Production ➢ All goods are produced by an equal number of agents, the fraction *x* of all agents. ➢ Before an agent can produce a unit of a good he has to consume. Production takes place immediately after consumption. ➢ The costs per unit produced are *c* (in terms of disutility). The quantity produced is one unit.
Endowment ➢ The fraction *M* of all agents is endowed with one unit an intrinsically worthless object called money. ➢ Money is indivisible. ➢ The fraction $(1 - M)$ is endowed with one unit of a good.
Trading technology ➢ In each period two agents are randomly matched. ➢ They trade iff it is beneficial for both of them. ➢ One makes a take-it-or-leave-it offer. Trade leads to an equal distribution of the gains of trade.[9] ➢ Accepting one unit of a good other than money in exchange involves a transaction cost ε (in terms of disutility).
Equilibrium

[7] In all three classes of models discussed an infinite horizon is necessary in order to ensure that accepting money is individually rational (see Kocherlakota 1998a, p. 244).

[8] Due to the symmetry between the fraction *x* of agents consuming each consumption good and the fraction *x* of consumption goods consumed by each agent and complete specialization (each agent always produces the same consumption good after having consumed himself) the expected fractions of all consumption goods supplied and demanded remain constant throughout all periods.

[9] See Kreps 1990, pp. 556.

- The equilibrium concept employed is a symmetric, steady state Nash equilibrium.

The frictions in the market due to the trading technology are of crucial importance: If we presume the existence of a centralized market with zero search costs of indirect exchange via a Walrasian auctioneer, consumption and production would take place in each period. A double-coincidence-of-wants constraint on bilateral barter would not pose any trading restrictions. Under the assumption of a zero search cost trading technology, no medium of exchange would be necessary.

Because there are a large number of agents in the economy it is unlikely that agents will meet more than once. Credit arrangements to facilitate trade are therefore not an option. The very low probability of ever meeting a certain agent and the restrictions on credible commitment technologies rule out the circulation of credit certificates as the probability of redemption is low. Consequently, the incentive structure would not be sufficient to constrain the issue of individual credit certificates in relation to individual future production.[10]

The equilibrium concept employed by Kiyotaki, Wright (1992) is restricted to symmetric, steady state Nash equilibria. This implies that agents are treated identically and treat each other identically. Furthermore, it implies that given the symmetry of consumption and production of all goods the acceptability of each good is identical. An equilibrium consists of the optimal trading strategies for all agents based on their belief about the strategies of all others that assign a specific trading decision to each current holding (of either money or the good produced) conditioned on the holding (of either money or the good produced) of each possible trading partner. The strategies must be consistent with maximization of discounted

[10] See Wallace 1997 and Townsend 1980, p. 269 FN 10.

expected utility and rational expectations.[11] Since the analysis is restricted to steady state equilibria, the optimal strategy is independent of time.

Solving the model

Because of the symmetry of the model, the distinction between different goods with respect to whether or not they have been produced by the agent is not necessary. Each agent might therefore hold either (*i*) money or (*ii*) a good which the agent does not himself consume at the end of the initial period. In each period each agent randomly meets someone who holds either money or a good he does not himself want to consume.

First consider the case in which two agents meet, both of whom hold goods. If they trade goods they do not themselves want to consume, both of them have to bear the transaction cost ε. What are the benefits derived from accepting a good one does not want to consume? Holding a good that is more likely to be accepted in exchange for the desired consumption good would increase the discounted expected utility of future consumption. But, due to the symmetry of the model, the acceptability of all goods in trade is equal. No gain in terms of discounted expected utility is associated with the exchange but the transaction cost of ε is incurred by each agent. Consequently, no agent accepts in equilibrium a consumption good he does not himself consume. Therefore, two agents holding goods trade if and only if both of them receive their desired consumption goods. Since each good is consumed by the fraction x of all agents, the probability for such a double coincidence of wants to occur is x^2. The equilibrium strategy in meetings with agents who hold goods, therefore, is: Accept a good in exchange for another good if and only if it is your desired consumption good. An agent derives utility $U = u - c - \varepsilon$ with probability $(1 - M)x^2$.

[11] See also Kiyotaki, Wright 1989.

After having resolved the acceptability of goods through meetings, the acceptability of money has to be determined endogenously in line with Wallace's dictum. The probability of accepting money is π and the expectations concerning the acceptability of money by others is denoted $\prod$. In order to determine the conditions for the acceptance of money being an equilibrium strategy, we have to analyze the relative values of holding (*i*) a good at the end of a period (V_c) and (*ii*) of holding money at the end of the period (V_m). The agent accepts money in exchange for goods if and only if $V_m \geq V_c$. The value of holding a good at the end of the period is defined by:

$$V_c = \beta\left\{(1 - M)x^2U + Mx\pi V_m + (1 - Mx\pi)V_c\right\} \qquad (1)$$

It is the discounted sum of: (*i*) the expected utility derived from a double coincidence of wants which leads to an exchange, consumption and immediate production $(1 - M)x^2U$ and the expected value of holding a good at the end of the period $(1 - M)x^2V_c$. (*ii*) the probability of exchanging the good for money and deriving the value V_m which results in an expected value of $Mx\pi V_m$. (*iii*) the expected value of holding a good at the end of the period because the agent meets someone who holds money, who desires the good the agent holds but the agent does not accept money $Mx(1 - \pi)V_c$. (*iv*) the expected value of holding a good at the end of the period because the agent meets someone who holds a good the agent does not consume and, therefore, does not accept in exchange $(1 - M)(1 - x)V_c$. (*v*) the expected value of holding a good at the end of the period because the agent meets a trading partner who does hold the agent's desired consumption good but does not consume the good the agent holds and is not willing to accept it in exchange $(1\ M)x(1 - x)V_c$.

The value of holding money at the end of the period is given by:

$$V_m = \beta\{(1-M)x\Pi(V_c+U)+[1-(1-M)x\Pi]V_m\} \quad (2)$$

It is the discounted sum of: (*i*) the expected utility of consumption net of transaction and production costs and the value of holding a good at the end of the period $(1 - M)x\Pi(U + V_c)$. (ii) the expected value of holding money at the end of the period $[1 - (1 - M)x\Pi]V_m$. Agents end up holding money in all matches other than when they can exchange money for their consumption good. In equilibrium, agents do not accept any good in exchange for money other than their consumption good.

In order to determine the optimal strategy with respect to the acceptance of money π, Kiyotaki and Wright express V_c in terms of V_m in equations (1) and (2) and substitute $1/(1 + r)$ for β:

$$V_c = \frac{(1 - M)x^2U}{(r + Mx\pi)} + \frac{Mx\pi}{(r + Mx\pi)} V_m \quad (3)$$

$$V_c = -U + \left[1 + \frac{r}{(1 - M)x\Pi}\right] V_m \quad (4)$$

The algebraic solution is derived by a reformulation of (3) and (4) and the subtraction of (4) from (3) to yield:

$$[r + Mx\pi + (1 - M)x\Pi](V_c - V_m) = (1-M)xU(x-\Pi) \quad (5)$$

As the terms $[r + M x \pi + (1 - M) x \Pi]$ and $(1 - M) x U$ are always positive, the sign of the left hand side of equation (5) depends on $(x - \Pi)$. If and only if it is expected that money is more likely to be accepted in exchange than goods $(x < \Pi)$, then it is the medium of exchange in the model. In this case it is the optimal strategy for the agent to always accept money in exchange for goods $(\pi = 1)$. However, the expected acceptability of money Π is not determined endogenously in the model. Therefore, Kiyotaki, Wright (1992) show that (*i*) it is indeed individually rational to accept money given the social institution of money, and (*ii*) that the resulting allocation Pareto dominates the allocation in a setting without that social institution.

2. Overlapping generations models

In overlapping generations models, the age structure of the population and the physical characteristics of the consumption good in the model mean that certain markets do not exist.. The exposition builds on Blanchard, Fischer (1989). Original contributions of OLG models of money include Samuelson (1958) and Diamond (1965).[12]

Table 2: Assumptions of a typical overlapping generations model of money (Blanchard, Fischer 1989)

[12] For critical discussion of OLG models see McCallum 1983 and Hoover 1988.

The Economy

- Agents live for two consecutive periods and maximize lifetime utility $u(c_{1t}, c_{2t+1})$ which is a twice differentiable, continuous, strictly concave, and either separable or homothetic function[13] increasing in its arguments.
- There is only one homogenous good that is not storable.
- Population grows at the rate n such that $N_t = N_0(1 + n)^t$.
- There is no intrinsic uncertainty in the model. Individuals are assumed to have perfect foresight.

Consumption

- Agents born in period t consume c_{1t} when young and c_{2t+1} when old.

Endowment

- Each agent is endowed with one unit of the good when young and zero units when old.
- At $t = 0$ the old are endowed with M_s units of money which is divisible and can be stored and exchanged at no cost.

Trading technology

- Agents can exchange money and the consumption good or engage in barter at competitive terms. Agents are price takers. There are no frictions in the money or good market (no information, transaction, or search costs).

Equilibrium

- Market clearing in the money market implies market clearing in the goods market (Walras' Law). In all markets all agents are price takers. The analysis is constrained to steady-state equilibria. All generations of young agents are treated identically as are all generations of old agents.

In an economy without money, the young consume their entire endowment and the old cannot consume at all. The decentralized equilibrium is not Pareto optimal as both, the old and the young, would profit from intertemporal (or intergenerational) exchange of goods. But the young cannot exchange with the current old because the latter can neither offer any consumption goods in exchange nor commit to settle their debt in the following period as they would then already be dead. Equally, the current young cannot exchange goods with the future young because these have not yet been born. Intertemporal barter is impossible. Agents of each generation could only engage in barter amongst themselves within each time period.

[13] See Shone 1997, pp. 497.

Intratemporal barter among agents of one generation is not necessary as a result of the homogeneity of all goods and the identical endowments and preferences of all agents.

The introduction of money in this economy can lead to the creation of a market for intertemporal exchange. This can have the following implications: (*i*) An intrinsically worthless object (money) can have positive value as a store of value since it dominates all other goods in its rate of return. (*ii*) Once money is valued, steady state equilibria involving trade between three generations are possible and, thus, can lead to a Pareto optimal allocation of resources between generations.[14]

Solving the model

Agents face the following maximization problem:

$$\max_{c_{1t},c_{2t+1}} u(c_{1t},c_{2t+1}) \qquad (6)$$

subject to

$$P_t(1-c_{1t}) = M_t^d$$

$$P_{t+1}c_{2t+1} = M_t^d$$

The first order condition is

$$\frac{\frac{\partial u(c_{2t+1})}{\partial c_{2t+1}}}{\frac{\partial u(c_{1t})}{\partial c_{1t}}} = \frac{P_{t+1}}{P_t} \qquad (7)$$

[14] See Blanchard, Fischer 1989, pp. 159.

The savings function of the young is given by $(1 - c_t) = M_t^d/P_t$ – their savings are equal to their real money demand. From the first order condition we know that optimal savings imply that the marginal rate of intertemporal substitution is equal to the real gross return on money holdings (P_{t+1}/P_t).[15,16]

In OLG models money serves solely as a store of value and not as a medium of exchange (see McCallum 1983 and Hoover 1988). This is particularly interesting from a Mengerian point of view since in Menger's "Money" the role of money as a store of value is only an incidental function derived from its central, defining role as the generally accepted medium of exchange. Wicksell (1935) emphasizes that only the medium of exchange function is fundamental to the role of money. This, he argues, implies the store of value function for short periods of time, i.e. between accepting money in exchange and spending it again. The decision to engage in monetary exchange rather than indirect barter is not influenced - at the margin - by changes in the real rate of interest over this short period of time. In defending the store of value function of money, Wallace (1977) argues that there cannot be any other asset with a rate of return distribution dominating that of money since the demand for money would then immediately drop to zero. Anything else would violate the intrinsic uselessness of money, which is a defining characteristic of fiat money. This implies that the 'use' of money as a medium of exchange would be incompatible with its intrinsic uselessness, and seems to be a rather narrow definition of the latter. Wallace (1988) emphasizes that – given the absence of legal restrictions – the value of all assets could be explained by their store of value function. This

[15] Future prices are equal to expected future prices due to perfect foresight and the absence of intrinsic uncertainty.

[16] If the economy has a finite horizon, the younger generation in the final period will not accept money in exchange since they would not reach old age to spend it again. By backward induction it can be shown that no generation would accept money in such a setting.

store of value, however, could be anything that supports the expectations of the young to receive compensation for foregone consumption when old, e.g. social security and not necessarily money.[17]

Since money is intrinsically worthless, the old offer their entire holdings M_s at the going price. The young demand money according to their savings function. Therefore, equilibrium in period t is given by:

$$(1+n)^t M_t^d = M_s \tag{8}$$

In the previous period the old have determined their real money holdings according to their own savings function $L(P_{t-1}/P_t)$. Therefore, we can rewrite (8) in terms of supply and demand in the market for intertemporal exchange between two consecutive generations by:

$$(1+n)L\left(\frac{P_t}{P_{t+1}}\right)P_t = L\left(\frac{P_{t-1}}{P_t}\right)P_{t-1} \tag{9}$$

$$(1+n)\frac{P_t}{P_{t-1}} = \frac{L\left(\frac{P_{t-1}}{P_t}\right)}{L\left(\frac{P_t}{P_{t+1}}\right)} \tag{10}$$

As the savings of the old and the young must be mutually consistent in steady state (e.g. $c_{1,t} = c_{2,t+1}$) and n and (P_t/P_{t-1}) are constant over time, it follows that the price level must decrease at

[17] See Hoover 1988.

the rate of population growth. As the nominal supply of money is fixed at M_s but the real demand for money increases with the growth of the population, the price level must fall in order for the real supply of money M_s/P_t to increase as well.

The crucial point is that equation (10) involves the price levels of three consecutive periods. Since the equation must hold in steady state, the expected value of money must be positive in all periods. "Suppose that the old and every generation thereafter believe that they will be able to exchange money for goods, at price P_t in period *t*." (Blanchard, Fischer 1989, p. 158.) The expectations concerning the future acceptability of money are not determined endogenously.[18] Given the social institution of money, the additional endowment of M_s units of an intrinsically worthless good can have the positive effects cited above: (*i*) It is individually rational to accept money in exchange for goods. (*ii*) The allocation in the monetary economy Pareto dominates the allocation in an economy without money.

3. Spatial Separation Models

In models with spatially separated agents, such as OLG models, certain markets do not exist. While in OLG models different lifetime spans are the source of the frictions, it is spatial separation between different markets, the impossibility of transfers and communication between markets, and the fact that the consumption good is not storable that render certain bilateral exchanges impossible in an economy without money. The following exposition of a typical spatial separation model builds on Townsend (1980).

Table 3: Assumptions of a typical spatial separation model of money (Townsend 1980)

[18] Also Samuelson (1958, p. 481) presupposes a "grand consensus" on the acceptability of (fiat) money.

The Economy

- Two groups of countably infinite numbers of agents (type A and B) - all of whom live indefinitely and maximize discounted lifetime utility – are situated along two turnpikes.
- They move along the two turnpikes in opposite directions.
- All agents are born at the same time and live forever.
- One agent of each group is born into each market.
- The utility of consumption is $U(c_t^{A,B})$ which is a twice differentiable, continuous, strictly concave, and time separable function with $U'(0) = \infty$, increasing in its arguments.
- There is no communication or transaction between markets.
- Agents discount expected future consumption at a constant rate $0 < \beta < 1$ or $1/(1 + r)$ where r is the real rate of interest.
- There is no intrinsic uncertainty in the model. Agents have perfect foresight.
- At the beginning of each period a lump-sum tax $z_t^{A,B}$ (positive or negative) on money holdings can be imposed by a central planner.
- Furthermore, the agents do not know the economy's full history of transactions (see Kocherlakota 1998a, b) nor can they commit to future actions (see Wallace 1997).

Consumption

- All agents consume the single consumption good.
- The consumption good cannot be stored.

Endowment

- One group of agents receives one unit of the consumption good in odd periods ($y_t^A = 1$ for all odd t). The other group receives one unit of the consumption good in even periods ($y_t^B = 1$ for all even t).
- Agents of both groups are endowed with initial money balances of $M_o^{A,B} \geq 0$.
- Money can be stored and carried costlessly. Money holdings cannot be negative.

Trading technology

- Each period two agents belonging to the two groups are paired at any one market.
- Agents cannot choose their direction and/or trading partners.
- They trade iff it is beneficial for both of them.
- Each market enables agents to exchange money and the consumption good or engage in barter at competitive terms. Agents are price takers. There are no information, transaction, or search costs.

Equilibrium

- Symmetry conditions: All agents are treated identically, independent of their initial position. The price of a unit of the consumption good in terms of money p_t is the same across all markets in each time period.
- A monetary equilibrium is defined as a set of sequences of positive finite prices, consumption, money holdings and

lump-sum taxes for each type of agent such that agents maximize lifetime utility and each market clears in each period.

Due to the fact that both groups move along their respective turnpikes in opposite directions each pair meets only once in a lifetime and shares no third persons as trading partners. As one trading partner has an endowment of zero units, he cannot offer anything in barter. Therefore, the situation constitutes a special form of an absence of double coincidence of wants. Intra-temporal barter is impossible as transfers and communication between markets are ruled out.

Private debt cannot circulate since any transfer of such debt could only take place with those agents who are situated "behind" the issuer. Therefore, debt would not be redeemable, no link between future wealth and debt could be enforced (there would be no limitation on the issue of private debt) and, consequently, the price level would not be determined. Bilateral inter-temporal trade is impossible unless individuals assume money to be accepted by all future trading partners. The consumption good cannot serve to facilitate inter-temporal trade as it is perishable while money is storable and transferable at no cost. Thus, money enables the creation of a market for intertemporal and intratemporal exchange.

Solving the model

The agents' problem for types A and B takes the following form:

$$\max_{c_t^{A,B}, M_t^{A,B}} \sum_{t=0}^{\infty} \beta^t U\left(c_t^{A,B}\right) \qquad (11)$$

subject to

$c_t^{A,B} \geq 0 \qquad \forall t \geq 0.$

$M_t^{A,B} \geq 0 \qquad \forall t \geq 0.$

$p_t c_t^{A,B} + M_{t+1}^{A,B} \leq p_t y_t^{A,B} + M_t^{A,B} - z_t^{A,B} \qquad \forall t \geq 0.$

with $M_0^{A,B} \geq 0$ and $z_0^{A,B} = 0$ given.

This yields the first order condition for a maximum:

$$\frac{\frac{\partial U\left(c_{t-1}^{A,B}\right)}{\partial c_{t-1}^{A,B}}}{\beta \frac{\partial U\left(c_t^{A,B}\right)}{\partial c_t^{A,B}}} \geq \frac{p_{t-1}}{p_t} \qquad \forall t \geq 1. \qquad (12)$$

The FOC holds as an equality iff money holdings are positive and non-zero (the constraint on M_t is nonbinding). Again, the rate of deflation must be *1 - β*. Money yields a positive rate of return and dominates the rate of return on consumption goods.[19] The maximized discounted lifetime utility yields a sequence of consumption $c_t^{A,B}$ and a sequence of "savings" $M_t^{A,B}$ for all *t*.

The equilibrium of the monetary economy involves positive money holdings and non-finite positive prices of consumption goods in terms of money consistent with the agents' maximization problem. Therefore, the model shows that (*i*) the acceptance of intrinsically worthless money is individually rational given the social institution of money.

As a benchmark for the monetary economy Townsend (1980, pp. 271) derives a solution for a centrally planned economy based on the maximization of a weighted average of the utility functions of types A and B in an economy without money. The exercise yields $c_t^A = \lambda$ and $c_t^B = 1 - \lambda$ for all t. Townsend (1980, pp. 272) establishes the following results: (*ii*) The optimal allocation $c_t^A = \lambda$ and $c_t^B = 1 - \lambda$ for all t cannot be attained without intervention ($z_t^{A,B} = 0$). (*iii*) A monetary equilibrium without intervention exists and, although nonoptimal relative to the benchmark allocation, it is Pareto superior to autarky[20].

4. Current neoclassical models of money and Mengerian institutional analysis

The neoclassical models focus on equilibrium allocations under different institutional arrangements and comparative statics of their welfare implications.[21] In a certain period (e.g. $t = 0$) agents maximize expected lifetime utility *given* the institutional arrangement and *fully anticipating* the other agents' optimal strategies. The equilibrium concepts adopted imply rational expectations[22] including perfect knowledge about preferences, expectations, and (future) optimal strategies of all agents, the technology and the institutional setting. The equilibrium allocation is derived under these restrictive informational assumptions and the additional assumption that money is expected to be accepted by all other agents in all future

[19] Again, the expected rate of return is equal to the rate of return due to perfect foresight and the absence of intrinsic uncertainty (see Blanchard, Fischer 1989).

[20] Autarky refers to the allocation achieved by the decentralized economy without money such that agents can only consume their endowments.

[21] See Green 1999.

[22] In many models there is no intrinsic uncertainty in the models such that rational expectations correspond to perfect foresight.

periods (i.e. in OLG models), at all spatially separated markets in all future periods.[23] It is shown that it is individually rational to accept money, and that the allocation in the monetary economy Pareto-dominates the allocation in the economy without money. Equilibrium and co-ordination are achieved instantaneously and at no cost. Wallace (1998) uses the notion of endogeneity in a strictly model theoretical context. The individual rationality of accepting money is not simply postulated exogenously by including money in the utility or production function or by imposing a cash in advance constraint but it is determined endogenously given the social institution of money. The scope of the models is to account for money in various examples of modified Walrasian settings.[24] The emergence of the latter, of course, remains determined exogenously. An endogenous theory of money, though, has to deal with both questions raised by Menger: (*i*) the individual rationality of accepting intrinsically worthless objects in exchange for goods, and (*ii*) the emergence of the social institution of money.

The formation of expectations concerning its acceptability and, thus, the emergence of the social institution of money are excluded from the analysis in the neoclassical models of money. Due to the fact that the equilibrium concepts focus on steady state (or stationary) equilibria, changes to the (simple) monetary systems are ex definitionem impossible, since the institutional arrangements, preferences, and technologies are exogenously given and institutional change is not an issue.

[23] In search models the assumption that money has a higher acceptability than consumption goods often suffices.

[24] „More or less all the models of monetary economics that are being used in practice proceed in this way, using artificial adaptations of the Walrasian centralized-markets to accommodate money without actually giving an account of what the role of money in the economy is." (Hellwig 1993, p. 215)

Menger interprets money itself as a social institution. Its emergence is the *unintended consequence of purposeful, individual action* (pp. 6, 9 and 17[25]). In Menger's article the institutional arrangement itself is the scope of analysis. The formation of expectations concerning the acceptability of different forms of money is crucial because (*i*) indirect exchange involves the passage of a time period between accepting and spending money, and (*ii*) money exhibits network effects. The demand schedule for participation in a network is downward sloping but shifts outwards with increases in the expected number of participants. Menger describes the process of the formation of expectations concerning the acceptability of money. Menger's institutional analysis of the origin of money emphasizes the following points:

Agents engage in exchange iff both of them expect to profit from the transaction, iff *mutual gains from trade* are expected (p. 33). Due to the division of labor and search costs, there is an *absence of a double coincidence of wants (p. 3).*

Goods are heterogeneous with respect to demand for them and, consequently, with respect to their acceptability in trade (pp. 4).[26] Although he provides a number of potential explanations (e.g. different goods are affected differently by habit or prevailing power structures and unilaterally imposed liabilities such as taxes, etc. (pp. 6)), this heterogeneity is exogenous to Menger's analysis. Iway (1996, p. 471) criticizes the assumption of different acceptability of goods and reaches different conclusions about the evolution of monetary equilibrium: "Contrary to what Menger said, we can find no 'natural' tendency for the evolution from a barter to a monetary economy." According to Iway, the acceptability of goods is not a 'fundamental' of the economy but the result of individual trading strategies based on

[25] In the following paragraphs all page numbers refer to Menger 1909.

(symmetric) endowment-need frequencies (defined as the proportion of individuals endowed with a certain good *i* while demanding another one *j*). The acceptability of money is endoginized in terms of endowment-need frequencies and increases in the proportion of the economy that demands money as medium of exchange. The use of an arbitrary good as a medium of exchange increases its acceptability and reinforces its role as 'money'. Thus, equilibrium in any good (e.g. fiat money) is sustainable. However, the sustainability of equilibrium is different from the proposition that this equilibrium evolves naturally. Based on symmetric endowment-need frequencies the barter economy is shown to be locally stable. Consequently, only an exogenous disturbance that decreases the transaction costs of one good relative to the others such that indirect exchange becomes more efficient for individuals shifts the economy to a monetary equilibrium. By assuming symmetric endowment-need frequencies, however, Iway's critique of Menger's analysis fails to take into account the differences in demand for different goods. Furthermore, Menger explicitly emphasizes the reinforcing effect of the emergence of indirect trade on the relative acceptability of different goods (p. 10) and thus implicitly distinguishes between (exogenous) demand and (endogenous) acceptability of different goods. Menger offers a rational reconstruction[27] of the evolution of monetary exchange through indirect barter based on the fundamentals of the economy, i.e. the heterogeneity of goods with respect to individual demand.

The question "... why agents [in a monetary economy] engage in indirect exchange through money rather than general indirect barter ... " (Hellwig 1993, p. 236) cannot be addressed by the neoclassical models of money. Indirect barter is ruled out in the Kiyotaki, Wright (1992)

[26] The differences in individual endowments are only discussed implicitly (p. 6).

[27] I borrow the terminology from Selgin's and White's contribution to this volume.

model by imposing symmetry of goods with respect to individual demand.[28] In the overlapping generations and spatial separation models discussed there is only a single consumption good and endowments and preferences are identical such that there is no intratemporal barter at all. Intertemporal (direct and indirect) barter is impossible due to the absence of markets and the structure of endowment and demand sequences. In Menger's account the singular position of money as the only medium of exchange is the result of indirect barter and the increasing acceptability of some of the goods that were used in indirect barter at early stages of the evolutionary process.

The advantages of indirect barter and indirect exchange (by exploiting the heterogeneity of goods with respect to their acceptability) are not understood by all agents at once (pp. 5). Initially, only a few agents understand the heterogeneity of goods with respect to their acceptability on the respective market and the related profit opportunities.[29] They engage in indirect barter at first, as this strategy increases their discounted expected utility (pp. 5, 7) (independently of whether or not others accept the respective commodity as a medium of exchange (!) – rather, based on the supply/demand conditions of the good under consideration). This increases their chances to trade the goods they bring to market for the goods they wish to buy on the market.

The process of learning about the different degrees of acceptability (pp. 5) is the driving force of the emergence of the social institution of money, the formation of expectations concerning the behavior of other agents. Instead of focusing on symmetric, steady-state equilibria in

[28] In their 1989 paper, indirect barter and monetary exchange are identical due to the structure of the model.

[29] For an attempt to endogenize investments in information about the qualities of goods offered on the market, exchange opportunities, or relative prices to explain the use of money see Brunner, Meltzer (1971). They

which agents take the expectations and strategies of all others as given, Menger focuses on the evolution of indirect exchange based on the heterogeneity of, both, goods and individuals. Moreover, he emphasizes the process of learning about the different degrees of acceptability of goods and about the strategies and expectations of the other agents.[30] Due to the structure of supply and demand curves, some goods are more likely to be accepted in exchange in a certain market at a certain time than others. Gradually, more agents learn about the higher degree of acceptability of certain goods through the economic success of those agents who have recognized the role of indirect barter first. They learn about the others' strategies in exchange and their expectations and adapt their own strategies and expectations. In particular, practice, imitation, and the formation of habit facilitate the assessment of these expectations. The acceptability of the goods with the highest degree of acceptability thereby increases even further. Finally, a certain good evolves into the generally accepted medium of exchange (p.8). The process does not end at this point as technological, legal, and institutional arrangements might emerge that economize on certain aspects of the medium of exchange. Examples of early media of exchange were domestic animals, furs and slaves. In order to reduce transaction costs (e.g. costs of evaluating quality and quantity of those goods) media of exchange evolved that were more fungible, divisible, marketable in wider boundaries of time and space, transportable, and preservable (p. 8). The imperfections of early monies led to their gradual displacement by coined precious metals (e.g. gold and silver) in many societies. Selgin, Klein (2000) analyze a related dynamic process in computer simulations based on

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criticize models of the origin of money that focus on stationary states. In their model, as information becomes abundant (at least in the limit) in a stationary state the raison d'être for a medium of exchange disappears.

[30] Selgin (1997) criticizes current search models of the Kiyotaki, Wright type along similar lines. Jones (1976) analyzes a simplification of the evolutionary process described by Menger. He focuses on the different degrees of acceptability and learning about changes in the acceptability of an emerging medium of exchange but abstracts from differences between individuals.

imperfect knowledge about the different degrees of marketability of different goods. They argue that, in Menger's approach, at least some individuals are assumed to recognize the single most marketable good and fully understand the benefits of indirect barter at once. Were this recognition shared by everyone, Menger's dynamic process would imply immediate convergence to a commodity money equilibrium (with the single most marketable good becoming the generally accepted medium of exchange). In fact Menger does not assume that all individuals learn immediately about the individual desirability of indirect exchange (Klein, Selgin refer to this assumption as ad hoc). In Menger's approach only a small fraction of the total population initially learns about different degrees of marketability while the rest regard all goods as equally saleable. Furthermore, the decisions to adopt indirect barter and, at a later stage, indirect monetary exchange involve expectations about future marketability, risk and time preferences, opportunity costs, and wealth constraints. The more general assumption, therefore, is that adoption patterns vary among individuals. Those who refrain from indirect barter and indirect monetary exchange are gradually convinced by the economic success of early adopters.

The medium of exchange function of money is central (pp. 52). All other functions of money – such as store of value (p. 31), unit of account (measure of price pp. 32) etc. – are only derived from the core function of money as the generally accepted medium of exchange. In OLG and spatial separation models money is modeled solely as store of value, facilitating intertemporal transfers.

Transaction costs, state involvement and institutional change play a role in the perfection of the social institution of money (pp. 9, 17-25, 65-7). The total economic costs (transaction, information, opportunity costs etc.) associated with the operation and use of the payment system can be reduced by continuously adapting its institutional structure: (*i*) The state can

have a role in ensuring the uniformity of the unit of account or declaring – in some circumstances – a legal tender. (*ii*) Private note issue economizes on the opportunity costs associated with the use of coined money.[31] (*iii*) Financial institutions can reduce the demand for money in an economy by consulting their clients on optimal cash management and by substituting book money for notes and coins.

The emergence of the social institution of money has positive real effects on the economy. (*i*) It is individually rational to exchange goods for intrinsically worthless money (p. 7). (*ii*) The emergence of a generally accepted medium of exchange leads to a move from bilateral monopsony to increased competition. Consequently, prices reflect market conditions (supply/demand) rather than the – more arbitrary - outcome of a bargaining process with a small number of buyers/sellers and sellers/buyers (p. 11).[32] In simple OLG and spatial separation models there is no exchange without money. Consequently, before the introduction of money, there are no meaningful market prices that could be compared with those in the monetary economy. The prices quoted by a Walrasian auctioneer are not affected by the introduction of money. In search models, agents do engage in exchange if there is a double coincidence of wants. The simple take-it or leave-it bargaining mechanism, indivisibility of goods, the symmetry of agents, and the absence of time discounting within bargaining periods mean that prices in bilateral monopsony are identical to hypothetical competitive prices. (*iii*)

[31] Today this private note issue can take place in electronic form (e.g. new electronic payment systems) to economize on central bank money. The reduction of resource costs at a given money stock due to the development of fractional reserve money system are also emphasized by Smith (1776) and Brunner, Meltzer (1971). Both works emphasis coinage and the latter also bank credit cards as examples of institutional change within the monetary system to reduce the marginal costs of information.

[32] Streissler in his contribution to this volume emphasizes the role of a medium of exchange in creating an information network among market participants in Menger's approach.

The emergence and evolution of the social institution of money facilitates trade, the division of labor, and contributes to economic growth (p. 4).

5. Conclusion

The neoclassical models of money focus on symmetric equilibria and simultaneous decisions. Menger emphasizes the heterogeneity of agents with respect to their understanding of the heterogeneity of goods with respect to their acceptability in trade. Agents do not posses perfect knowledge about each other's preferences and expectations. They cannot fully anticipate each other's optimal strategies. Thus, they have to learn about these and adapt their own strategies accordingly. The neoclassical models assume the existence of the social institution of money as exogenously given. Their attempt to explain the rational acceptance of money in (modified) Walrasian structures cannot be successful as long as the emergence of the social institution of money is not endogenized either. The scope of Menger's paper is the rational reconstruction of the development of the social institution of a generally accepted medium of exchange from barter via indirect barter.

Moreover, the differences between the Mengerian contribution to the institutional analysis of money and the current neoclassical models of money make it worthwhile for "Mengerians" to reconsider the original contribution of Carl Menger's "Money".

The emergence of new electronic payment systems is an example of institutional change in the financial system. Current neoclassical models of money are essentially static and assume that a specific institutional arrangement is given exogenously. Thus, there is no endogenous institutional change. The formation of expectations concerning the acceptability of money is crucial for the understanding of the social institution of money. Current neoclassical models do not endogenously model expectations and changes to expectations. They are assumed to be

exogenously determined. The current neoclassical models of the origin of money are therefore of limited use in the understanding and analysis of new electronic payment systems.

Menger's method of institutional analysis, on the other hand, focuses on the process of the formation of expectations. Money is interpreted as a social institution that is subject to constant change. Selgin, White (1987, 1994) and Selgin (1997) discuss further examples of institutional change within the institution of money, such as (among others) the introduction of fiat money and the evolution of a complex financial system inspired by Menger's approach. The emergence of new electronic payment system is yet another example of institutional change. Thus, Menger's method of institutional analysis is well suited to analyzing new electronic payment systems.

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