

# Issues related to the conceptual changes and perception difficulties of scarcity

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*Abstract* – Scarcity is a basic concept in modern economics. This article briefly describes the changes that the various theoretical schools have made during the past 250 years in this concept until the emergence of its current notion. Formerly, scarcity was defined on the basis of production. Later, this notion was completed with an increasingly dominant definition on the basis of consumption. This dominance is currently seen gradually weakening. By now the equilibrium price, based on the general equilibrium theory of Walras, has become the benchmark and best definition of scarcity. Actually, it includes the scarcity notion of both production and consumption, although the level and impact of the two cannot be clearly distinguished. It means that prices and the underlying market mechanisms alone cannot – even under the best conditions (e.g. in case of perfect competition) – prevent the stock of certain resources from dropping below a critical level that may substantially hinder the successful achievement of the future goals of economic players or society as a whole. Apart from market mechanisms, there is a need for the proper operation of other – such as ethical or bureaucratic – coordination mechanisms to enable economic players to timely adjust to, or to avoid altogether, the emergence of bottlenecks.

*Index Terms:* coordination Mechanism, General Equilibrium, Macroeconomics, Prices, Scarcity, Uncertainty

## I. INTRODUCTION

Easter Island, extending on an area of 171 km<sup>2</sup>, was reached and populated by settlers around 900 A.D. [1] At that time it was an island with dense subtropical forests and abundant tree stock. When, some 800 years later, Dutch explorer Jacob Roggeveen “discovered” the island on Easter Sunday 1722, he portrayed it in his log as a treeless place with undernourished population. [1] At the time of its first occupation by settlers, Easter Island was a nesting habitat for 6 land and 25 marine bird species. However, these gradually disappeared from the island – and thus from the diet of islanders –, just like most other fish, dolphin and clam species from the neighbourhood. The only things left were chickens and rats. [1] This is how islanders became the prisoners of their own island. In lack of forests, they were unable to make robust canoes that would have allowed them to venture out into open sea either for fishing or for finding a

new place to live. From its likely peak of 15,000 people, the island’s population had dropped to about 2,000 people during a few centuries by 1722. [1] If white explorers had not bumped into the island at that time, about a hundred years later the place would probably have been deserted as a result of human extinction.

Students frequently asked Professor Diamond questions like “What did the Easter Islander who cut the last palm tree say while he was doing it? Was he aware of what he was doing? How on earth could a society so obviously destroy its own living conditions?” [1] Professor Diamond also asked himself: how often did people wreak ecological damage intentionally, or at least while aware of the likely consequences? How often did people instead do it without meaning to, or out of ignorance? He also wondered whether – if there are still people left alive a hundred years from now – those people of the next century will be as astonished about our blindness today as we are about the blindness of the Easter Islanders. [1]

The inhabitants of Easter Island should have paid attention to the fact that the availability of the commodities used and consumed by them was not only limited – living on a small island, they were obviously aware of this fact with regard to land resources – but was prone to termination once and for all. They should have perceived that the quantity of certain commodities was not only diminishing but would end irrevocably. Apart from such perception, they should have made preparations for, or made efforts to avoid, the occurrence of this fact. Both the perception and the resulting reaction are critical for the survival of a community or society. We have no means to establish when exactly the Easter Islanders were faced with the fact that their forests might disappear and whether they tried to do anything against it or to prepare for a life without forests. No matter what they did, it was a failure. Certainly, if they had recognized the importance of the forest issue earlier and if they had restructured their logging practice on an increased forest area, the chances of success would have been greater for them. Mostly because – even after an eventual series of failed attempts – the islanders still would have had enough trees to leave the island the way they arrived, or to bring timber or help from other islands. Therefore it is crucial for a society to be well aware of the actual quantity of its major commodities. The more precise information a society has in this regard, the more options are available for it – in terms of either time or means – to take the right actions in order to properly address the issue of the diminishing quantity of certain commodities. The success of such actions is never

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guaranteed. However, success is more probable if the members of a community are faced with the actual quantity problems of their critical resources in an early stage. As far as resources are concerned, the problems are caused not by their abundance but by their scarcity. That is why the recognition of the actual level of scarcity is a key to the survival of a community. Naturally, it is not required for the individual members of a society to know precise figures expressed in physical units: perception will always differ somewhat from the actual situation. Nevertheless, the smaller the error in the perception of scarcity, the greater the probability that the community will perceive the actual situation in an early stage, increasing the number of options available for action and the chances of successfully achieving its goals in the future.

## II. ADAM SMITH'S DEFINITION OF SCARCITY

Working in the second half of the 18th century, Adam Smith did not and could not really experience that, no matter how it is perceived, the scarcity of a commodity might hinder development or long-term survival as far as the operation of the national economy is concerned. Nevertheless, even Adam Smith dedicates much room in his famous book [2] to the description of the natural resources, mining and agricultural products divided into three classes according to scarcity in the Chapter of "Different effects of the progress of improvement upon three different sorts of rude produce". His first class includes the commodities that are considered actually scarce and the multiplication of which is not in the power of human industry. Therefore the first class includes only a few things such as rare animal species, gems, precious metals or other special mineral resources but excludes, among others, arable land: their disappearance would not substantially affect societies.

The second class contains commodities, the quantity of which can be increased or decreased by human industry in proportion to the demand. Adam Smith includes here the useful plants and animals, the quantity of which is diminishing, as a result of their usefulness to humans, until a certain level of scarcity where the quantity stops diminishing anymore as the resulting higher prices will induce humans to produce greater quantities. [2] It is interesting that arable land is still not considered by Adam Smith as a scarcely available commodity despite the fact that in several parts of the book he discusses in detail the process, causes and consequences of the deterioration and depletion of arable land. As a matter of fact, he was of the opinion that soil fertility could be restored through human activity and care. [2]

Also, the author did not doubt the success of human efforts in maintaining or increasing the quantities of the commodities listed in the third class, although he considered the relevant time schedule uncertain and did not think that the increase of the results could be unlimited. Typically, these are intermediate products such as raw hide, wool or milk. [2] As to fishing, Adam Smith notes that maintaining, or eventually increasing, the fish quantities would be possible only with

increasing uncertainty and increasing expenses. In fact, the supply of ten times more fish would not be possible without employing more than ten times the original expenses. [2] According to Smith's classification, minerals used as raw materials also belong to this third class of commodities where the efficacy of the industry is either limited or uncertain to maintain or increase their quantities. Adam Smith is obviously aware of the limited and finite availability of minerals on earth. Yet, as a person devoted to human ingenuity, knowledge and skills, Adam Smith considered minerals as a commodity of practically unlimited abundance. A country's ability to benefit from this abundance depends on two circumstances: the power of purchasing and the fertility of the mines operating at the given time. Typically, this group is limited by the income restraints resulting from the power of purchasing and by the uncertainty resulting from the mismatch between the rate of discovery of new mines and the rate of depletion of existing mines. [2] It is clear that the quantities of "rude produce" (whether they are agricultural or industrial raw materials) are not considered by Adam Smith as an actually threatening limitation of economic development despite the fact that he unambiguously recognized the law of diminishing marginal utility in economy and the finiteness of arable lands and minerals that may create contradictions along with population growth. Although the settlement of such contradictions may not always be perfect and problem-free, the mechanism of the "invisible hand" and human skills may ensure economic development in the long run. All that is said by Adam Smith already in the "Introduction and plan of the work": the development of an economy is determined by the skill, dexterity and judgment of the economic players and not by the quantity of available commodities or by the quality of other conditions. [2]

## III. DAVID RICARDO'S APPROACH

David Ricardo's book titled *On the Principles of Political Economy and Taxation* was published in 1817. As mentioned in the book's Introduction, he thoroughly studied the works of Smith and Malthus, and agreed with most of their content. When he did not agree with any statement or substantiation, he said so in his book.

Similarly to Smith, Ricardo considers scarce such commodities, the quantity of which cannot be increased by labour and therefore their supply cannot be substantially increased in the future. However, these commodities play an insignificant role in the economy: they do not limit the economic activities in any way. [3]

Ricardo's theory of rent is based on the notion that land and minerals are not unlimited in quantity and uniform in quality. [3] The *limited availability* (including, in particular, the *tangibly limited availability* as experienced by farmers) is important because otherwise the variable quality of the given commodity would not pose any difficulty: farmers would always choose the absolutely highest quality. In lack of such abundance, they are forced – in order to meet excess demand

– to take commodities of poorer quality into production. [3] As the use of commodities of poorer quality leads to diminishing marginal utility, it generates and augments rent in Ricardo's theory. [3]

According to Ricardo, rent has three necessary conditions in terms of the relevant commodity. Firstly, *tangibly limited quantity*; secondly, *variable quality*; thirdly, *monopolizable* nature. Ricardo also mentions the contradiction that – obviously because of the regularly repeated excess demand for food caused by population growth – more fertile lands may generate increasing profits, while their fertility keeps deteriorating in the meantime. In his view, rent comes not from the yield but from the selling price of the yield. This is the price that creates harmony between consumption and supply. However, Ricardo – apart from stating a similar opinion with regard to minerals – calls the attention to other natural factors not considered by him as limited, such as air or yeast present in nature. [3]

In Ricardo's theory, scarcity is caused by the fact that – as a result of excess demand – we are forced to use also commodities of poorer quality or that, at the same time, commodities of higher quality may become poorer due to their excessive use. In this case the law of diminishing marginal utility applies continuously to any individual parcel of arable land of any quality (due to the continuous deterioration of fertility) and to all arable lands (due to the call of areas of poorer quality into cultivation). When demand is rising (e.g. due to population growth) or stagnant, scarcity will necessarily increase unless *supplementary capital investments* are made regularly to counterbalance the yields dropping constantly as a result of diminishing marginal utility. It means that scarcity does have a level. Also, this level may be reduced but only at the expense of constant supplementary efforts.

#### IV. LEON WALRAS AND 'RARETÉ'

Leon Walras did not follow in the footsteps of the great classical authors either in addressing the questions of the social distribution of income or in search for a definition of the intrinsic value of commodities. When *Elements of pure economics*, considered as his main work, was published in 1874, Europe was living a real economic "golden age". Neither the distribution of income, nor the definition of value represented such imminent tasks as the definition of market price or the clarification of the operating mechanisms of markets seen gradually interlocked at international level. Therefore it would not be true to say that Walras forgot about the scarcity of commodities. In fact – although he is considered by his successors as a great builder of the theory of marginal utility – he repeatedly and consequently uses the notion of the scarcity of commodities with regard to the procedures of market exchanges. However, his notion of the scarcity of commodities does not mean that such basic commodities become less accessible to society but that there is a limitation in the quantity of commodities available for the consumer, who is in the centre of the market procedures.

According to his definition, social welfare means all – either material or non-material – commodities that are scarce i.e. that are useful but available in limited quantities. [4]

While in Ricardo's theory the diminishing quantity and quality of land and natural resources represents the primary bottlenecks for the society, Walras replaces such natural limitations of social level with economic limitations of individual level. It means that, in this particular case, scarcity may be reduced not at social level but at the individual level of economic players. Yet, the multitude of such individual levels making up a closely integrated system is embodied in the form of a community called society.

Walras classifies "things" as follows: there are useful things that are limited in quantity but that can be manufactured, multiplied or reproduced by the industry. Such things are worth producing until it is possible with normal and systematic efforts. There are things (e.g. weeds) that are not harmful but not useful to humans. These things do not make us act, except when occasionally we try to benefit from them. There are useful things that are not limited in quantity. We must be convinced of their usefulness but we need not think about how to increase their quantity. Finally, there are useful things that are limited in quantity. These are considered by Walras as scarce commodities, though for him it is only the name of a category. In this regard our purpose may be to ignore the limitations as much as possible. [4] Walras says that scarcity is a natural feature of certain economic commodities (i.e. those with limited quantities). Nevertheless, he tries to specify the level and the practical measurement of scarcity, to see how the economic players are affected by the limitations of quantity or to examine the impact of the useful features of a commodity on scarcity. Walras pays special attention to this issue. All the more so that, not wanting to change or overwrite the already available definition of scarcity (inherited from Smith and Ricardo), he introduces a new term for his understanding of scarcity: it is *rareté*.

*Rareté* is determined on the basis of the subjective judgment of the consumer/user that is assigned to the purchased, kept or consumed quantity of the relevant commodity. Walras says that exchange value, as a relative term, is similar to weight and *rareté*, as an absolute term, is similar to mass. For example, if one of two economic commodities – (A) and (B) – ceases to be useful, or continues to be useful but ceases to be limited in quantity, its scarcity will not apply anymore, leading to an end of its exchange value. In this case the exchange value of the other commodity would also end but it would continue to be scarce; it would still remain scarce more or less and each of its users would have their own *rareté* value for such other commodity. As a result of each economic player's individual needs and mentality, *rareté* is something personal and subjective, while the exchange value is a physical and objective category that can even be observed. [4] Applicable to scarce commodities, *rareté* is defined according to the consumer's own perception of usefulness. However, as the *rareté* of a particular commodity is quantified not as a result of the usefulness or quantity limitation of other commodities, it is not a relative notion. Walras wanted to find out how the *rareté* of a particular commodity could be

identified and how to express the many subjective rareté values in the form of a single – general – rareté. According to his findings, the market exchange values of a particular commodity are proportional to the rareté values. [4]

As far as the consumer is concerned, bottlenecks may be cleared in two ways. On one hand, a utility maximization should be performed by the consumer pursuant to Gossen's second law to achieve a greater fulfilment of needs at the given level of income. On the other hand, the income should be raised to the highest possible level by selling the consumer's factors of production to contractors. In fact, the contractors create a demand in line with their sales of economic commodities. Eventually, in a general equilibrium deemed desirable by Walras, the prices prevailing on the market of economic commodities will enable households to use their income obtained from the market of factors of production for the purchase of exactly the same quantity of economic commodities as offered by the contractors for sale. Similarly, the consumers will offer the contractors exactly the same quantity of factors of production as the contractors wish to purchase.

However, due to their subjective nature, the individual rareté values of the commodities may range on a wide scale. Yet, in a general equilibrium, the rareté values assigned to the quantities of commodities consumed or kept by a player will become – through a simultaneous “tentative” auction mechanism – the same for the market unit of all commodities consumed or kept by the player and for all players, while each market reaches a state of equilibrium. In the case of such general equilibrium the market prices of the commodities will precisely express the rareté values of the commodities: “the equilibrium prices are identical with rareté”. [4] At the same time, when equilibrium prices are reached, the perfectly competing producers will sell the commodities precisely at production cost. Therefore rareté, expressed in equilibrium prices, will merge and interlink, in terms of both expenditures and consumption, the main production and consumption information of the particular commodity without any distortion. Actually, when a general equilibrium is achieved and maintained, the prices can precisely and simultaneously convey the usefulness and quantity limitation of each commodity to each economic player. In a non-equilibrium situation the constantly changing prices are nothing but snapshots during the tentative auction, which means that rareté is shown in the prices undervalued for certain commodities and overvalued for others.

Obviously, in this general equilibrium model, the privileged consumers must properly ensure, through reasonable consumption, both the supply and (indirectly) the demand of the factors of production. In case of equilibrium the factors of production (and the economic commodities) show the same supply and demand quantities. It means that there is no scarcity because there are no more bottlenecks in sight. The Walras era did not give warnings as to the scarcity of the factors of production in everyday practice. Actually, just the opposite happened: the economic players perceived an abundance of the factors of production, while in the case of economic commodities they thought that the onset of

equilibrium (tangible reduction of scarcity) was just a matter of time.

#### V. THE LAW OF INCREASING RELATIVE COST BY PAUL SAMUELSON AND WILLIAM NORDHAUS

A coordinating Basically, Samuelson and Nordhaus start studying the issue of scarcity from the fulfilment of human needs and not from the finite factors of production. The difference is not small as, roughly speaking, the authors start out from a family's wish for supper and then examine the supplies available in the pantry. They could do it the other way round, that is start out with examining the food stored in the pantry and then determine how it could be used to satisfy the family needs. According to the authors' opinion, scarcity would not be present if all commodities were free and if there were no limits in the fulfilment of all consumer needs. [5]

The authors do not conceal that the ability of the individual players to entirely fulfil all their needs is hindered not by their personal opportunities but by the tangibly finite quantity of resources available for the society. The limited nature of the resources suitable for the production of various commodities forces the society to choose among the relatively scarce commodities. [5]

However, Samuelson and Nordhaus seem to approach scarcity not from the direction of expenditures but from that of output: the economic player is unable to produce commodities in unlimited quantity or to achieve the unlimited output of any commodity. The reply to Samuelson's question of “What?” necessitates a decision: choosing an alternative as to what quantities of which commodities should be produced by the economic player or by the entire community called society in Samuelson's dictionary. [5] As a result of this approach, Samuelson and Nordhaus initially present the economic scarcity not as a combination of bottlenecks emerging on the side of expenditures but rather as a maximum combination of output representing the complex of the economic player's or society's “boundary of production opportunities”. In this regard economic scarcity is presented only as a situation where, despite full-time employment, the production of a certain commodity requires the renouncement of a certain share of the production of another commodity. [5]

It is clear from Samuelson's approach that the root of the standard of living, never thought high enough, lies indirectly in the finite quantity of society resources, although the surface shows only output scarcity resulting directly from the resource limitation of the players. The priority of Samuelson's output-based scarcity approach is shown in the distinction made between the “poor country” and the “developed country” with regard to the boundary of production opportunity. Endowed with the same natural resources as the undeveloped country, the developed country has greater production opportunities for all commodities but mostly for non-food commodities. [5] As a second step, scarcity on the side of expenditure is presented by the authors in the “law of diminishing returns”, approaching the issue only in part and from the logical direction of output. Where certain resources are scarce and

finite – e.g. arable land in societies that have already passed the settler period defined by Samuelson – this fact has a substantial impact on the boundary of production opportunities. In particular, in the case of commodities requiring a relatively greater use of arable land the expenditure growth taking place through “economic development” – i.e. labour in Samuelson’s example – increases the output in a gradually smaller rate than in the case of using the relatively more abundant resources. The law of diminishing returns means that the output coming from an unchanged area of land cannot keep pace with population growth.<sup>1</sup> [6]

It should be noted that, as a follow-up to the above example, the “law of increasing relative costs” is determined so that the scarcity of lands suitable for good production and the law of diminishing returns will induce higher relative costs as a rising share of industrial articles must be sacrificed in order to achieve a growth in food output units, while operating (efficiently) along the boundary of production opportunities (Figure 1).

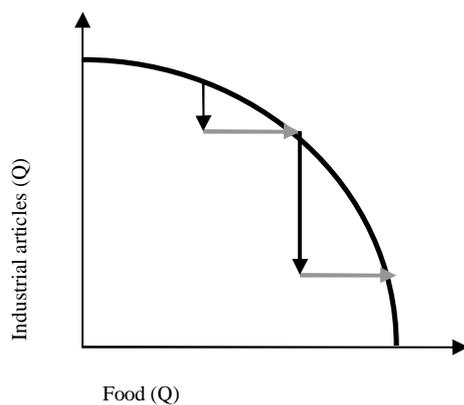


Fig. 1. The law of increasing relative costs according to Samuelson and Nordhaus

In terms of scarcity, boundary of production opportunities, law of diminishing returns and law of increasing relative costs it is important to note that the authors are consistent in their use of physical units to express the costs and the possible yields related to the individual commodities. This is how they wish to avoid the monetary unit’s impact of information concentration and information loss already referred to by Hayek in his famous tin example.<sup>2</sup> [7]

This definition of the law of increasing relative costs is especially interesting as it includes the foundations of defining the expenditure-based notion of scarcity. On top of that, it is not the definition of default scarcity – tangibly finite quantity – but that of “increasing scarcity” (diminishing quantity).

<sup>1</sup> Eventually in agreement with the famous theory of Malthus, in which the growth of population is exponential but that of agriculture is only linear.

<sup>2</sup> Based on the market price of tin, an average producer or buyer cannot decide whether the price rise is the result of mine depletion or demand growth.

It means that a commodity – considered as a resource – is deemed as – increasingly – scarce in social terms if the society has to sacrifice the increasing quantity of a commodity in order to obtain an additional unit of another commodity to be produced (also) by it. Therefore a society (or a member of it) can be sure of perceiving the scarcity of the available quantity of a commodity when such society (or member of it) is forced to assume rising relative costs (expressed in physical quantity) to obtain each additional unit of the said commodity. Obviously, if the input commodity becomes a scarce commodity as a result of the rising relative costs of the output commodity then such output commodity must also be considered as scarce because its quantity becomes limited, too. When this output of limited quantity is the input of another output then it may be considered as scarce under the theory of Samuelson and Nordhaus. If such output of limited quantity is an economic commodity, its consumption produces only “utility” instead of physically measurable results. Therefore, unlike the resources owned by the consumer, this economic commodity cannot be considered as scarce in this regard. The notion of scarcity used by the authors is “reflected back” on each commodity through the rising relative cost of the other commodity produced by it.

This definition of scarcity can avoid problems related to the decoding of price information because the physically measurable quantity of sacrificed commodities carries the scarcity information more precisely. Nevertheless, given that the scarcity of a commodity is defined in comparison with the efficiency of producing another commodity, this may lead to a new problem as shown in Figure 2.

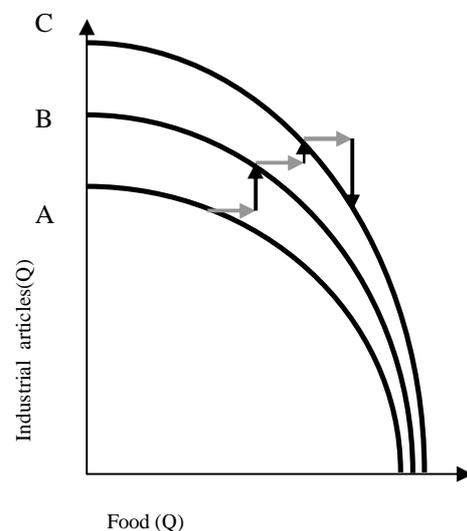


Fig. 2. The law of rising relative costs shown in a developing economy with improving efficiency, particularly in terms of industrial articles.

If the efficiency of producing industrial articles improves in the function of time (A-B-C curves), there is no need to renounce the former industrial article during a certain development phase in order to obtain an additional food

product unit. Arable land would not become a scarce commodity in this case. However, it is clear from curve C that arable land is actually a scarce commodity as food production can be increased only at the expense of a renouncement.

Although this confirms the theory of Samuelson and Nordhaus, it is evident that in certain development phases the economic players may perceive the reduced, or even terminated, scarcity of certain resources.

## VI. CONCLUSIONS

Adam Smith treated scarcity as the problem of economic systems routinely manageable with skill and dexterity, while a generation later David Ricardo handled the issue more carefully. Actually, he considered rent as an indicator of scarcity. He also had a solution worked out for scarcity but it involves an increasing level of supplementary capital investments and temporary accommodation difficulties because the right timing of the solutions is uncertain. In Ricardo's theory, however, certain commodities – that cannot be monopolized and therefore will not generate any rent – may also become scarce. Yet, in lack of rent, there is no social accommodation to the situation. In his theory, Leon Walras attributed special importance to the prices prevailing in periods of general equilibrium also for determining the actual level of scarcity or, according to his terminology, rareté. In fact, such prices show the actual level of scarcity and supply reliable information for the economic players. However, as the occurrence of a general equilibrium is, to say the least, very rare in an economy, Paul Samuelson and William Nordhaus looked for and found such an indicator of the presence and level of scarcity that can supply reliable information also during the non-equilibrium periods of an economy. Nevertheless, pursuant to the law of rising relative costs, the evaluation of such information in a developing (i.e. non-stationary) economy may easily lead to opposite conclusions and, as a result, the economic players may perceive an abundance of actually diminishing resources. Therefore it can be stated that market mechanisms, the related prices and quantities or their ratios are unable to supply sufficient information for a society about the group of scarce commodities and the eventual increase of their scarcity.

What can be the solution? Due to space limitations, this article shows only a direction for further thinking. The activities of economic players in a society and economy are influenced not only by market mechanisms but also by other coordination mechanisms. Professor Janos Kornai have identified [8] several of such mechanisms including bureaucratic, ethical, family-based and aggressive coordination mechanisms. These mechanisms should supplement the market coordination mechanisms so that the economic players will obtain an early and realistic picture about the scarcity of their commodities. This way they may get a relatively good chance for adapting to the situation or for the avoiding of any further increase in the level of scarcity.

As Easter Island lacked any monetary system and therefore, even if there was a period of general equilibrium, no rareté could be experienced by the islanders. In lack of prices, they had to use exchange values and exchange ratios for orientation. However, despite the circumstances, the law of increasing relative costs may have remained hidden before them as long as their society and economy produced an adequately high rate of development. Facts show that their coordination mechanisms worked insufficiently. These mechanisms did not supply them with the right information and therefore the adaptation of their institutional system did not start in time.

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