

A FEMINIST CHALLENGE TO PAUL A. SAMUELSON'S OVERLAPPING GENERATIONS MODEL

KARIN SCHÖNPFLUG and DORIS A. BEHRENS

University of Klagenfurt, Department of Economics

We look at Paul A. Samuelson's 1958 article "An Exact Consumption-Loan Model of Interest With or Without the Social Contrivance of Money" as an exemplary, Neo-classically misconstrued model of nowadays society and its economic activities. The failure to notice the existence of unpaid labor in the framework of the model, and the implicit dependence of the outcomes on unpaid (omitted) reproduction work has apparently gone unchallenged so far. The logical inconsistencies of the model and their androcentric backgrounds are discussed in this paper. Furthermore, we aim to debate (but not explicitly formulate) an alternative modeling approach based on the use of Genetic Algorithms to include – at least some – crucial features of modern society in its whole heterogeneity.

Keywords: OLG, feminism, critique, Genetic Algorithms, retirement contributions.

On the one hand, Paul Samuelson's 1958 article "An Exact Consumption-Loan Model of Interest With or Without the Social Contrivance of Money" appears to be a paradigmatic misconstruction of nowadays society and its economic activities, but on the other hand, it is still the uncriticized core of numerous economic theories in various fields. Men as Hobbesian Mushrooms, Robinson-Crusoe-Individuals, and Mother Earth are the agents populating Samuelson's analogy. Though often challenged, e.g. by Hahn and Solow (1995), Samuelson's overlapping generations (OLG) model also explains the basics of monetary theory and social contrivance. The androcentric bias in Samuelson's assumptions leads to partially bizarre results which have apparently gone unchallenged so far. Among these assumptions are (1) the failure to acknowledge the existence of unpaid labor in the framework of the OLG model, and (2) the fact that the model outcomes implicitly depend on the (unpaid) "reproduction work" (of women). The logical inconsistencies in the assumption-output relations – in contrast to the wide recognition of Samuelson's OLG model – are discussed in this paper.

1. THE THEORETICAL CONTEXT FOR AN APPROACH TO SAMUELSON'S OLG MODEL

1.1 DEFINITION OF THE BASIC KEYWORDS

The critique of the OLG model presented in this paper is based on a *feminist background*¹, and the awareness of *androcentric*² biases inherent in the model. We focus on the social inequalities between

¹ "... common to virtually all feminist views [...] is the belief that women are subordinated to men to a degree that is morally wrong and unnecessary." (England, 1993).

² The term *androcentric* refers to a system of any sort, where everything is related to men.

men and women from a *gender*³ point of view rather than explaining the occurrence of unpaid work via the existence of (possibly racist) wage discrimination – extending to *slavery*⁴-like conditions, i.e. working conditions of illegal immigrants or prisoners in private detention centers.

1.2 THE CONCEPT OF INTEREST RATES AND THE ORIGINS OF MECHANICAL BELIEFS

The origins of the use of *interest rates* are closely related to the invention of devices to measure time. If a society does not keep track of time, interest rates are without any meaning. With the invention of mechanical clocks around 1300 AD, mechanical concepts have become characteristic for natural as well as for socio-economic sciences.⁵ Nowadays, the principle of interest rates is usually not questioned, on the contrary, it seems to be one of the most normal concepts of everyday life. Students are trained to cope with them in school, the influence of interest payments on private investment acts as source of joy (or threat), and the government's indebtedness may bring wealth or poverty to its citizens. Note that nonetheless, a

³ "Gender, as the word is used by many feminists, means something quite different from biological sex. Gender is the social meaning given to biological differences between the sexes; it refers to cultural constraints rather than to biological givens." (Ferber and Nelson, 1993).

⁴ Notions of racism imbedded in rational economic theory lay for example in the use of Robinson Crusoe's persona as an anchor for the agents populating Samuelson's modeled world (see Grapard, 1995).

⁵ The belief in mechanics as the most successful approach to science is meanwhile widely challenged by feminist scientists in almost all fields of research. E.g. Wertheim (1997) describes physics as a male dominated religious clique, and relates the witch hunts in Europe and the destruction of wise women's wisdom during the Middle-ages to the boom of mechanistic sciences.

prevailing strain in economic theory aims at explaining and legitimizing the phenomenon of using interest rates. E.g., Samuelson (1958) defines interest rates as the “*intertemporal terms of trade between generations*”. They will spring up spontaneously in ideally competitive markets.

1.3 THE DIFFICULTIES OF MATHEMATICAL MODELING

Closely intertwined with the origins of all modern sciences (and the belief in mechanics) is the technique of *mathematical modeling*, a tool which is excessively used to describe the generations’ interactions in Samuelson’s model. Whenever we set up a mathematical model of a real world process, we have to pay particular attention to the fact whether the aspired features of real world behavior carry over to the mathematical model which is subject to restrictions caused by the choice of the methodology – in terms of Albert Einstein “*we should make models as simple as possible, but not simpler*”. Since these limitations caused by the choice of methodology do not only restrict the model’s input, but also the model’s output, it is essential for further discussion to be aware of the degree of real world’s alienation due to the modeling procedure. Note that “*the information we omit from our stories reveals as much, if not more, of our values and beliefs than the information we choose to include.*” (Grapard, 1995). Symptomatically, this applies, in particular, as soon as we attempt to involve the principle of *value* into a mathematical modeling approach.

1.4 THE THEORY OF RATIONAL CHOICE (AND LABOR)

Economics was (and still is) regarded as the “*science of rational choice*”. With respect to scarce resources individuals are supposed to maximize their utility (and/or minimize their pain) in a rational way. These rational optimality decisions are treated like scientific laws (Samuelson, 1947), and, hence, economics may be regarded as a physical-mathematical science (Walras, 1881). Relying on the theory of rational choice, the models used to describe the phenomenons of physical mechanics are often precisely copied and applied to economic problems (using the identical mathematical approaches) – “*Under the assumption that mathematics is based on geometry, geometrical rules can be applied to situations in economics.*” (Debreu, 1959).

The majority of rational decisions in economic life arise from the demand for labor in order to satisfy the desire for consumption. Labor is related to its utility and the value or wage, respectively, associated with it. Traditionally, economists view labor as painful experience. Adam Smith (1778) defines labor as an activity which forces a worker to give up “*his tranquility, his freedom and his happiness*”. Charlotte Perkins Gilman (1964) links “*that pitiful conception of labor as a curse to the very old and androcentric habit of despising it as belonging to women and then to slaves. [...] Our current teachings of the infant*

science of political economy are naively masculine. They assume as unquestionably that the “economic man” will never do anything unless he has to; will only do it to escape pain or attain pleasure; and will inevitably take all he can get and do all he can to outwit, overcome, and if necessary destroy his antagonist”. Samuelson’s consumption-loan model of interest perfectly mirrors this belief and the basic features of mechanical thinking. We will try to extract these “*mechanical beliefs*”, their consequences, and their applications, from the implicit assumptions of Samuelson’s OLG model – since these beliefs are used as an instrumentality of the justification of oppression and exploitation of women (or slaves) deeply rooted within them.

2. SAMUELSON’S OLG MODEL AND ITS CURRENT APPLICATIONS IN ECONOMICS

In his famous 1958 paper Paul A. Samuelson intends to develop equilibrium conditions for lifetime consumption-saving patterns determined by the market interest rates in a society of rational consumers. Actually, Samuelson seeks to explain the survival of a single group of (currently) non-productive agents in an ideally competitive world. As a pioneer in this field of research, Samuelson develops a brand new model including “*some interesting mathematical boundary problems, a little like those in the modern theories of dynamic programming*” (Samuelson, 1958), and he contributes to the current theories of money and interest. But beyond these clearly specified issues a hidden agenda influences the choice of the assumptions, of the methodology, and, finally, of the outcomes of the mathematical analysis of Samuelson’s OLG model.

Figure 1 seeks to visualize Samuelson’s construction, i.e. its explicit and its implicit assumptions (explained in detail in Section 3), its conclusions (discussed in Sections 3 and 4), and their relations among each other. Additionally, the diagram shows a few extensions of the last decades to adapt and to improve the model’s fit to real-world behavior.

Though Samuelson’s article was published more than 40 years ago, still each economist working in the field of intertemporal interactions (between generations) seems to stumble over Samuelson’s OLG model, because the application of this model emerges in various areas – ranging from the most obvious ones like retirement contribution systems, social policies, taxation, income distribution, financial and monetary theory to environmental economics, and economics of war and peace, see e.g. Bommier and Lee (1995), Brunner (1997, 1999), Galor (1989), Goenka and Spear (1994), John et al. (1993), Koskela and Ollikainen (1998), Macher et al. (1999), Manne (1999), McCallum (1983), Nishimura and Shimomura (1997), Pingle and Tesfation (1993), Raut (1989), Rutherford (1999), Spiegel (1998), Wallace (1978), Weizsäcker (1996) to mention only some of them.

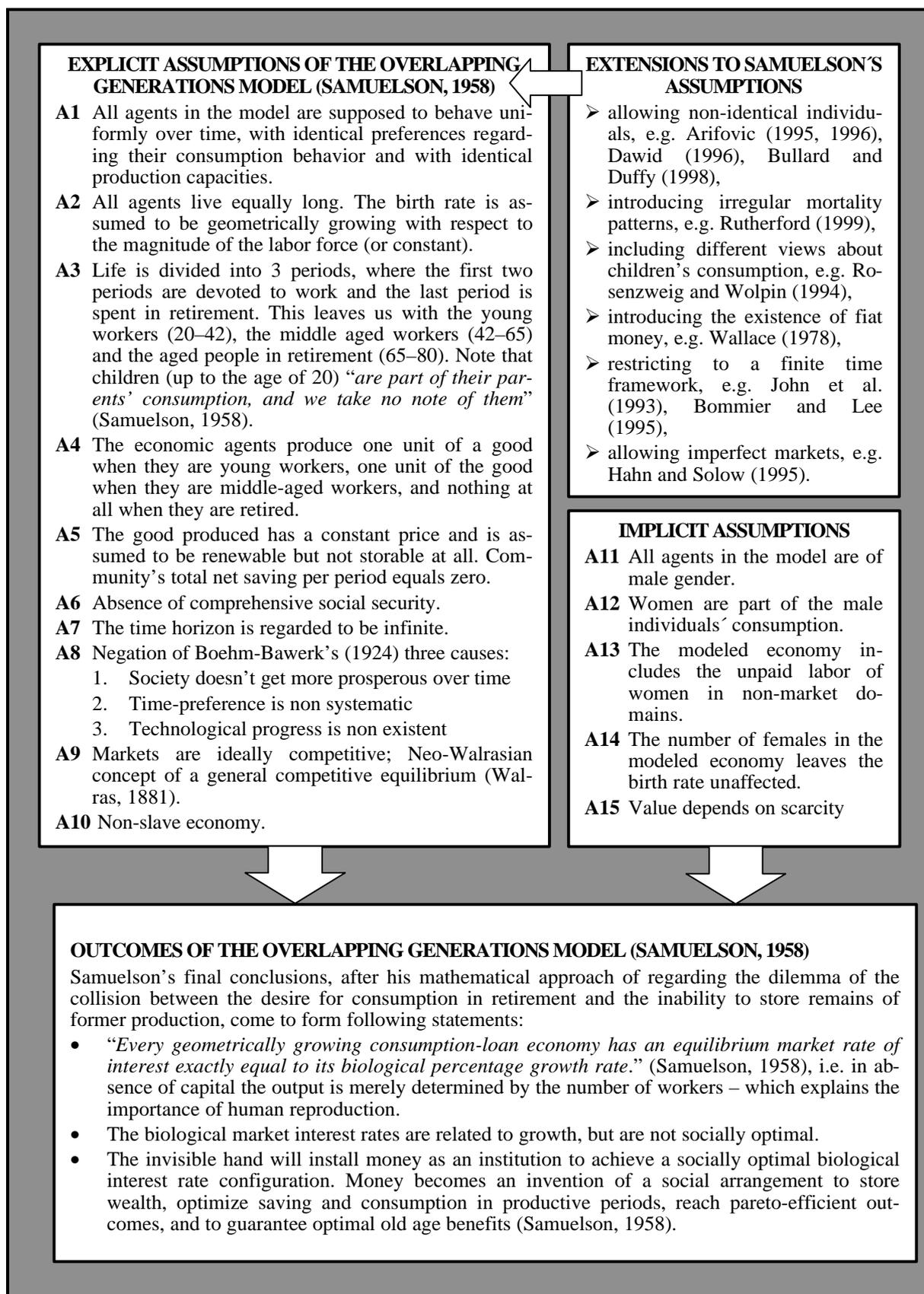


Figure 1: Samuelson’s modeled world including extensions to his assumptions.

The OLG model, however, is not only used as a major requisite in most economists' toolkit, it also serves as a rigid philosophical framework for economic and political activities in mainstream economics, e.g. new classical economists, like Gary Becker, are still building their theories on the dogmatic opinions stemming from Samuelson-like models. The difficulties arising from this traditional (ab)use of exclusively male economic theories as propaganda instruments to strengthen male advantages combined with the naive gender-blindness inherent in such models, often lead to logical dead-ends and paradoxes in the model outcomes. This is why we carefully have to answer the question whether or not Samuelson's analogy is an appropriate and, especially, a technically correct reflection of real-world behavior – particularly of nowadays real-world behavior.

3. THE HIDDEN AGENDA IN SAMUELSON'S OLG MODEL

3.1 THE ECONOMIC AGENTS' GENDER (ASSUMPTION A1)

A major bifurcation in the logical motivation of the overlapping generations model already arises due to Samuelson's (1958) first assumption,

“... men enter the labor market at about the age of twenty ...”

Does *men* stand for *male persons only* or does Samuelson refer to the second meaning of the word *men* which includes *all humans* in a common *manhood*? This distinction between the corresponding scenarios is absolutely necessary, since the very essence of the model, and all its implications have to be looked at differently in either way.

Let us assume that Samuelson was indeed taking an inclusive approach, referring to men and women by the use of the term “men”. Then men and women are considered to have identical production patterns and identical possibilities according to assumption **A1**. They produce identical goods, get paid identical wages, are equally present in the labor market, and equally share work among both sexes. The birth of a child, however, is “a women's job” – and the existence of children is essential for the outcomes of the OLG model (see Figure 1). But the time invested into the so-called “reproduction phase” does not cut back the labor force at any time. Consequently, either “reproduction work” is assigned a market price which would be a real innovation and should have caused some discussions, or women are not included to act as economic agents in the OLG model.

Furthermore, considering the OLG model in its historical context -the late 1950ies- one has to admit, that the “men-and-women-are-identical-individuals-with-respect-to-labor-and-wages”description of the

labor market (and of society in general) would not have fit white, middle-class surroundings at all. It seems unlikely, that Samuelson aimed to model a situation opposite to the real-life situation he was facing –especially, according to Robert Solow's opinion (1993) which says that an economist's (or scientist's) subjective view of a real-world problem inevitably emerges in the corresponding economic model:

“The economist, in thinking about the economy, is inevitably thinking about herself or himself. Introspection plays no part in the framing of hypotheses about chemistry or molecular biology, but I do not see how it can be wholly avoided in framing hypotheses about economic behavior.”
(Solow, 1993)

Therefore, we can assume that Samuelson was referring to (male) men only. Then his assumptions with respect to the agents populating his model make more sense (though these assumptions are, nonetheless, a considerable simplification of human behavior): The (male) individuals amongst each other can be thought of as “far more identical” than in the previous scenario which tends to satisfy assumption **A1**. The life cycles are quite similar, work life starts at around the age of 20 and is not interrupted till retirement which fulfils assumption **A3**. The levels of productivity and wages are more equal in a group of workers consisting out of men only as outlined by assumption **A4**; duties or responsibilities aside from professional labor are not an issue. But now the role of women in the context of the OLG model is quite unclear.

3.2 THE ROLE OF WOMEN IN SAMUELSON'S OLG MODEL (ASSUMPTIONS A12–A14)

We know that females have to exist somewhere in the OLG model, since the existence of children is inevitably necessary for the outcomes of Samuelson's model – and, indeed, Samuelson does not forget females as he refers to the importance of the reproductivity of human mothers (and even “*Mother Earth*” herself as a metaphor for fertility). Since the labor market is not accessible for females according to Section 3.1, women must be (working) somewhere else. But where? If they are “simply at home”, we have to continue our inquiry: What is their occupation? Who pays their expenses? Are they – just like children – part of their parents' (or husbands') consumption, and “*we take no further note of them*”? Do mothers solely serve as a source for the *Hobbesian men*⁶, or are women only existing in the form of children and mothers?

⁶ “*Let us consider men ... as if but even now sprung out of the earth, and suddenly, like mushrooms, come to full*

Even though the scenario of excluding women – according to assumption **A11** – piles up an enormous amount of questions with respect to the argumentation in Section 3.1 it still is the one Samuelson had in mind with respect to his modeling process. This fact is embarrassing, but not new or special in the field of economic theory. When trying to explain the different approaches of “individuals” with respect to their actions on the free market compared to their altruism at home, Gary Becker (1995) walks in Adam Smith’s (1778) boots just like Paul Samuelson by continuing the Neo-classical tradition of male bias⁷:

“Every man feels his own pleasures and pains more sensibly than those of other people. ... After himself, the members of his own family, those who usually live in the same house with him, his parents, his children, his brothers and sisters, are naturally the objects of his warmest affections. They are naturally and usually the persons upon whose happiness or misery his conduct must have the greatest influence.” (Smith, 1778).

Here, we may witness the typical, symptomatic Neo-classical blindness for the role and for the status of women: In the long list of nearest and dearest people in a man’s household, neither Smith, nor Becker, nor Samuelson realize that the inclusion of a beloved partner, and/or wife who cares for her husband’s physical and emotional needs, and/or a mother of joint children, and/or a woman who does the housework, is not accomplished.

Behind this obvious insufficiency lurks the vehement discussion whether it is correct to reduce the agents populating an economic model to the (mathematically tractable) paradigm of the *homo oeconomicus*. This construction dates back to John Stuart Mill (1869), and seeks to describe seemingly objectified personae, which should create the objectivity needed by scientists. The concept has been source of a wide dispute, where the heart of the discussion was the debate whether the *homo oeconomicus* is an idealized picture of human rationality, or a ruthless ego-maniac. Another interesting controversy arises from the question, whether this “device for objectivity” reflects the sexism and racism most economists are

blind for.⁸ The *homo oeconomicus* is the personification of a white, middle-class male; people less privileged are not mentioned at all in this context. On the contrary, as a component of historical tradition (see e.g. Mies, 1988), these people are regarded as consumption goods rather than as agents, just like it seems to be the case in Samuelson’s analogy.

3.2.1 RETIREMENT BENEFITS FOR WOMEN

To exclude women from the modeling process according to assumption **A11** mirrors the (often) oppressive real-life conditions. A practical example is delivered by the retirement contribution insurance: The core problem in Samuelson’s modeled world is the desire of the aged *men* to consume once they are retired. To guarantee retirement incomes it is necessary to have worked and produced beforehand. Women are not mentioned in this context; they are not even considered as intertemporal trading partners with respect to retirement benefits. This happens because women, who are not working in the labor market, but e.g. operating solely as mothers – being part of their husbands’ consumption which satisfies assumption **A12** – will not produce anything in the framework of the OLG model. If a housewife’s husband dies after a long marriage she will receive a retirement income since the insurance has guaranteed *him* to care for his wife in case he dies first. But if the husband leaves his wife after a whole life of housework he will receive his retirement benefits – while she will not. Just like in Samuelson’s model world the wife does not exist in the retirement contribution scheme. Generally, the consumption of “Samuelson’s women” of any age depends entirely on the altruism of a male relative as expressed by assumption **A12**.

3.2.2 WOMEN’S REPRODUCTION WORK

The imperfection of the conditions for women in real life does not start in retirement age. Economic theory dismisses a whole segment of production, namely the unpaid reproduction work in the household as outlined by assumption **A13**. The reluctance to acknowledge women’s traditional work results in low wages if these duties are performed on the labor market, and in no wages if performed at home. Women and their work go unnoticed and the value of their work is disclaimed.⁹ The fact that women receive lower-level

maturity, without all kind of engagement to each other” (Nelson, 1996a). Nowadays the Hobbesian mushroom theory is replaced by the more popular technocratic approach of parachuters, who fall from the skies with their full supplies.

⁷ Feminists who are criticizing some obvious inequalities, e.g. discrimination via wages, are constantly facing theoretical rationalizations originating from such economic basics. In order to falsify theories like that, it is indispensable to look into the reasoning which justified the slip from the reality which theories sought to portray.

⁸ “There are androcentric biases in the deep theoretical structure of Neo-classical economics. [...] It presumes that humans are autonomous, impervious to social influences, and lack sufficient emotional connection to each other to make empathy possible [...] in the market. [But] in the family, individuals (particularly men) are presumed to be altruistic.” (Mies, 1988).

⁹ “Men’s interests are furthered because analyses proceeding from these [biased] assumptions direct our attention away from the ways in which typical arrangements between men and women perpetuate women’s disadvantage

wages is often justified by the dubious argument that this is a necessary condition to increase welfare (Maier, 1993). Diane Elson (1993) points out that, though (or even because), “*economics does not distinguish between men and women, economics is not neutral with respect to gender. The overestimation of the importance of issues like GDP, growth, imports, exports, optimization of resource allocation, prizes, and so on, elucidates the male bias in economics*”. The sphere of household and household production is terribly neglected, even though most economists should be aware of the fact that (women’s) reproduction work emerges as the basis of all economic activities. Economic theories assume implicitly that reproduction work is independent of all other economic activities (so does Samuelson in assumption **A13**), i.e. reproduction work will always be available to an extent that ensures that the remaining economic activities will never be negatively influenced by a shortage of production due to reproduction. For instance, Samuelson simply assumes: “... *let us [...] keep births forever constant.*” (Samuelson, 1958). Remarkable, however, is the fact that the birth rate is completely independent of the number of women as outlined by assumption **A14**. We pay attention to this paradox in the following section.

3.3 SUMMARIZING THE CHANCES OMITTED FOR THE IMPROVEMENT OF THE OLG MODEL PERFORMANCE

When Samuelson discovers that interest rates are related to the growth of the population in the framework of his OLG model the track of ignorance begins:

“I seem to be the first, outside a slave economy to develop a biological theory of interest relating it to the reproductivity of human mothers.” (Samuelson, 1958).

Samuelson emphasizes his surprise about his discovery with the words,

“Is there a common-sense market explanation of this (to me at least) astonishing result?” (Samuelson 1958),

and proceeds to solve the mystery. He finds the seemingly sufficient explanation that an increment in the number of younger workers makes the life of the old more pleasant. Rigorous examination of the model assumptions and its conclusions, however, yields a different answer. Instead of sticking to the dogma, one might follow the two blatant hints arising from Samuelson’s analysis.

- (1) The existence of a biological interest rate already strongly points towards the source of children

both in their families and in labor markets.” (England, 1993).

and the new workers – and Samuelson (1958) himself realizes and acknowledges that “*the interest rate is related to the reproductivity of human mothers*”. Nevertheless, Samuelson relies on an everlasting constant fertility rate or a birth rate geometrically growing with the size of the labor force, respectively. The fact that women – whose number is exogenously determined, and who are treated to be outside the modeled labor force – are at least as important for the determination of the birth rate as (working) men are. But the model assumptions are confusing: Does the extent of the labor force (**A2**) determine the birth rate or is the fertility of women dependent on their number to keep the population growth constant? (**A14**)

- (2) The second hint comes up when Samuelson adds the statement to his astonishing discovery about the relation between interest rates and biological growth that his results are imbedded in a modeled world “*outside a slave economy*” according to assumption **A10**. This is more than a gentle push for examining whether there is really no unpaid work hidden somewhere in the depths of the unspoken model assumptions – or in other words, whether a contradiction between explicit (**A10**) and implicit (**A13**) assumptions exists.

Samuelson ignores these hints and sets up the story of the Hobbesian young men who pay for (and nurse?) the old. This simplification follows a long tradition, and is usually regarded with a congenial smile, but it is essential not to play down this practice.

“Well socialized economists, however, in practice tend to view their simplifications - especially those required by the core assumptions of self-interested individualism and contractual exchange - as relatively innocent. The prevalence of jokes about economists forgetting that assumptions are just assumptions is no accident. The microfoundations of economic theory are seen as being approximately true rather than as only partially true. The notion of modeling as approximation however, disguises the value judgements hidden behind the decision to count some phenomena as more important than others.” (Strassmann, 1993).

If Samuelson decided to follow the hints mentioned above, he would have had to allow unorthodox and unwanted economic truths, namely that the reproductivity of human mothers allows positive interest rates and that incident causes an increase of well being for part of the population – contradicting assumption **A8**. But then he would have had to conclude that child-birth must have some kind of value (this principle will be discussed in the next section) instead of taking it for granted and not valuing it at all. These contradicting issues associated with a monetary valuing

system lead to even more questions: Does money really create socially optimal outcomes for all individuals (either existing implicitly or outspokenly within the modeled world)? Why does economic theory deny the importance of women's work? Does this denial mirror the subjectivity and real political interests of economic theory? Is the discrimination faced by women and by people who are non-white and/or members of "lower social classes" a consequence of concepts like Samuelson's contribution to Neo-classical theory? Some of these questions will be answered in what follows.

4. MONETARY UNITS AND THEIR VALUE

4.1 MONEY AS A SOCIAL CONTRIVANCE TO ENSURE SOCIAL OPTIMALITY

The third outcome of Samuelson's analysis is "to see one *"function"* of money from a new slant – as a social compact that can provide optimal old age social security." (Samuelson, 1958). Indeed, money serves as a deposit of goods' values, as an instrument to shift individual saving from productive periods to non-productive (future) periods, and, consequently, as a medium to guarantee consumption in retirement. Economists love to tell stories about the origins of money in different cultures. Kauri shells, stone-wheels, elephants' tails, pressed tea, or dogs' teeth, are curious examples of prehistoric currencies. These paradigms are often used to make us believe that every advanced culture is obliged to invent money to store wealth. But what is the nature of the "values" which need to be preserved and stored for the future? While women perform "non-monetary" (actually non-measurable) activities like reproduction work, child-care, taking care of the sick and old, household work, work on the family's fields, etc. for free, other (measurable) values become non-perishable as monetary units. Money seems to be an invention by men to preserve values for men. Symptomatically, the invention of money pops up in Samuelson's model, when we try to answer the question of how to preserve men's production (of goods) for their old age.

These observations are consistent with women's experiences having to face (a lot of) money. For men the ownership of money clearly means independence, for women it often indicates an ambivalent situation: Historically, women's access to money was via men. Receiving money was never associated with a deal of neutral nature; the interpersonal relationships accompanying monetary transfers were (and are) usually quite complicated. The husband provides physical things and money to satisfy the family's needs, in return the wife produces children and emotional support and other monetarily invaluable deeds. The difficulty to measure the wife's performance in monetary units leads to arbitrary rewards for her duties. On the labor market the rewards (i.e. wages) are less arbitrary.

The field of responsibility of the woman worker is still somewhat blurred. Bosses often feel they have a right to special services of their female employees – just think about the coffee ritual. Sexual harassment at the working place is partly resulting from traditionally far-reaching boundaries for women's working domains. Hence, for women money often creates dependence instead of the desirable independence. The creation of money to preserve typically male values in a men's world is an androcentric tool to maintain power.

4.2 VALUES

Both the use of the technique of mathematical modeling and the invention of money allow to combine and to measure groups of durable and non-durable goods (which have different values) over time, however,

"One of the great metaphysical ideas in economics is expressed by the word "value". ... It does not mean market prices, which vary from time to time under the influence of casual accidents; nor is it just an historical average of actual prices. Indeed, it is not simply a price; it is something which will explain, how prices come to be what they are. What is it? Where shall we find it? Like all metaphysical concepts, when you try to pin it down it turns out to be just a word." (Robinson, 1979)

Most crucial is the very basic assumption **A15**. Goods which are rare are most valuable: e.g. gold charms. Others which are easily available are of less value: e.g. bricks. The usefulness of those rare items compared to widespread articles does not influence the evaluation process. With regard to services, Adam Smith was the first economist to connect moral values to market values. In doing so he scientifically founded the arrangement that men's doings are valuable and non-altruistic and therefore need to be paid for, while women's doings are nothing of that sort. In the free market the homo oeconomicus is operating as follows:

"It is not from the benevolence of the butcher, the brewer or the baker, that we expect our dinner, but from their regard to their own interest." (Adam Smith, 1778).

The wife's provision of a dinner is not so clearly founded on her own interest. Altruistic motives and emotional ties are believed to be the driving force of interactions in the family. Not only women, but also men are in this context unselfishly straining to make each others' and their children's lives more happy:

"Becker refers to the altruistic head [of the family] as male and to the beneficiaries as women and children, although he claims that he used masculine

and feminine pronouns only to distinguish the altruist from the beneficiary. Since Becker certainly knows that it is generally men who have greater access to money, we must be suspicious of his claim that his choice of the male pronoun to denote the altruist was arbitrary. Yet Becker never discusses the effects of such differential power in the family. [...] It is particularly ironic that altruism, in which women seem to specialize more than men, gets credited to men!" (England, 1993).

As mentioned above, goods and services like birth of a child and motherhood, childcare, emotional support, relief of aged people, etc. can hardly be measured in monetary units because these goods are not produced and purchased in a free market. Since women traditionally (re)produce in their families, most of their deeds – whether regarded as valuable or not – are performed (altruistically) without orientation on compensation. But remembering the connection of value to scarcity it would be interesting to find out if reproduction work became more valuable if performed less frequently.

According to Marilyn Waring (1988) all our beliefs of value are strongly influenced by androcentric bias. Assigning a certain value to an economic action is independent of the actual time or energy invested, but solely dependent on who performs the deed. The value of a service or good is determined by an exogenous instance and related to an abstract monetary value. Patriarchal ranking of values is solely connected to money and based on more or less arbitrary cultural and androcentric standards. The implications for the real life of women and people from non-white and/or lower-class backgrounds are aggravating.

“Economic approaches and policies are rooted in a problematic, and often deadly, dichotomization of what does and does not have value.” (Waring, 1988)

The justification of androcentric valuing in economics evolves around the idea of a well-meaning monetary system.¹⁰ Samuelson’s 1958 paper also takes this point of view. The insight that money creates pareto-efficient optimal conditions seems convincing, until we look more closely at the hidden agenda. Actually, Donald McCloskey believes that

“after the masculinist programs of Paul Samuelson [...] we know more about economic models lacking contact with the world.” (McCloskey, 1993) .

¹⁰ The ambivalence of money creating optimal welfare conditions on the one hand and an utterly ruthless homo oeconomicus who uses money to cheat others and to live on their expense on the other hand is reflected in Lucas and Stokey (1987).

However not the lack of contact, but the dramatic influence of such programs on the real world and their strategy to maintain the status quo is crucial. Economists systematically omit information about women and their spheres of life to emphasize the importance of male interests. To give up this strategy would also mean to give up male privileges in real life.

5. GENETIC ALGORITHMS AS AN ALTERNATIVE MODELING APPROACH TO CONSIDER NOWADAYS SOCIETY?

A possible way to overcome the troublesome “representative agent” assumption, **A1**, (and also the neo-Walrasian concept of a general competitive equilibrium expressed by assumption **A9**), is the use of Computational Intelligence (CI) techniques like neural networks, genetic algorithms and/or cellular automata. All of these approaches from computer sciences are used lately to describe the adaptive behavior of *heterogeneous individuals* in economic systems, see e.g. the survey in (Dawid, 1999a). CI techniques do not yield analytical results, but the numerical results obtained allow to suggest features of the model, to examine the transient behavior of economic systems before they settle down in an equilibrium, and to investigate features of social learning like imitation and communication effects which cannot be dealt with in a representative agent model, as performed in e.g. Behrens and Dawid (2000) – and this “heterogeneous agents” approach is absolutely necessary considering nowadays family demography. E.g. ÖSTAT (1998) reports that a marriage lasts on average approximately 8-9 years due to a divorce rate of about 38%. The associated increase in the number of single-parent families manifests the flaws of the 1958 OLG model or any of its extensions including assumption **A1**.

To illustrate the whole variety of the characteristic features of a heterogeneous society we refer to the use of Genetic Algorithm (GA)-based models,¹¹ see e.g. Goldberg (1989) or Dawid (1999a). The idea to use Genetic Algorithms to capture the basic features of OLG models is not new in economic theory. Azariadis (1981) and other authors show that in OLG models rational expectations equilibria with random

¹¹ Genetic Algorithms may be treated as models of adaptive behavior in a population of boundedly rational individuals and were recently used to examine adaptive behavior in several economic models, e.g. Andreoni and Miller (1995), Arifovic (1994, 1995, 1996), Dawid (1999b), Dawid and Kopel (1998), Marimon et al. (1990), especially, because in several of these contributions, e.g. Arifovic (1994, 1995), it is shown that Genetic Algorithms are well-suited tools to describe actual human learning behavior and match experimental results often better than standard learning rules, like least-square learning or stochastic approximation.

prices¹² may exist though there is no uncertainty within the model. Arifovic (1995) uses GAs to learn stationary equilibria with perfect foresight in a simple OLG model. She extends her analysis to the case of a two-country OLG model in Arifovic (1996). Dawid (1996) shows that a simple OLG model with fiat money is able to learn sunspots and even cycles. Bullard and Duffy (1998) deal with a n -period OLG model where the agents' adaptive learning is again modeled by GAs. We argue that it might be very fruitful to follow this line of investigation combined with Becker's (1992) "Economy and Fertility" approach, and set up a "Dawid-type" OLG model (see Dawid, 1996), *but differentiate between populations of opposite genders*. In spite of the GA-based extensions of the standard OLG model which are listed above, to our knowledge, no two-gender approach exists. We argue that this is a consequence of the enormous difficulty associated with the so-called encoding mechanism – without destroying the "convergence" behavior of the GA.¹³

We argue that a model which captures the basic features of overlapping generations in nowadays society has to include at least two populations, namely,

- a population of type M individuals whose productivity phase lasts from their, say, 20th to their 65th "birthday" without being interrupted by a reproduction phase, followed by a retirement phase as described by e.g. Samuelson (1958), and
- a population of type F individuals who are able to decide whether to "reproduce or to produce" where children are assumed to be part of their consumption. But in case of reproduction these individuals have to be – for a while (or for the rest of their lives) – part of the consumption of "somebody else". This immediately raises the well-known question: Who is somebody else?

In a number of cases this could be a partner, say a type M individual. But who is going to provide consumption for an average type F individual during the reproduction phase in the remaining number of cases? Certainly, we cannot use Samuelson's principle of the interest rate ("You get something, because you once gave something") to guarantee consumption during the reproduction phase. If we use the "trading" principle of give and receive we have to face the well-know prob-

lem: What is the *value* of a child's birth, and what is the *value* of raising that child?

We have to find a monetary equivalent which can be used as an equalization payment (from society) to finance consumption during the reproduction phase to guarantee that type F individuals are in a position which allows a rational counterbalance between production and reproduction. This may be accomplished as follows: Contradicting assumption **A8**, the reproductivity of human mothers allows positive interest rates which causes an increase of well-being for part of the population, namely the women having and raising a child.

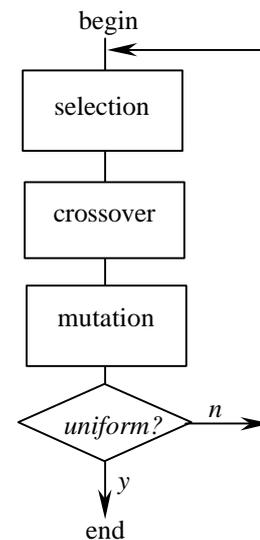


Figure 2: Structure of a Simple Genetic Algorithm

Then, the modeling approach proceeds as follows: Each single agent in the GA-based OLG model (i.e. each member of one of the populations) is represented by a binary string of predetermined length. The coding mechanism for the populations of type M and type F individuals, respectively, could work as follows.

- ♦ Consider a binary string, b_i , of length, l_M , in the population of type M individuals. Interpret the first, say, 8 bits of this binary string as the representation of an integer, h , in the binary alphabet. This value represents individual i 's consumption, e.g. the string, 01010100, describes an individual with a consumption of 84 units. This value should, however, be normalized, e.g. by dividing this integer by $2^{l_M}-1$, which gives a value in the unit interval, $(0,1)$. Additional bits might reflect information about the age, the family status including marital status, the number of children, etc.
- Strings in the population of type F individuals are of length $l_F > l_M$. The first parts of their strings may

¹² These equilibria, which are governed by the beliefs of the individuals that an external random variable has some influence on the prices, are called *sunspots*.

¹³ Though, strictly speaking, GAs never converge if the mutation rate is positive, we will use the term "convergence" to outline a state, where one strategy spreads over the entire groups (of both genders), and the only fluctuations within the populations are due to mutations.

be designed equivalently to the strings in the type M population, but the rest should include more information about children and, particularly, the time devoted to bringing them up, the corresponding working status, the income level, etc.

These artificially intelligent agents have much higher computational capabilities than the traditional economic agents who react exactly to the predetermined rules according to the economic model. In each period each artificially intelligent agent receives some payoff for his/her choice of consumption, which defines the so-called fitness value. (These values depend on the situation of the artificial agents with respect to their ages and their family circumstances.) Using these fitness values the transition from one generation to the succeeding one is executed by the application of the GA Operators which are described in detail by e.g. Dawid (1999a). This application, visualized by Figure 2, is affected separately for each population. The Selection Operator models an imitation effect within a population. Individuals with low payoffs will very likely imitate those with high payoffs.¹⁴ Within a single population, individuals will be influenced by others, even if they do not imitate each one. The whole – or only notions of their – strategy are adopted. This is accomplished by the Crossover Operator and gives strings with high fitness a chance to produce even better individuals. The Mutation Operator models some kind of innovation: Either actions are randomly mistaken, or the agents think that the best strategy has not yet been found. Thus, with very small probability, strings come into existence, which can not be found in the initial generation. This procedure will be repeated until all strings are equal, (or a predetermined number of iteration steps is reached).

The resulting uniform populations hopefully outline the equilibrium features of a heterogeneous society consisting of overlapping generations of opposite gender coming close to real-world human behavior.

¹⁴ In the setup presented here, the fitness of a string in either of the populations depends on the values of other strings in both populations. Such a situation, which is rather usual in economic models and quite different from the standard applications where GAs are used to solve static optimization problems, was analyzed by Dawid (1994, 1999a) and Dawid and Hornik (1996). They refer to such kinds of models as “GAs with states dependent fitness functions” and show how possible outcomes of simulations in such models are characterized. In particular, they show that a population state, which is the result of a GA simulation, is not necessarily an equilibrium of the underlying economic system, and they describe the possible impact of variations in implementation details (like the coding scheme, the crossover probability or fitness re-scaling). Taking these findings into account, we keep in mind to be very careful when interpreting the results in economic terms.

6. CONCLUDING REMARKS

Economists systematically omit information about women and their spheres of life to emphasize the importance of male interests in economic theory. Theories like the one developed in Samuelson's OLG model is used scientifically to strengthen the privileged position of men in society. The androcentrically biased assigning of monetary values to certain actions and goods but not to others is a core strategy in that regard.

Samuelson's OLG model creates the typical Neoclassical world seen from the perspective of a white, male economist in the late 1950ies. To illustrate the accusation of subjectivity in this paper, try to imagine how "the female African economist Paula Samuelson" would try to model the problems of retirement (from her point of view). Do you think she would have come up with the same modeled world as Paul Samuelson?

Trying to be innovative in our critique of the OLG model, we briefly outline an alternative modeling approach based on the use of Genetic Algorithms. In doing so, we follow the basic model setup of Dawid (1996) but extend the model assumption to consider two populations of artificially intelligent agents of different gender.

As a different approach which avoids the androcentrically biased assigning of monetary values entirely, Marilyn Waring advocates the use of time rather than the use of money as a more adequate and equitable standard to measure the value of productive activities (Waring, 1988). But not to find a concept for change is most problematic. To give up androcentric strategies also means to give up male privileges in real life, therefore a strong denial of bias or subjectivity usually arises when the injustices supported by economic theory are pointed out.

REFERENCES

- Andreoni, J. , Miller, J.H.. 1995. "Auctions with Artificial Adaptive Agents." *Games and Economic Behavior* 10: 39–64.
- Arifovic, Jean. 1994. "Genetic Algorithm Learning and the Cobweb Model." *Journal of Economic Dynamics and Control* 18: 3–28.
- Arifovic, Jean. 1995. "Genetic Algorithms and Inflationary Economics." *Journal of Monetary Economics* 36: 219–243.
- Arifovic, Jean. 1996. "The Behavior of the Exchange Rate in the Genetic Algorithm and Experimental Economics." *Journal of Political Economy* 104: 510–514.
- Azariadis, C.. 1981. "Self-Fulfilling Prophecies." *Journal of Economic Theory* 15: 380–396.
- Becker, S. Gary. 1992. "Fertility and the Economy." *Journal of Population Economics* 5: 185–201.
- Becker, S. Gary. 1995. Febrero, Ramón. *The essence of Becker*. Stanford, Calif.: Hoover Inst. Press.
- Becker, S. Gary. 1996. "Altruism in the Family and Self-

- ishness in the Market Place," in Nancy Folbre (ed.) *The Economics of the Family*. Chicago: The International Library of Critical Writings in Economics 64.
- Behrens, A. Doris, Dawid, Herbert 2000. "The Consequences of Imitation and Communication Effects in Illicit Drug Markets," in R. Trappl (ed.) *Cybernetics and Systems*. Vienna: Austrian Society of Cybernetic Studies.
- Böhm-Bawerk, Eugen von, Weiss, X. Franz. 1924. *Gesammelte Schriften von Eugen von Böhm-Bawerk*. Vienna: Hoelder Pichler-Tempsky.
- Bommier, Antoine, Lee, Ronald D. 1995. "Overlapping Generations Models with Realistic Demography: Static and Dynamics." Manuscript. On-line. Available: <http://arrow.ql.berkeley.edu/papers/rlee/olg/conc.html>
- Brunner, K. Johann. 1997. "Ökonomische Analyse des umlagefinanzierten Pensionsversicherungssystems." *Discussion Paper 9703*. Linz: Johannes Kepler University. On-line. Available: <http://www.economics.uni-linz.ac.at/index.HTM>
- Brunner, K. Johann. 1999. "Transfers zwischen den Generationen." *Discussion Paper 9904*, Linz: Johannes Kepler University. On-line. Available: <http://www.economics.uni-linz.ac.at/index.HTM>
- Bullard, J., Duffy, J. 1998. "A Model of Learning and Emulation with Artificial Adaptive Agents." *Journal of Economic Dynamics and Control* 22: 179–207.
- Dawid, Herbert. 1994. "A Markov Chain Analysis of Genetic Algorithms with a State-Dependent Fitness Function." *Complex Systems* 8: 407–417.
- Dawid, Herbert. 1996. "Learning of Cycles and Sunspot Equilibria by Genetic Algorithms." *Journal of Evolutionary Economics*, 6: 361–373.
- Dawid, Herbert. 1999a. *Adaptive Learning by Genetic Algorithms: Analytical Results and Application to Economic Models*. New York: Springer.
- Dawid, Herbert. 1999b. "On the Convergence of Genetic Learning in a Double Auction Market." *Journal of Economic Dynamics and Control* 23: 1545–1567.
- Dawid, H., Hornik, K. 1996. "The Dynamics of Genetic Algorithms in Interactive Environments." *Journal of Network and Computer Applications* 19: 5–19.
- Dawid, Herbert, Kopel, Michael. 1998. "The Appropriate Design of a Genetic Algorithm in Economic Applications Exemplified by a Model of the Cobweb Type." *Journal of Evolutionary Economics* 8: 297–315.
- Debreu, G. I. 1959. *Theory of Value*. New York: Wiley.
- Elson, Diane 1993. "Feministische Ansätze in der Entwicklungsökonomie." Trans. Bohlken, Gerd. *Prokla* 4: 529–550.
- England, Paula. 1993. "The Separative Self: Androcentric Bias in Neoclassical Assumptions," in Marianne A. Ferber and Julie A. Nelson (eds.) *Beyond Economic Man: Feminist Theory and Economics*, pp.37–53. Chicago: University of Chicago Press.
- Ferber, A. Marianne, Nelson, A. Julie. 1993. "The Social Construction of Economics and the Social Construction of Gender," in Marianne A. Ferber and Julie A. Nelson (eds.) *Beyond Economic Man: Feminist Theory and Economics*. Chicago: University of Chicago Press.
- Galor, Oded. 1994. "Tariffs, Income Distribution and Welfare in a Small Overlapping-Generations Economy." *International Economic Review* 35 (1).
- Goenka, Aditya, Spear, E. Stephen. 1994. "Market Games and the Overlapping Generations Model: Existence and Stationary Equilibria." Discussion Paper of the Carnegie Mellon Graduate School of Industrial Administration. On-line. Available: http://netec.ier.hit-u.ac.jp/WoPEc/data/Papers/wopcarnewp_002.html
- Goldberg, D.E.. 1989. *Genetic Algorithms in Search, Optimization and Machine Learning*. Reading: Addison-Wesley.
- Grapard, Ulla. 1995. "Robinson Crusoe: The Quintessential Economic Man?" *Feminist Economics* 1(1): 33–52.
- Hahn, Frank, Solow, Robert. 1995. *A Critical Essay of Modern Macroeconomic Theory*. Cambridge, MA: MIT Press.
- John, A. Andrew; Pecchenino, A. Rowena; Schreft, L. Stacey. 1993. "The Macroeconomics of Dr. Strangelove: An Overlapping Generations Model of the Apocalypse." *The American Economic Review* 83(1): 43–62.
- Koskela, E., Ollikainen, M., Puhakka, M.. 1998. "Renewable Resources in an Overlapping Generations Economy without Capital." Discussion Paper of the University of Helsinki.
- Lucas, E. Robert, Stokey, N. 1987. "Money and Interest in a Cash-In-Advance Economy." *Econometrica* 53.
- Macher, S. Gregory, Brazee, Richard, Koselka, Erkki, Ollikainen, Markku. 1999. "Taxation, Bequest, and Short and Long Run Timber Supplies: An Overlapping Generations Problem." University of Helsinki.
- Maier, Friederike. 1993. "Homo Oeconomicus - Zur geschlechtsspezifischen Konstruktion der Wirtschaftswissenschaften." *Prokla* 4: 551–571.
- Manne, S. Allan. 1999. "Efficiency, Equity and Discounting," in Paul R. Portney, and John P. Weyant (eds.) *Discounting and Intergenerational Equity, Resources for the Future*. Washington, D.C.: RFF books, Johns Hopkins University Press
- Marimon, R., McGrattan, E., Sargent, T.J.. 1990. "Money as a Medium of Exchange in an Economy with Artificial Intelligent Agents." *Journal of Economic Dynamics and Control* 14: 329–373.
- McCallum, T. Benett. 1983. "The Role of Overlapping Generations Models in Monetary Economics." Carnegie-Rochester Conference Series on Public Policy, 18: 9–44.
- McCloskey, N. Donald. 1993. "Some Consequences of a Conjective Economics," in Marianne A. Ferber and Julie A. Nelson (eds.) *Beyond Economic Man: Feminist Theory and Economics*. Chicago: University of Chicago Press.
- Mies, Maria. 1988. *Patriachat und Kapital*. Fulda: Rotpunkt Verlag.
- Mill, S. John. 1836. "On the Definition of Political Economy; and on the Method of Investigation Proper to It,"

- in Theodor Comperz (ed.) 1869. *John Stuart Mills gesammelte Werke*. Leipzig: Fues.
- Nelson, A. Julie. 1996. *Feminism, Objectivity and Economics*. New York: Routledge.
- Nishimura, K., Shimomura, K. 1997. "Chaotic Equilibria in Small Open Overlapping Generations Economy with Child-Parent Externality." Working Papers of Kobe Research Institute for Economics and Business Administration, Kobe University.
- OESTAT. 1998. *Oesterreichischer Zahlenspiegel. Jahressausgabe 1998*. Vienna: Oestereichisches Statistisches Zentralamt.
- Perkins Gilman, Charlotte. 1964. *Women and Economics*. New York: Basic Books.
- Pingle, Mark, Tesfation, Leigh. 1993. "Active Intermediation in a Monetary Overlapping Generations Economy." Discussion Paper of the Iowa State University. On-line. Available: <http://ideas.uqam.ca/ideas/data/Papers/wpawuwpm9312001.html>
- Raut, Lakshmi-Kanta. 1989. "Effects of Social Security on Fertility and Saving: An Overlapping Generations Model." Discussion Paper 89-3. University of California at San Diego, Department of Economics.
- Robinson, Joan. 1979. "The Accumulation of Capital," in Joan Robinson (ed.) *Collected Economic Papers*. Oxford: Blackwell.
- Rosenzweig, R. Mark, Wolpin, I. Kenneth. 1994. "Parental and Public Transfers to Young Women and their Children." *American Economic Review* 84 (5): 1195–1212.
- Rutherford, F. Thomas. 1999. "Overlapping Generations with Pure Exchange: An MPSGE Formulation." Discussion Paper of the University of Colorado. On-line. Available: <http://robles.colorado.edu/~tomruth/olg/exchange/index.html>
- Samuelson, A. Paul. 1958. "An Exact Consumption-Loan Model of Interest with or without the Social Contrivance of Money." *Journal of Political Economy* 66(6): 467–482.
- Samuelson, A. Paul. 1947. "Foundations of Economic Analysis,". Duesseldorf 1997: Verlag Wirtschaft und Finanzen.
- Smith, Adam. 1778. *An Inquiry into the Nature and the Causes of the Wealth of Nations*. London: Strahan.
- Solow, M. Robert. "Feminist Theory, Women's Experience, and Economics," in Marianne A. Ferber and Julie A. Nelson (eds.) *Beyond Economic Man: Feminist Theory and Economics*. Chicago: University of Chicago Press.
- Spiegel, Michael. 1998. "Stock Price Volatility in a Multiple Security Overlapping Generations Model." *Review of Financial Studies* 11(2). On-line. Available: <http://www.haas.berkeley.edu/~spiegel/vita.html#Publications>
- Strassmann, Diana. 1993. "Not a Free Market: The Rhetoric of Disciplinary Authority in Economics," in Marianne A. Ferber and Julie A. Nelson (eds.) *Beyond Economic Man: Feminist Theory and Economics*. Chicago: University of Chicago Press.
- Wallace, Neil. 1978. "The Overlapping-Generations Model of Fiat Money." Discussion Paper of the University of Minnesota and Federal Reserve Bank of Minneapolis. On-line. Available: <http://research.mpls.frb.fed.us/research/sr/sr37.pdf>
- Walras, Leon. 1881. *Mathematische Theorie der Preisbildung der wirtschaftlichen Güter*. Stuttgart: Vier Denkschriften. (Reprint 1972).
- Waring, Marilyn. 1988. *If Women Counted: A New Feminist Economics*. London: Harper.
- Weizsäcker, K. Robert von. 1996. "Distributive Implications of an Aging Society." *European Economic Review* 40: 729–746.
- Wertheim, Margaret. 1997. *Pythagoras' Trousers: God, Physics, and The Gender War*.