Prelude to a Critique of Ecological Economy

Abstract:

Classical economic theory, represented by Adam Smith, David Ricardo, John Stuart Mill and Karl Marx, has conceived the economy as a circular process. From the end of the 19th century to the present a different approach has dominated economic thought, which is named marginalism or neoclassical theory. In the neoclassical conception the economy is a one-way street from „factors of production“ to consumer goods to waste. This change in economic theory reflects the ever growing input of non-renewable resources and output of waste which is not recycled. The founders of „Ecological Economy“ such as Herman Daly have identified some defects of the neoclassical theory, but they adopted its basic assumptions. The work of Piero Sraffa (1898-1983), which is a revival and extension of classical theory, offers a totally different framework for ecological economy. Although the word „sustainable“ does not appear in his writings, he shows how the requirement of sustainability determines prices. Here, his theory is applied to the recycling of iron scrap, to carbon dioxide emission and absorption, and to the question, how a steady-state economy with full employment is possible.

Key words: Ecological Economics, History of economic theory, Recycling, Climate protection, Steady-state economy

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Introduction

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At the beginning I want to locate my contribution within the spectrum of different currents of theory and practice of a degrowth society. Matthias Schmelzer has identified five currents which are present in Germany:
1. conservative (M. Miegel)
2. reformist (Seidl/Zahrnt)
3. localist (N. Paech)
4. ecosocialist
5. feminist
I have used the word „localism“ for the project of small self-sufficient commu-nities with strongly reduced division of labour, proposed by Niko Paech.

My own position is somewhere between reformism and ecosocialism. I agree with Seidl and Zahrnt, that the institutions of education, culture, health services and social security, which have evolved in the affluent society, should be preserved in a postgrowth society. For this, division of labour is necessary, because otherwise we cannot have good teachers, excellent musicians and good health services. I agree also with the supporters of ecosocialism, that socialism is a great idea and that private property of basic means of production is an evil. But I am convinced that the transformation of the existing economy to a sustainable non-growth economy, may it be capitalist or socialist, cannot be achieved without a serious study of the economic problems which such a transformation would raise. Therefore I have dedicated several years to the study of economic theories in order to find a sound economic basis for a sustainable degrowth society. The following is a summary of this work.

1. The Schisma in Economic Theory

Human life and all life on Earth depends upon cycles. Populations of plants, animals and humans maintain themselves by the cycle of reproduction. Since the Neolithic Revolution, 10'000 years before present, mankind has learned to control the cycle of reproduction of domestic animals and plants. This cycle at the level of populations is supported by cycles at the level of ecosystems: the carbon and oxygen cycle, the nitrogen cycle, the water cycle. The pre-industrial economy has not disturbed these natural cycles. There was a natural balance of nitrogen in traditional agriculture because animals provided organic fertilizer for the fields. Emission of CO_2 through combustion of wood was compensated by photosynthesis of living plants.

This state of the World has changed dramatically during the 20th century. Natural cycles have been interrupted, and the cyclic processes of traditional human activities have been replaced by unidirectional processes which lead from non-renewable resources to consumer goods to waste. Cows of German farms are fed with soya from South-America, interrupting the nitrogen cycle of traditional farming. The emission of CO_2 in developed countries exceeds by far the amount which can be absorbed by forests in other parts of the World, so the carbon cycle is out of balance. Huge quantities of waste are produced which are not recycled.

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These changes in the real world have been reflected by a fundamental change in economic theory. From 1770 to 1870 economic theory was shaped by the ideas of Adam Smith, David Ricardo, John Stuart Mill and Karl Marx, who represent what is called classical economy. After 1870 a new theory developed, known today as marginalism or neoclassical theory. The classics have proposed the labour theory of value, which says that the price of a commodity depends basically upon the amount of labour embodied in it. The neo-classics say that the price depends on its marginal utility. But this is neither the only nor the most important difference.

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The classics where interested in the reproduction of the whole society, including the working class. Adam Smith reflected on the conditions which secure the reproduction of the working class. He studied Halley's mortality tables and argued that a workers family should have at least 4 children, because only half of all children born would grow up to adults. He wrote: „*A man must always live by his work, and his wages must at least be sufficient to maintain him. They must even ... be somewhat more; otherwise it would be impossible for him to bring up a family, and the race of such workers could not last beyond the first generation*“ [1].

100 years later, Marx conceived the whole economy as a circular process of reproduction. In vol. II and III of Das Kapital he considers his Schemata of simple and extended reproduction. The economy consists of two

aggregated sectors, one producing means of production, the other means of consumption for the workers, i.e. products become again means of production:

Sector (division) I	means of production	+	means of consumption	→	means of production
Sector (division) II	means of production	+	means of consumption	→	means of consumption

Adam Smith was very interested in the advanced methods of production which were used in his time, he has seen the first steam engines and has described the division of labour in a factory.

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In contrast, the first pioneer of neoclassical theory was exclusively interested in consumption. This was the German H. H. Gossen, a man who was not obliged to work, because he could live of the interests of a small fortune inherited from his father. In a book, published in 1854, he wrote that every human being should try to *maximize the sum of his pleasures of life,* given a certain amount of resources. Of course, the financial resources of Mr. Gossen were limited, or as modern economists would say, scarce.

Now, it es enough to extend the idea of Gossen from the individual to the whole society, and we arrive at modern neoclassical theory. For the neoclassics the principal problem is the allocation of scarce resources. In a textbook for students, which has seen more than 20 editions, the authors write:
„*Economics covers all kinds of topics. But at the core it is devoted to understanding how society allocates its scarce resources"* (Samuelson, Paul A. and Nordhaus, W.D. Economics, 14th edition, 1992, p. 2)

As has been said, in classical Political Economy the economic process is cyclic. In neoclassical economics it is a one-way street from „production factors" labour L and capital K to output Y:

[L, K] → Y

Here it is an open question, where labour and capital come from.

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2. Neoclassical Environmental Economy and Climate Change

When environmental problems became urgent, nearly all professional economists were followers of the neoclassical line and some of them developed neoclassical environmental economy. Their approach is based on the theory of welfare economics due to Pigou. The core of this theory is a social-welfare function, which measures aggregate utility of the society, i.e. the sum of all individual utilities. When applied to environmental problems, the environment is taken into account as a source of utility together with the utility of tradable commodities. Thus, the pollution of the environment must be charged with a tax to be payed by the polluter, and the loss of utility of the environment through pollution must be compensated with payments

of money. This approach works quite well in a local and short-period setting. But since the late 1980s we are confronted with the global and long-lasting problem of climate change. Nicholas Stern, the editor of the famous Stern Review, admits that „the special features of the climate-change externality pose difficult questions for the standard welfare-economic approach to policy“ [2].

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The application of welfare economics to climate change would require the summation of utilities over all future human generations. But the sum goes to infinity, if humanity is not doomed to extinction and the utility per generation does not tend to zero. In this case, the usual mathematical procedure of optimization cannot be applied. Formally, this difficulty can be circumvented by some sort of „discounting“, such that the discounted utilities per generation become members of a convergent series, for example a falling geometric series such as 1 + 1/2 + 1/4 + 1/8 + ... The idea of discounting goes back to the Austrian economist Boehm-Bawerk, who wrote: *Present goods have more value than future goods of equal quality* [3]. This topic of neoclassical theory is called time preference. At the beginning it was applied to individuals only, but now it is applied to all future human generations.

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The following table shows the impact of discounting on the decision whether a dam against floods should be constructed. Assume the present generation spends 800 millions for a dam which brings a benefit of 400 millions for each following generation.

		present	1st gener.	2nd gener.	3rd gener.	4th gener.
cost	800	0	0	0	0	
benefit		400	400	400	400	
discounted 2%		400	200	100	50	
discounted 0.1%(Stern)		400	386	373	360	

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Nicholas Stern has discussed the question whether intergenerational discounting can be justified ethically. He wrote:

„If a future generation will be present, we suppose that it has the same claim on our ethical attention as the current one“ [4].

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So far, so good. But then Stern makes a retreat. He postulates a small probability that human society will not survive some unspecified cataclysm, arbitrarily set at 0.1 percent per year. Is this ethically correct or is it only a new disguise of the latent egoism of the present generation?

This approach is also used by life insurance companies. When I have made a contract for a life-annuity, the company must pay until my death. A big company has several thousands of such contracts. Therefore, if I live 10 years longer than expected, this is no problem for the company, because some other man with a similar contract would live shorter. So, the law of great numbers enables the company to fulfill all her contracts. But this approach does not work for small numbers of insured persons, and for the same reason it does not work in speculations about the survival of the human race.

Another justification of discounting is proposed by the defenders of eternal economic growth. They argue that a damage caused by climate-change in 2100 would be repaired with less costs than the same damage in 2014, due to the advances in technology and the accumulation of capital. For example, if a flood destroys 100 houses and the reconstruction of these houses costs 10 millions today, in 2100 it would perhaps cost only 5 millions. Therefore they say, it is better not to spend much money for climate protection.

Against the defenders of growth it can be argued, that technical progress today is different from that in the past. It has shifted from heavy industry to information technology and production of luxuries. Therefore we cannot hope, that building of houses in the year 2100 it will be much easier than today.

(Slide 10) 3. Ecological Economics under Neoclassical Command

In 1987, economists who were not satisfied with neoclassical environmental economics founded the International Society for Ecological Economics. Two years later, the journal Ecological Economics was born. Meanwhile several textbooks have appeared (Daly, Costanza, Faber, Rogall ...) . These books differ from conventional textbooks in Economics in their interdisciplinary approach. They contain chapters on Physics, especially Thermodynamics, Biology and Ethics, and this is new. But the chapters on economic topics are almost identical with corresponding chapters in conventional textbooks. These authors admit, that neoclassical theory has defects, but their aim is its extension (Weiterentwicklung) without fundamental change. Herman Daly begins his book „Ecological Economics“ with the phrase: „Economics is the study of the allocation of limited, or scarce, resources among alternative, competing ends“. This is the fundamental credo of neoclassical theory.

4. The need for an alternative (Slide 11)

Of course, scarcity is the great problem in developing countries. But it is not the main problem in the affluent society. Therefore, an economic theory, which is only a theory of allocation of scarce resources, is like „the rich man who deludes himself into behaving like a mendicant“ (Galbraith, The Affluent Society). The discourse of scarcity is rather an ideology, that is promoted to justify low wages and reduction of social and cultural services. Technology has reached a state, in which the production of some goods costs less than

their disposal. Therefore, we need a new approach. But those of you who expect that I will talk about Georgescu-Roegen und the law of enthropy, will be disappointed. Instead I will talk about Piero Sraffa. Already in 1983, B. Schefold proposed to apply Sraffa's theory to environmental problems, but he did not proceed on this way. It seems that my approach to ecological economy is totally new.

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5. The Renaissance of Classical Theory: Sraffa

In 1925 a young Italian economist published a paper which demonstrated that neoclassical theory is contradictory in itself. His name was Piero Sraffa. Two years later he emigrated to Great Britain, where JM Keynes invited him to become lecturer at the University of Cambridge. Sraffa assumed the editorship of the first complete edition of the Works and Correspondence of David Ricardo, which began to appear in 1951. Sraffa's own theory is contained in a small volume entitled: „Production of Commodities by Means of Commodities“, which appeared in 1960. A German translation appeared 1968 in the GDR and 8 years later in the FRG [5]. This book is short but difficult to read. Joan Robinson called it a „double-distilled elixir“, that one can „enjoy drop by drop for many a day“ [6]. The words environment, ecosystem etc. are not found in it, but nevertheless I believe that it can provide a better foundation of ecological economy than the neoclassics. The reason is that Sraffa conceives the economic system as a cycle.

A summary of Sraffa and his theory is found in the articles „Sraffa, Piero“ and „Sraffian economics“ in the New Palgrave Dictionary of Economics, London 1987.

Chapter 1 of Sraffa's book treats production for subsistence, i.e. production without surplus or net product. He begins with a model of a very simple economy, in which

„only two commodities are produced, wheat and iron. Both are used, in part as sustenance for those who work, and for the rest as means of production - wheat as seed and iron in the form of tools. Suppose that, all in all, and including the necessaries for the workers, 280 quarters of wheat and 12 tons of iron are used to produce 400 quarters of wheat; while 120 quarters of wheat and 8 tons of iron are used to produce 20 tons of iron“. A year's operations can be tabulated as follows:

280 qr. wheat + 12 t. iron → 400 qr. wheat
120 qr. wheat + 8 t. iron → 20 t. iron

At the end of the year certain quantities of wheat and iron must be exchanged by the producers in order to be able to repeat the whole process in the next year. (At this stage of the theory it is not taken in account, that the iron industry needs iron ore and the tools become scrap after one year of use.) Sraffa writes: „There is a unique set of exchange-values which if adopted by the market restores the original distribution of the products and makes it possible for the process to be repeated“ [7].

In other words: prices must be such that the economy becomes sustainable. Therefore, they do not depend on individual tastes but on the technology applied in the production process. With p_1 the price of wheat and p_2 the price of iron we have $p_1 : p_2 = 1 : 10$.

6. A Model with Recycling of Iron Scrap

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In a second step Sraffa increases the harvest of wheat from 400 to 575 qr. and shows how prices and the profit rate can be calculated in this case.

It could be objected that the economy described by this model is not sustainable, because it produces scrap and needs iron ore, a non-renewable resource. In a green economy scrap would be partly recycled. Therefore, let us modify the model in the following way. We assume that the iron industry is divided into a branch which uses iron ore and a branch which collects and recycles scrap. We denote with e the efficiency of recycling ($e < 1$). This means that 1 ton of scrap yields a fraction e of a ton of iron. If the labour force is distributed 1 : 1 among the branches of the iron industry, then we have the following model:

280 qr. wheat + 12 t. iron → 575 qr. wheat + 12 t. scrap
60 qr. wheat + 4 t. iron → 10 t. iron
60 qr. wheat + 12 t. scrap → 12e t. iron

Now the farmers can offer two commodities on the market: wheat and scrap.

When the trade between the three branches is fair, each branch must have the same profit rate. We denote with p_3 the price of 1 t. of scrap and with r the profit rate. Then the prices and r must satisfy the equations

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$$(1 + r)(280\, p_1 + 12\, p_2) = 575\, p_1 + 12\, p_3$$
$$(1 + r)(60\, p_1 + 4\, p_2) = 10\, p_2$$
$$(1 + r)(60\, p_1 + 12\, p_3) = 12e\, p_2$$

In order to have 4 equations for the 4 unknowns, we may add $p_1 = 1$.

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The following table shows how the price of scrap depends on the efficiency of recycling. If efficiency is very low, the price of scrap is negative. Otherwise, wheat becomes cheaper in relation to iron, due to the fact that farmers can sell scrap in addition to wheat.

efficiency	profit rate	price of iron	price of srap	price of wheat
0,25	0,219	14,3	- 2,07	1
0,5	0,266	15,4	1,08	1
0,8	0,322	16,8	5,19	1

This example shows how Sraffa's theory can be applied to determine prices of waste in an economic system with recycling of waste.

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7. An alternative CO_2 - emissions trading scheme

The method of comparing present-day costs and future benefits of climate protection is fraught with many uncertainties and problems. Prof. Ekardt has said enough about this. Nevertheless, I want to mention that those economists who are members of the Intergovernmental Panel on Climate Change are well aware of these problems, which have been discussed in the Working Group III of the Second Assessment Report of the IPCC [8]. Three major lines of thought have emerged in the debate [9]. Two of them agree, that cost-benefit-analysis and discounting are appropriate in the context of climate-change, while they differ in the assumed level of the discount rate. The third line proposes to define long-term environmental goals and work out the optimal policy for reaching them. The idea of defining a long-term goal right at the beginning, without any unfounded assumptions on the needs and preferences of future generations, is also inherent in my proposal of an alternative CO_2 - emissions trading scheme. The long-term goal is:

CO_2 - emission = CO_2 - absorption

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Neoclassical economists have already proposed market-based instruments for attaining a reduction of emissions of greenhouse gases in developed countries. A well-known example is the Emissions Trading Scheme (ETS) of the European Union, operational since 2005. It established a uniform price of carbon for emissions from specific heavy industries in the 25 EU member states. Compared with subsidies paid in Switzerland for CO_2 reduction (between 56 and 70 CHF per tonne CO_2 , NZZ 18.9.2013), the price of emission permits in the EU trading scheme was very low, oscillating between 10 and 25 € per tonne of CO_2 [10]. The Stern Review admits, that „it has been difficult to ensure scarcity in the EU ETS market“ [11].

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The EU ETS deals with greenhouse gas emissions, but the role of forests in carbon sequestration is not considered. The Kyoto Protocol failed to mention climate forestry in its Article 12 on the CDM (clean development mechanism), but at the conference held at Bonn in 2000, afforestation and reforestation were made eligible under the CDM [12]. Still later, the topic has been addressed in a decision taken by the Copenhagen Conference on Climate Change (2009), which highlights „the importance of reducing emissions from deforestation and forest degradation, and the role of conservation, sustain-able management of forest and enhancement of forest carbon stocks in de-veloping countries“ [13]. But hitherto there is no economic theory which links CO_2 emission and absorption. A first step in this direction will be made now.

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CO_2 is not a scarce good, to the contrary, today it is too abundant. In the following a mechanism of reduction of CO_2-emissions is proposed, in which CO_2 is treated as a tradable commodity with a negative price. Of course, such a „trade“ is not possible in a neoliberal economy. In fact, powerful international institutions are needed which are able to compel the emitters of CO_2 to pay.

The idea of allowing negative prices was inspired by Sraffa. Part II of Sraffa's book begins with a chapter on joint production. This is any production which through the same process produces different things, useful goods as well as harmful by-products. It makes sense to study the economics of release and abatement of such by-products within the framework of a theory of joint production. Baumgärtner, Faber and Schiller have applied the neoclassical theory of joint production to environmental problems caused by the chemical industry [15]. Schefold has suggested to apply Sraffa's theory of joint production to the use of waste as fuel in power stations [16]. So far the issue of release and sequestration of CO_2 has not yet been studied as a problem of joint production.

In the following we assume that an intergovernmental institution has installed a trade between emittors and absorbers of CO_2. It will be shown that Sraffa's theory of joint production can be applied in order to calculate a negative „price“ of CO_2 which would determine the money transfer per unit of CO_2 from emittors to absorbers, in such a way that an equal rate of profit can be obtained by all parties. The main result is that such a trade would imply a drastic change of prices of many goods.

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In a first step we will not take into account the costs of fossil fuels and the rent on land. As a simple example, let us consider a circular production system consisting of 2 commodities W_1 and W_2 and 3 processes with constant returns to scale. Process 1 absorbs CO_2 and produces W_1. This may be traditional agriculture or forestry. The processes 2a and 2b produce W_2, the first with a low-carbon, the other with a high-carbon technology. W_1 is a necessary consumption good, whereas W_2 can be used both in production and in luxurious consumption, as is the case of many products of modern technology. Wages are regarded as consisting of the necessary subsistence goods for the workers, so they are not mentioned explicitly. It is assumed that a year's operations can be tabulated as follows:

process 1	$60\ W_1 + 30\ W_2 + 80\ CO_2 \rightarrow$	$100\ W_1$	
process 2a	$15\ W_1 + 25\ W_2$	$\rightarrow$	$50\ W_2 + 30\ CO_2$
process 2b	$10\ W_1 + 25\ W_2$	$\rightarrow$	$50\ W_2 + 50\ CO_2$

Table 1.

At these levels of activity, a final demand of 15 W_1 and 20 W_2 can be satisfied, and all CO_2 emitted is absorbed by process 1. But if CO_2 is not regarded as a harmful by-product, then obviously process 2b is more productive than process 2a which would not be activated. In order to satisfy the final demand for W_2, the level of activity of process 2b would be doubled and emission of CO_2 would increase to 100. Instead of the system of Table 1 we would have:
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process 1	$60\ W_1 + 30\ W_2 + 80\ CO_2$	$\rightarrow\ 100\ W_1$
process 2b	$20\ W_1 + 50\ W_2$	$\rightarrow\ 100\ W_2 + 100\ CO_2$

Table 2

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The equations for the prices p_i of W_i (i = 1, 2) and the uniform profit rate r would be:

$$(1 + r)(60p_1 + 30p_2) = 100\ p_1$$
$$(1 + r)(20p_1 + 50p_2) = 100\ p_2$$

With $p_1 = 1$ the solution is:

$$r = 0.25 \qquad p_1 = 1 \qquad p_2 = 0.67$$

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Now we assume that there is a trading scheme, in which emission permits are sold by the operators of process 1. Furthermore, we assume that there is a uniform profit rate r for all processes. Formally, we treat CO_2 in the same way as the commodities W_1 and W_2. Whether p_3, the „price“ of CO_2, will be positive or negative is not known in advance. We assume that the payments for CO_2 sequestration are made at the beginning of each year. Then the equations for prices and profit rate are:

$$(1 + r)(60p_1 + 30p_2 + 80p_3) = 100\ p_1$$
$$(1 + r)(15p_1 + 25p_2) = 50\ p_2 + 30\ p_3$$
$$(1 + r)(10p_1 + 25p_2) = 50\ p_2 + 50\ p_3$$

With $p_1 = 1$ the solution of this system is: (slide 29)

$$r = 0.25 \qquad p_1 = 1 \qquad p_2 = 1.5 \qquad p_3 = -0.3125$$

This result shows that an emissions trading scheme, which includes CO_2 absorbing processes, can make a low-carbon technology as profitable as a high-carbon technology. But this requires a substantial change of the price system, in this case from $p_2 = 0.67$ to $p_2 = 1.5$. Those commodities, which are produced with high CO_2 emissions, will be much more expensive than in an economy without trading of emission permits.

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8. A steady-state economy with full employment

The defenders of economic growth argue that zero growth would entail the loss of many jobs. Surely, it may be that some branches become smaller and must reduce their personal, e.g. the auto industry, but in other branches new working places can be created. This can be illustrated with the same model we used in section 5. Consider again an economy with only two products: wheat and iron (tools). Assume that there are 24 workers in farming, 12 workers in the iron industry, that the wage consists in 10 quarters of wheat, and that the activity of 1 year can be tabulated as follows:

	280 qr. wheat	+ 12 t. iron	+ 24 workers →	480 qr. wheat
	120 qr. wheat	+ 8 t. iron	+ 12 workers →	24 t. iron
sum:	400 qr. wheat	20 t iron	36 workers	

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This economy produces a surplus of 80 qr. wheat and 4 t. iron, which is 20% of the input. If all the surplus is invested in production and labour force and land are abundant, then growth with a rate of 20% is possible. In the second year employment would grow from 36 to 43 workers.

An alternative to permanent growth is the following adjustment:

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reduce the activity of the iron industry by 25% and create a new branch of services (education, care, arts) with a wage sum of 110 qr. wheat. Then you have the following steady-state economy:

	280 qr. wheat	+ 12 t. iron	+ 24 workers→	480 qr. wheat
	90 qr. wheat	+ 6 t. iron	+ 9 workers→	18 t. iron
	110 qr. wheat		+ 11 workers→	services
sum:	480 qr. wheat	18 t. iron	44 workers	

This economy satisfies the basic needs of the workers (440 qr. of wheat) and the conditions of reproduction (40 qr. wheat for seed, 18 t. iron for tools), it rises employment from 36 to 44 workers and in addition it brings social and cultural improvement.

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John Stuart Mill was right, when he wrote: „It is scarcely necessary to remark that a stationary condition of capital and population implies no stationary state of human improve-ment. There would be as much scope as ever for all kinds of mental culture, and moral and social progress“ [17].

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