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Infrastructure of the Market Economy

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Abstract

Infrastructure is the economic growth framework of the market economy. The missing comprehensive approach to infrastructure corresponds to the practiced neglect of the long-term policy objective of economic growth in the economic order of the German social market economy since its creation after World War II. Starting from Jochimsen's distinction of material, institutional and personal infrastructure, infrastructure policy as an indirect approach to economic growth policy is suggested. The main reason for this approach is our lack of knowledge about the process and results of future economic growth.

With respect to the three categories of infrastructure selected aspects are discussed. Concerning material infrastructure now a definition is presented that can be integrated into a general definition of infrastructure. Regarding institutional infrastructure, after the presentation of relevant terms (rule, order, institution, organization) the analysis of important implications of institutional economics and its integration into constitutional economics follows. As to personal infrastructure, a quantitative component (population) and a qualitative component (human capital) are consistently distinguished and their determinants systematically elaborated. The determinants of human capital are education and learning from experience, research and development as the production of new knowledge or technological progress (inventions, innovations and diffusion of innovations). All of these considerations can be brought together in a general definition of the infrastructure of a market economy so far missing. Basically, this definition refers to a number of specifically characterized individual economic agents interacting under secure living conditions according to certain rules in the presence and the future.

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The analysis of infrastructure in a growing economy essentially leads to the result that personal infrastructure, especially human capital, is most important for structuring future economic growth. In the growth process, material and institutional infrastructure depend on personal infrastructure which in turn is influenced by material infrastructure (producing existence goods and services) and institutional infrastructure (e.g., population and education policy). Thus we discover infrastructure of the market economy to constitute a system in the sense of systems theory. Personal infrastructure of today may determine economic growth in the medium, long, and very long term, whereas institutional and material infrastructure indicate, as a rule, to have shorter reference periods. Due to its character, material infrastructure must be controlled and permanently maintained within the medium term. What is needed is a comprehensive and balanced time-oriented infrastructure policy approach, observing the natural environment, to settle the growth problems of the market economy. This approach would result in a revision of the present economic order of the social market economy.

Keywords: infrastructure, market economy, economic growth, existence goods, economic order, institution, population, human capital, infrastructure policy

JEL classification: D 78, J 11, J 24, O 10, P 11

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I. Economic Growth of the Market Economy

The concept of the social market economy in the long run Infrastructure takes on an important, however, not much understood role in shaping economic growth of the market economy, as will be demonstrated with reference to the economic order of the German social market economy (Section I). In order to be able to formulate a comprehensive general definition of infrastructure, selected important aspects of the categories of infrastructure are discussed, referring to Jochimsen's distinction of material, institutional and personal infrastructure (Section II). Subsequently, we shall analyze the relationships of these infrastructure categories to each other in the growing market economy (Section III). Important results for infrastructure policy will follow (Section IV). Concluding remarks emphasize again some essential points of the paper (Section V).

Not many people observe that their existence has also a long-run dimension, except for the obvious short-term perspective of life. On the one hand, there will be the remaining years of a person's lifetime, the number of which will be the bigger, the younger the person is right now. On the other hand, in the case of a mother who wishes her children and grandchildren to experience a fulfilled life in the future we easily deal with a period of about one hundred years. It is true, in the long run we shall be dead, but our children will live -- an important fact to be considered in many respects. One of them is formed by the long-term implications of the economic order (*Wirtschaftsordnung*) of a country of which it is assumed that it deserves its name, not being a simple description of the results of inconsistent economic policies of the country.

The object of *order policy* is the design of ethical, legal and institutional conditions regulating the behavior of economic agents and political decision-makers, i.e., the economic order on the one hand (economic order policy) and the political order on the other hand (state order policy) (cf. Cassel 1988, 313).

The *economic order* of a country is the entirety of all rules and norms that constitute the framework of economic activities and their organization, i.e., the order of the economy. By economic order policy (cf. Grossekkettler 1997, Vanberg 1997, Pies 2000) that requires thinking in a system the given order will be changed, in contrast to process policy that interferes with economic processes taking place within the economic order. Germany's economic order

is called "*social market economy*" (basic texts are Koslowski 1998, Hasse/Schneider/Weigelt 2005). According to Müller-Armack (1965) this term means that it is necessary to combine the principle of freedom in the market with the postulate of social equity (on the inherent problems cf. Böbel 1988, Streit 1998).

According to modern economic thinking, the concept of the market economy based on the principle of competition is the only economic order that realizes not only the greatest possible individual freedom, but also stimulates the individuals' economic performance to be harmonized with the interests of other economic agents, respectively. Correspondingly, the social market economy may be understood "... as a programme in the ... context of liberal philosophy, a programme of how to shape the political and the economic order, culture, press, higher learning and science – to mention just a few topics where freedom is important and where institutions can be shaped according to the essence of liberalism" (Watrin 1998, 17). The central idea of this variety of market economy is personal freedom primarily as a value in itself and then as an instrument of increasing the efficiency of economic activities in order to stimulate economic growth (cf. Woll 1992b, 51-55). Necessary prerequisite is a competition order to be created and protected by economic policy (cf. Cassel 1988). In order to avoid the emergence of an inconsistent economic order by pursuing isolated interventions and ad hoc-measures, economic policy ought to follow specific constitutive, regulative and supplementary principles (cf. Eucken 1955; Grosseckler 1987, 12a; Cassel 1988, 330). Sectors of the economy to which -- as is generally believed -- some of these principles cannot be applied are called order policy exclusion domains. Two examples are agriculture and network industries such as energy provision or railroad transport which often are supposed to need state regulation.

With regard to the postulate of social justice, a general understanding has always existed that in everybody's life there may be periods in which one cannot participate in a market process (e.g., childhood, unemployment, sickness, and old age). The representatives of the social market economy have been convinced that the growth performance of the economy would overcompensate the welfare losses caused by the negative impacts of redistributive measures or social policy. In addition, starting from the ideal of a free society, this assumption has been thought to be justified by the introduction of liberal principles shaping the organization of the social security system wherever possible (cf. Watrin 1998, 20-22; Breyer 2008). Examples

can be found not only in the field of health care, but also in other fields such as housing and education.

Deficiencies of the social market economy Until today a number of inadequacies of the social market economy as realized have emerged. Firstly, the state did not act as strongly and limitedly as expected for many years. Despite all promises of the politicians as to the reduction of public activities the obligations of the state have steadily increased over time. Secondly, already the concept of the social market economy implies deficiencies that turn up in political decision-making. On the one hand, the competition order is incomplete (e.g., permanent attempts of cartelization); many policy measures are not conform to the market order. On the other hand, to a substantial extent the allocation and distribution systems of the economy have become less compatible to each other due to the growing extent of public measures of redistribution and the aggressive attitudes of trade unions (cf. Hamel 1994, 117-120). Thirdly, the long-term economic consequences of government policy failures, decisions and activities have frequently been neglected so that a long list of policy sins has come into existence (cf. Donges et al. – Kronberger Kreis 1997, 86-137). Fourthly, the institutional preconditions for the successful implementation of the social market economy at the political level have always been insufficient so that economic order policy has nearly been crowded out by political discussion and decision processes (cf. Cassel/Rauhut 1998, 13-24). Thus, it is not amazing that the social market economy as economic policy guide as well as economic reality has lost much of its former lustre and its attractiveness for other countries. Its organization on the corporatist model -- a tripartite system preserving the interests of established companies, large trade unions and an interventionist government -- calls for reforms (cf. also Phelps 2000, 2007). To say that the idea of the social market economy has already been given up means the lack of insight that there is no alternative concept, except for accepting a chaotic (sometimes euphemistically called "pragmatic") economic policy.

The worst weakness of the social market economy in practice has been the very controversial general attitude towards the phenomenon of *economic growth* defined as the change of per capita real income (cf. Frey 1979, 11-35; Nitschke 1992, 83-86). The approaches to economic growth have often been ambiguous, imprecise and impractical. To a considerable extent, this statement is also true of the reference to the objective of "steady and appropriate growth" in the German "Law on the Formation of a Council of Economic Experts for the Evaluation of Economic Development", 1963 (Gesetz über die Bildung eines Sachverständigenrates zur

Begutachtung der gesamtwirtschaftlichen Entwicklung) and the "Stability and Growth Law", 1967 (Gesetz zur Förderung der Stabilität und des Wachstums der Wirtschaft) (cf. Oppenländer 1988, 184-186). There have been different standpoints on economic growth for quite some time (cf. Mishan 1977). Some people have totally neglected long-term growth-inherent structural changes of the economy, attempting to maintain the existing state of affairs. Some have rejected economic growth, claiming that it dehumanizes the spheres of labor and exploits the natural environment. Others have taken economic growth and its structural changes to be the result of market forces characterizing a free economy so that measures of direct growth policy such as a public investment policy are absolutely misleading, inefficient and thus unnecessary, particularly since the belief that increased future output will easily be "makeable" turns out to be a myth. Nowadays, socialists tend to have no trust in future economic growth guaranteeing a higher national income in which also workers may participate, probably under conditions of less equity; instead today they give priority to the postulate of social justice, cast against the background of equalitarianism, demanding right now a bigger share of the given social product and thus making economic progress difficult (cf. Kirsch 2005). More conservative forces of society are of the opinion that growth is necessary to increase economic welfare of all economic agents and to reduce social conflicts among them, also by redistributing income and by all kinds of reforms; therefore they plead for public support of education and research, technological progress and innovations.

This unconvincing diversity of approaches to economic growth corresponds to the accounts on the development of the social market economy during the last sixty years which pay little attention to growth phenomena. In the programs of German political parties essentially three growth-relevant fields of political activity in the seventies were mentioned: neglected problems such as public assistance for housing and health care, structure policy (particularly public policy of material infrastructure) and framework planning (Rahmenplanung) , e.g., maintaining international competitiveness (cf. Schröder 1971, 162-167, 373-385). In the economic literature, the main emphasis has been on the implications of competition policy in the context of economic growth, often omitting a systematic reference to the given economic order of the social market economy (cf. Schneider 1970, Dürr 1977, Giersch 1977). In Cassel (1998) only the economic effects of population change, the impacts of education and research as well as environmental issues of the market economy are dealt with. Also only few references to long-term growth aspects can be found in Lenel et al. (1997) and Hasse/Schneider/Weigelt (2005), a dictionary of the social market economy.

In view of the opinions on economic growth sketched above, economic growth has never been considered as a purpose in itself. The justification and detailed meaning of the growth objective were controversial for a long time (for an overview see Woll 1968). Again and again, the debate has been stimulated by references to goal conflicts between the long-term objective of economic growth and the mainly short-term objectives of stabilizing business fluctuations and the price level as well as improving income distribution. Here again, we have a good case how short-run thinking dominates a long-term orientation of economic policy.

The present attitude with regard to the economic growth objective Today, in general, economic growth seems to be accepted and is considered desirable, although serious questions remain, especially with reference to the contradictory behavior of economic agents (cf. Miegel/Petersen 2008). The essential remaining question, however, is how to generate growth. The theory of economic growth and empirical growth research come up with rather modest policy implications (cf. Hemmer/Lorenz 2004, 375-379). The most promising approach turns out to be an understanding of economic growth mainly as the result of market processes so that economic order policy may be identified as growth policy. This position (cf. Frankfurter Institut 1989, p. 5) must here be criticized with reference to two aspects. On the one hand, the core area of order policy is market competition so that the question comes up as to the limits of order policy (cf. Röller/Wey 2001). Do the rules of order policy underlie the field of health care or other fields such as education (as a negative example cf. Häberle 1992)? Moreover, specific rules of order for different areas of economic policy are incomplete or missing (cf., e.g., the given liability regime of the international banking sector; cf. Sinn 2008). On the other hand, economic order policy has always been oriented to the present time, being carried on into the future, without a long-term (legal) fixation, so that politically motivated attempts of modification have been made possible at all times.

The result of our discussion is that, in the long run, economic growth is considered here as the most important economic objective, without specifying any target rate of growth. Consequently, other economic objectives such as full employment, price stability, balance of payment equilibrium and income distribution must be taken into account, since they may have a supportive function at realizing the growth target. These aims, however, are of secondary importance for long-term analysis in the context of infrastructure policy. Their relevance in economic policy today often originates from a short run approach to political decision-making. In this respect the economic growth objective takes on the character of a means realizing full

employment or changing income distribution. In traditional growth theory, the growth objective is an aim derived from the full employment postulate, here again extrapolating the short-term perspective into the future.

The reasons for pursuing the objective of growth in the future are manifold; in order to give some examples: the unsatisfied needs of a substantial part of the population, the necessity of structural changes and reforms, the decrease of the national debt, the immense amount of resources needed to organize care for future requirements (climate change, public policy failures) and to cope with the omnipresent waste in human decision-making. It should be clear that economic growth in the future will express itself in very different forms compared to what we are used to experience nowadays. Probably, quantitative economic magnitudes will lose their weight and qualitative aspects of output variation will act a more important part. Growth barriers such as the maintenance and improvement of the environment (sustainable development) or the given supply of energy will force us to learn more about institutional reforms, technological progress and resource substitution in organizing economic activities. And, adhering to the postulate of solidarity and peace, national economic growth must in no case result from the exploitation of foreign economic resources, e.g., by international trade.

In this sense, this is now the time to plead for the start of an *indirect approach to economic growth* leading to a policy that concentrates on the fortification of the preconditions of growth (cf. also Woll 1968, 27-28), leaving aside the permanently existing requirement of increasing the efficiency of factor allocations. The indirect approach essentially concentrates on the determinants of the factors of production and of the combination of these factors. It may result in positive, zero or even negative growth rates. The cases of non-positive growth rates may imply mere restructuring of the economy, the specifically related problems being disregarded in this context. What we need is the installation of a long-term adjustable growth framework fixed at a solid, long-term lasting groundwork within the protected human environment. It must be flexible enough to be able to react quickly to any type of economic shock or unforeseen serious event in the future. The market economy in reality is a living organism that develops best with direct reference to suitable guidelines over time, as is true of a plant climbing upwards by the help of its tendrils at metallic wires. These guidelines concentrate on the advancement of the rules and the establishments of the economic order. Institutional improvements in the widest sense serve interrelated human activities, focusing now on interacting economic agents, i.e. the working population and its human capital, and their basic require-

ments, e.g., of water, warmth and shelter. Thus, the indirect approach to economic growth refers to a growth framework that is called the *infrastructure of the market economy*. It is the long-term given, permanently lasting fundament of economic growth in the market economy.

The syllable "infra" stems from the Latin language, meaning "below", thus, in a static sense, "infrastructure" can be taken to express "foundation". Here infrastructure is understood to be the economic growth framework in the dynamic sense of a more or less rigid supportive structure, a skeleton-like network, of the market economy. Within this network changing over time economic growth occurs, being supported and stimulated by the categories of infrastructure.

II. The Definition of Infrastructure

1. The Starting-point: Jochimsen's Approach

Jochimsen's definition of infrastructure The broadest version of the term "infrastructure" dates back to Jochimsen (1966). In his book on the theory of infrastructure (a summary can be found under www.uni-siegen.de/infrastructure_research), the author seeks to present preparatory studies for a modern theory of development of a market economy, especially by systematically considering the problem of infrastructure endowment (cf. Jochimsen 1966, 1). For this purpose, Jochimsen unites three sources: (a) the usage of military language where infrastructure refers to military installations such as barracks, airports, roads, and telecommunication equipment; (b) the scientific contribution of List who explained a nation's foundations of wealth to be its productive forces such as natural resources, labor and human capital as well as the social order of society (cf. List 1841; 1959, 143-155); and (c) the seminal work of Malinowski who formulated instrumental cultural imperatives and the pertaining cultural reactions to these imperatives (cf. Malinowski 1944; 1949, 148-158).

Jochimsen defines *infrastructure* as the sum of the material, institutional and personal foundations of an economy that contribute to realizing the assimilation of factor remuneration, given an expedient allocation of resources, i.e., a relatively high degree of integration and a level of economic activities as high as possible (cf. Jochimsen 1966, 100).

Material infrastructure is understood as " ... 1. the totality of all earning assets, equipment and circulating capital in an economy that serve energy provision, transport service and tele-

communications; we must add 2. structures etc. for the conservation of natural resources and transport routes in the broadest sense and 3. buildings and installations of public administration, education, research, health care and social welfare" (Jochimsen 1966, 103).

"*Institutional infrastructure* comprises the grown and set norms, institutions and procedures in their "reality of constitution", insofar as it refers to the degree of actual treatment of equal economic data, excluding "meta-economic" influences. It determines the framework within which economic agents may formulate their own economic plans and carry them out in cooperation with others" (Jochimsen 1966, 117). The institutional fundament of the market economy includes, apart from the legal rules, the actual implementation of these rules by habitual norms, "self-created" regulations of business and economic policy (cf. Jochimsen 1966, 121, 122).

Personal infrastructure refers to " ... the number and the qualities of people in the market economy characterized by the division of labor with reference to their capabilities of contributing to the increase of the level and the degree of integration of economic activities" (Jochimsen 1966, 133).

Evaluation Determining critically Jochimsen's understanding of infrastructure, we must consider that his definition of infrastructure is cast in rather general wording. The term "material infrastructure" takes on the form of an enumeration of different aspects without applying discriminating criteria. "Institutional infrastructure" is solely geared to the economic order in its traditional sense and its underlying economic constitution. Although the size of population is mentioned in the definition of personal infrastructure, the variable of population, its structure and its problems are not discussed; the emphasis lies on human capital.

Nonetheless, after the publication of Jochimsen's book it became clear that his approach would form a solid and systematic basis for the discussion of infrastructural problems. So, in 1970, the Verein für Socialpolitik, the German-speaking Economic Association, organized a conference under the title "Grundfragen der Infrastrukturplanung für wachsende Wirtschaften" (Basic Questions of Infrastructure Planning for Growing Economies) at Innsbruck/Austria (cf. Arndt/Swatek 1971; Jochimsen/Simonis 1970). More than thirty-five years later, in 2006, the association held another infrastructure conference concerning the topic "Öffentliche Investitionen und Infrastrukturleistungen bei knappen Staatsfinanzen" (Public In-

vestments and Infrastructure Services under Scarce State Finances) at Bayreuth/Germany (cf. Kirchgässner (et al.) 2007).

Despite these efforts and the ensuing stimulated research two essential deficiencies of infrastructural analysis remained until today. On the one hand, there is neither a generally accepted economic definition of material infrastructure, nor a comprehensive clear-cut definition of the total field of infrastructure. Enumerations of infrastructure facilities and of their properties and descriptions of basic functions underlying an economy are insufficient for the formulation of a useful definition of infrastructure. On the other hand, there is little understanding as to which absolute and relative role the three components of infrastructure, material, institutional and personal infrastructure, perform in economic growth of the market economy.

Maintaining the distinction between material, institutional and personal infrastructure means that alternative distinctions such as economic/technical infrastructure (e.g., transport and energy facilities) and social infrastructure (e.g., schools and hospitals) or household-oriented infrastructure (e.g., parks) and firm-oriented infrastructure (e.g., telecommunications equipment) are rejected. These terms are usually not wrong, however, in many cases deficient. Their economic background is theoretically weak and they are not comprehensive enough in many respects.

2. The Categories of Infrastructure

(a) Material Infrastructure

Characteristics of material infrastructure Today infrastructure is frequently understood as material (or physical) infrastructure meaning an enumeration of public capital stocks such as roads, water reservoirs and schools in most cases produced and operated by the state (cf. Frey 1978, p. 201; Bannock/Baxter/Davis 2003, 191; Kessides 2004). Obviously, in some instances, the term "infrastructure" is even unknown (cf., e.g., Eatwell/Milgate/Newman 1998, 851). The predominant emphasis on material infrastructure is mainly due to this field being relatively easily accessible for quantitative analysis and evaluation (cf. Aberle 1985, col. 79) by engineers, economists, geographers, operations researchers and regional scientists (a good example from engineering is Friesz 2007).

With regard to a more appropriate and applicable definition of material infrastructure (cf. Buhr 2007, 14-17) we shall assume the preferences of the population, the levels of technol-

ogy, the institutional rules, the level of development and the geographical situation -- particularly the amount of useable land -- of a nation as given. Our discussion will essentially start from the viewpoint of households, taking firms and other economic agents to be institutional offspring that developed during the intensified process of the division of labor so that their infrastructure demand will not be neglected.

Material infrastructure is characterized by two distinguishing qualities. The *first trait* refers to the essential prerequisites of human life. Many of these basic wants stemming from physical and social requirements of human beings are satisfied by infrastructure outputs (goods and services) which have been produced by the use of pertaining immobile capital stocks fixed to the ground, called material infrastructure (exception: communication satellites that operate in outer space). For example, the need of light in a building is met by the corresponding supply of electricity produced in generation plants and distributed by circuits -- the plants and circuits being capital goods, i.e., specific types of material infrastructure. A material infrastructure output results from the interplay of its corresponding supply and demand that depends on physical or social wants. The supply side is determined by the production functions, finance situation, and organizational structures (including regulations of ownership) of infrastructure producers such as industrial enterprises and administrative units. Representing technical characteristics of production, the production functions relate infrastructure outputs to the factors of production, which are the given quantities of land needed, the labor force employed, and the capital stocks utilized (material infrastructure). In some other cases, the services of capital stocks may directly be considered as supplied infrastructure outputs, e.g., in the case of roads. The capital stocks are the capital outputs of preceding production processes. The main problems of production related to material infrastructure such as cost reduction, price formation, investment evaluation (cf. Joskow/Tirole 2007) or network design will not be discussed here (cf., e.g., Bobzin 2006, Knieps 2007).

Subsequently, essential requirements of human life or wants of economic agents will be listed, stating examples of corresponding infrastructure outputs (goods and services) separated from their pertinent capital stocks (material infrastructure) in round brackets. For a comprehensive overview of these stocks cf. Biehl (1986, 102-108).

Physical requirements:

water (drinking water / reservoirs, pipes)

warmth (oil, coal / drilling platforms, pipelines, coal mines)

light (electricity / generation plants, circuits)

health (medical care, waste water disposal / hospitals, sewerage systems)

physical growth (physical training / playing fields)

protection against nature, shelter, physical convenience (accommodation, flood protection / houses, levees)

Social requirements:

security (protection against crimes, outward defence / police stations, military installations)

information (telephone services, newspapers / telecommunication facilities, newspaper production works)

craving for knowledge, education, culture (child care, lectures, painting exhibitions/ schools, universities, theatres)

mobility (usage of roads and tracks /roads, tracks)

environment protection (clean air / air purification filters, insulation of buildings)

We should be aware that, in the above sketched summary, a number of economic terms have solely been mentioned with reference to their implied capital stocks which are taken combined as material infrastructure. We may refer to a marguerite whose yellow central part of a blossom represents material infrastructure and whose white petals stand for the different fields strongly related to material infrastructure capital stocks and basically organized according to the pertinent institutional and personal infrastructure. The term "material infrastructure"

serves as a bracket of these capital stocks. There are many more problem aspects related to keywords such as housing, health care, information technology and environment. It should be clear that, in the long run, economic growth must not endanger or even exploit human environment. The fundamental importance of infrastructure goods such as water and electricity becomes obvious in a spectacular situation of even temporary emergency such as the contamination of water or the break-down of an electricity supply system. In view of increasing water usage we are on the brink of a global water crisis. The availability of energy will be a decisive limiting factor of world economic growth in the future; it has already acquired this growth-barrier relevance in single countries such as Uganda.

It may be a surprise to notice that man's need for food was not mentioned in the overview given above. Although the marketability of some agricultural products may only be imaginable with reference to the existence of particular types of material infrastructure such as farm houses or slaughterhouses, these capital goods are of a very specific, not a dominant relevance at satisfying the desire for nourishment. Therefore we should not give special attention to them in the present context. Moreover, food production does not generally necessitate mass production.

Since we as purchasers turn our attention to the want-satisfying qualities with which goods and services are endowed it is suggested here to designate material infrastructure outputs as *existence goods and services* (as opposed to luxury goods and services). It is remarkable that, although economists have produced various catalogues of wants, "such lists tend to dangle free of theoretical constraints. They remain mere lists whose parts do not mesh into any theory" (Douglas 1998, 872; see also Milgate 1998). With reference to material infrastructure this situation is now overcome.

Let us also notice that material infrastructure facilities are often highly complementary to each other. An example is housing in relation to utility networks (e.g., water and energy supply equipment).

The *second distinguishing quality of material infrastructure* is the non-availability of infrastructure goods and services to the individual household or firm for production and cost reasons. Under the given modern technology, the supplies of infrastructure outputs result from

mass production. The usually high fixed costs of facilities require the (often joint) production of large volumes of outputs (fixed costs depression).

This second quality of material infrastructure implies the obligation of society, the responsibility of the government, to guarantee the supply of infrastructure goods and services to the individual economic agents of a country, i.e., to build up an economy's material infrastructure. Because of this infrastructure quality, material infrastructure outputs are sometimes called *collective* (or *community*) *goods*, as it is done by the Max Planck Institute for Research on Collective Goods, Bonn. There, collective goods are defined " ... to encompass all those goods whose provision and enjoyment are treated as community concerns" (www.coll.mpg.de/index.html).

Supplementary considerations Using this designation of infrastructure goods and services we should have in mind, firstly, that the role of the state in shaping material infrastructure is controversial, secondly, that material infrastructure goods in most cases are no public goods (for an opposed view see Adams/McCormick 1993), and thirdly, that community concerns with reference to the possibilities of mass production can only be satisfied on the basis of applying modern production technology. At a low level of development, relatively simple and small-scale substitute facilities are used to satisfy basic infrastructure needs. For instance, base-stations can be powered utilizing their own generators in places where there is no electrical grid. Or, households are referred to rather primitive sanitary installations attached to their accommodation.

The result of our preceding discussion is that the first trait of material infrastructure is of decisive importance. Material infrastructure outputs are existence goods and services. The second trait -- material infrastructure outputs being collective or community goods and services -- may have a constitutive, however, supplementary character.

The preceding analysis discussed the general necessity of providing infrastructure outputs from the viewpoint of households, in a wider sense also other economic units such as firms. In order to deepen our understanding of material infrastructure we may extend the question as to the availability of infrastructure outputs to the question of their relative importance. This question is answered by the actual demand for these outputs by households and firms, i.e., we must look at households' preferences and firms' production technology. Concentrating here, in

a microeconomic approach (as an example), on firms that exist at given locations, variable input quantities may concern specific factors of production such as water and electricity as well as labor (personal infrastructure), fixed inputs may refer to developed land used, buildings or the installation of information equipment. As far as the applied production technique is concerned, each of the three categories of infrastructure, respectively, may come to the fore: material infrastructure (e.g., usage of transport facilities, existence of clean air and/or water); institutional infrastructure (e.g., legal regulations as to the safety of production processes), personal infrastructure (e.g., technological education of personnel). Also the relevant aspects of the firms' cost situation must be considered. Are certain technologies using infrastructure inputs specifically characterized, e.g., by subadditivity of cost functions? With respect to location-decisions of firms, the different types of infrastructure outputs and services represent an important aspect of the supply of location factors. The corresponding demand for these factors depends on the character of the production processes planned and the inherent cost implications (e.g., dependence on the availability of a substantial provision of electricity in the case of aluminum production). As soon as the relative importance of material infrastructure will have been tested, the defined delimitation of the term "material infrastructure" may be reconsidered.

State production of infrastructure goods and services and *public ownership* of material infrastructure are not stringently necessary characteristics of material infrastructure, as, for example, private schools, private hospitals and private railroads already indicate. In the present context, the term "public capital" for material infrastructure and its pretended relevance (Aschauer 1989, Esfahani/Ramirez 2003, Romp/de Haan 2007) have only limited importance. With regard to the future provision of basic necessities for life (Daseinsvorsorge) (cf. Forsthoff 1973, 368-371, 410-411, 567-571) the present role of the state must be questioned. Firstly, in most cases state material infrastructure activities such as public enterprises have historical origins. Historically determined influences must now be reconsidered and many of them probably be eliminated under economic aspects. Exceptions are material infrastructure facilities related to the production of genuine public goods such as legislation and judiciary, administration of the community, in particular internal national security, safeguard of the value of money, and outward defense. They are all connected with the social requirement of security, a basic aim of society. Secondly, instead of pursuing the principle of production responsibility the state must increasingly concentrate on the principle of regulatory responsibility. Public production should be substituted by private production under public control (as an

element of institutional infrastructure) of varying degrees in the fields of material and personal infrastructure (cf. Buhr 2007, 26-27). Control may entail hidden costs since many agents reduce their performance as a response to the state's (principal's) controlling decision (cf. Falk/Kosfeld 2006). Thirdly, the Tinbergen (1962, 132-133) rule should generally be applied. Tinbergen suggests that the decision on the public or private provision of material infrastructure has to be subject to cost-benefit analysis. This means that the state representatives as competitors, e.g., in planned project construction, must demonstrate the economic superiority of their proposal as compared to private solutions in order to be successful as to project realization. In all, the three points given above would lead to a reduction of the volume of public activities that is desirable in view of the high state share in national product being incompatible with the given economic order of a market economy.

Trying to characterize material infrastructure capital stocks by their properties (cf. Jochimsen/Högemann 1996, 198-200) such as their long duration, technical indivisibility and high capital-output ratios is not convincing, since large mobile capital stocks may also have the same properties (on the microeconomic implications of indivisibilities of factors of production and goods cf. Bobzin 1998). However, the recourse to the *functions of material infrastructure* is helpful. In a dual view, the satisfaction of the physical and social requirements of human life by material infrastructure outputs corresponds to the creation of the functions of material infrastructure stimulating and supporting economic growth. These functions help to mobilize the economic agents' potentialities and to safeguard the opening and the development of the activities of households, firms and at markets. For example, roads enabling mobility of travelers (social requirement) serve economic agents to access specific locations (function of roads) (cf. Buhr 2003, 14-17) with the consequence of reduced or increased disparities among regions due to the rate of mobility people are prepared to accept. Reductions of material infrastructure capacities may have contrary effects.

Since the fixed costs of material infrastructure capacities are very different in magnitude comparing various capital stocks, material infrastructure provision takes place under the conditions of different market structures, above all (natural) monopolies, however, also different forms of competition (e.g., housing construction). Leaving aside the generally given investment problems in various contexts, in particular the monopoly case (e.g., electricity supply) raises the questions of regulating the output price and of vertically separating private or public network provision from planned or existing private operation in order to create sufficient

competition at the operation level (cf. Knieps 2001). On the complexities of the liberalization process cf. Armstrong/Sappington 2006.

What are the main differences between *material infrastructure and non-infrastructure capital stocks*? From the viewpoint of material infrastructure, firstly, it generally serves to generate necessary outputs satisfying basic needs of the population. Secondly, since its supply functions are indispensable for maintaining and safeguarding quantitative personal infrastructure, the population or the inherent workforce, the state at least carries the burden of regulatory responsibility (institutional infrastructure!) for the development of material infrastructure. Thirdly, for the state this obligation creates business in the long run, if not in the very long run. All three points generally are not relevant for investment in non-infrastructure capital stocks.

Material infrastructure takes on different *configurations*: point infrastructure (e.g., airports), point-network infrastructure (e.g., electricity supply) and network infrastructure (e.g., roads). These forms may refer to different spatial levels: national territory, area, region, community or lot. Thus material infrastructure constitutes the capital element of an economy's landscape structure that is the result of the interactions in space and time between the geo-factors (including the climate) and the anthropogenic land use of a nation (cf. Lutze/Schultz/Kiesel 2004, 313). For a historical review of the evolution of the landscape and the making of modern Germany cf. Blackbourn 2006.

A definition of material infrastructure We may now define material infrastructure as those immobile capital goods that essentially contribute to the production of infrastructure goods and services needed to satisfy basic physical and social requirements of economic agents and unavailable to the individual economic agents (households, firms etc.) for production and cost reasons so that mass production is economically cogent. The fulfillment of these requirements implies the activation of the functions of material infrastructure. The configurations of material infrastructure in space constitute the capital element of an economy's landscape structure.

(b) Institutional Infrastructure

A definition of institutional infrastructure This category of infrastructure encompasses all customary and established formal rules and informal constraints (conventions, norms of be-

havior) to shape human interaction (on social capital cf. Durlauf/Fafchamps 2005, Sabatini 2008) as well as the procedures of enforcement to guarantee and to implement these rules, e.g., by the state. This obligation of the state in the form of pursuing legal and economic policy is not controversial in industrialized countries. "Polities significantly shape economic performance because they define and enforce the economic rules" (North 1994, 366).

Basic terms An appropriately defined set of rules may result in an *order* as a framework. Codified rules are represented by the legal order which is based on the legal constitution of a nation (the German constitution being the Grundgesetz). From these fundamental principles the economic constitution (Wirtschaftsverfassung) of the country emerges as the totality of economically relevant laws. They represent the legally determined main issues of the economic order (Wirtschaftsordnung) which is also constituted by commonly used economic practices (cf. Buhr 2007, 17-18). As we know, the German economic order is the social market economy embedded in the internal market of the EU.

Alternatively, a specific set of rules may lead to the creation of an *institution* which, under the given content of the economic order, is in a position to enforce its pertinent activities by an *organization*. This means that a distinction is made here between institutions and organizations. In an organization the set of rules is administered by qualified labor, a combination of skills, strategy and coordination (personal infrastructure), within the framework of non-infrastructure capital and components of material infrastructure (e.g., buildings). "Organizations include political bodies (political parties ...), economic bodies (firms ...), social bodies (churches ...), and educational bodies (schools ...). They are groups of individuals bound by some common purpose to achieve objectives ... the focus on organizations ... is primarily on their role as agents of institutional change ... " (North 1990, 5).

We shall start from the conception that rules and norms converge into orders, both -- rules and orders -- resulting in the creation of institutions that again react upon rules and orders (cf. also North 1990, 3-5, and Wenig 2000, 152). Rules, orders and institutions may have political, social, and economic dimensions.

A new term comparable to "institutional infrastructure" is "economic governance" understood as the "structure and functioning of the legal and social institutions that support economic activity and economic transactions ... " (Dixit 2009, 5).

Institutional infrastructure also has specific mobilizing and safeguarding functions similar to those mentioned with reference to material infrastructure; they shall not be analyzed here in detail.

Economic order policy primarily concentrates on the design of the *economic constitution* which results from the interactions of the legislative, executive and judicial powers of the state. In Germany, under the heading of the economic constitution we subsume the planning and coordination constitution; the production constitution, subdivided into the property constitution (cf. the Grundgesetz), the business constitution (e.g., law on share capital, works constitution act, employees' co-determination act) and the labor constitution (see social constitution); the market constitution (e.g., laws against restrictive trade practices, law on labor agreements); the monetary constitution (e.g., law on the German Bundesbank, law on credit creation and distribution); the finance constitution (e.g., the Grundgesetz, stability and growth law); the social constitution (e.g., the Grundgesetz, law on workers' asset formation, law on workers' education assistance, law on social welfare); and the international economic constitution (e.g., law on foreign trade, World Trade Organization Agreements, Treaty Establishing the European Economic Community (EEC Treaty)). Thus the economic constitution presents the basic legal guidelines for economic activities, e. g., for setting up the reward structure and the contracting arrangements of an economy, for regulating its market structure and its adoption and use of new technologies -- topics discussed in modern growth theory (cf. Acemoglu 2009, Ch. 4).

In the long-term perspective, economic policy is essentially *growth policy* which focuses on infrastructure policy. It comprises political approaches supporting and improving material, institutional and personal infrastructure with the aim of increasing national product (cf., e.g., also Pitlik 2005).

The theory of economic policy is laid out to explain and consult practical economic policy. In many cases the recommendations of experts are not accepted by politicians on account of diverse reasons. Often the reproach of political failure or government failure may be justified, one possibility of understanding political failure being the non-implementation of potentially Pareto-improving public action (cf. Besley/Coate 1998). For a summary of the relevant contributions on political or government failures and their discussion cf. Kirsch (2004); examples are given in Buhr (2007, 22-23). However, the deeper lying causes will not always be lack of

insight and knowledge or willful malice on the part of the politicians concerned, but the existence of a political constitution not to the purpose. Dealing with such problems is an object of constitutional economics.

The function of practical *state order policy* (leaving aside the normative theory of the political constitution) is to determine rules according to which political decision-making should be organized. There are different areas of implementation for which the following issues must be settled: selection and delimitation of the sphere of political decision-makers, motivation and control of political activities, and delimitation of rights and duties of citizens and the state. In detail, the spheres of design refer to the national constitution (organization and legitimization of state coercive power, regulation of relationships between national state powers (distribution and separation of the functions of power, federalism), protection of the individual's freedom against the state (guarantee of constitutional rights)), to the political system (political structure of the state with respect to the rules of electing political decision-makers and the influence of individual voters, associations, organized interest groups, institutional policy advice and control of political decision-making), to the relationship to supranational institutions and to the political role of cultural institutions (schools, media, churches etc.). The political order must be set up in such a way as to guarantee the best possible conditions of success for economic order policy (cf. Cassel 1988, 319–322).

Created by social decisions, economic rules and institutions structure the incentives of and the constraints on economic actors in political, social, and economic exchange. These social choices generally lead to conflicts, often resolved in favor of groups with greater political power, since different groups and individuals typically benefit from different economic institutions. "The distribution of political power in society is in turn determined by political institutions and the distribution of resources. Political institutions allocate *de jure* political power, while groups with greater economic might typically possess greater *de facto* political power ... Economic institutions encouraging economic growth emerge when political institutions allocate power to groups with interests in broad-based property rights enforcement, when they create effective constraints on power-holders, and when there are relatively few rents to be captured by power-holders" (Acemoglu/Johnson/Robinson 2005, 386-387). On the persistence of economic institutions over time in view of changes in political institutions cf. Acemoglu/Robinson 2008. These statements are valid independent of whether the political institutions exist in a unitary, centrally organized state or in a federal state. For a more com-

plete understanding of economic growth we need " ... to study (1) how political institutions affect policies and economic institutions, thus shaping incentives for firms and workers; (2) how political institutions themselves change, especially when interacting with economic outcomes and technology; and (3) why political institutions and the associated economic institutions did not lead to sustained economic growth throughout history ..." (Acemoglu 2009, Ch. 24.1).

Growth-conducive economic organization, according to North and Thomas, is characterized by the solid establishment of institutional arrangements (cf. also Phelps 2004) and the constitution of property rights channeling economic activities so that private rates of return will approximate social rates of return (cf. North/Thomas 1973, 1; Greif 2006; Clark 2007). A property right implies that " ... it is the physical use and condition of a good that are protected from the action of others, not its exchange value" (Alchian 1998, 1031), by private and public law, informal social actions, and prevailing ethical norms.

Institutional economics The relevant background and a general reference for institutional analysis would be institutional economics; " ... institutionalism has served the dual functions of providing critiques of mainstream neoclassical ... economics and producing an alternative conception of the economy ... " (Samuels 1998, 864). Representatives of institutional economics share the common opinion that national output is mainly a function of both technology and institutions. In contrast with neoclassical economics which concentrates on the explanation of market results and their implications, " ... institutional economists assert the primacy of the problem of the organization and control of the economic system, that is, its structure of power." They argue " ... that the market is itself an institution, comprised of a host of subsidiary institutions, and interactive with other institutional complexes in society" so that " ... it is not the market but the organizational structure of the larger economy which effectively allocates resources" (Samuels 1998, 865). In this context, it may be of interest to understand that the expression "market infrastructure" recently came up in economic discussions.

This position at least raises two questions. The first refers to the relative effects that markets have in the organizational structure of the economy in reality (cf. Hollingsworth/Boyer 1997). And the second question, starting from the intimate relationship between the institution "market" and its dynamic regulating force "competition", is dedicated to the problem of evaluating

the economic importance of competition in the special context of markets and in the general context of all types of institutions. Incentives govern human behavior and its activity results.

Concerning the different principal themes of institutional economics (e.g., social change, social control and collective choice, economic role of government, technology) our main emphasis here will be put on the impact of man-made institutions on economic performance and the processes of institutional change (cf. Samuels 1998, 865; Paldam/Gundlach 2008).

Thus the *discussion of institutional infrastructure* may concentrate on *two approaches*, one concerning the analysis of the economic relevance of rules (and norms) and institutions and the other concerning the change of rules and institutions.

There is sufficient evidence to assume that economic institutions explain significant portions of the observed differences in per capita incomes among countries (cf. Acemoglu/Johnson/Robinson 2005; on the effects of democracy on economic growth cf. also Barro 1997, Ch. 2). Generally, two approaches of analysis exist. On the one hand, research concentrates on specific aspects of the institutional setup, e.g., the functioning of the legal system, to establish a relationship to economic growth. As an example we may take a study that contributes to the literature about the effects of laws and law enforcement on the investment behavior of individual firms and focuses on the quality of the judiciary (cf. Lensink/Scholten 2007). On the other hand, the growth effects of the institutional setup taken as an entity are studied. Since it is difficult to assess empirically the impact of institutions taken together on economic growth, Eicher and Röhn (2007, 39-40) propose the construction of an institutions climate index to be tested on the basis of data on OECD countries. The aim of the index " ... is to summarize a country's institutional performance in several distinct growth-relevant dimensions that capture overall institutional quality". Factor and regression analyses of candidate variables result in an institution index that is composed of eight sub-indices, each of which is again comprised of several components. The sub-indices allow for optimal taxation, basic institutional quality, fiscal burden, human capital efficiency, trade openness, labor markets, structure of government expenditures and capital markets. The conclusion of this study is that the index is able to reproduce remarkably well average OECD growth over the period 2004-2006 (cf. Eicher/Röhn 2007, 43, 46, and Appendix).

Another important aspect of institutional infrastructure is *political and administrative governance* that can be defined as the traditional and modern practices according to which a country's authorities are exercised in managing their resources. Kaufmann/Kraay/Zoido-Lobaton (1999, 1) have specified this definition by emphasizing (1) the process by which those in authority are selected, monitored, and replaced, (2) the government's capacity to specify and implement sound policies, and (3) the respect of citizens and the state for the national institutions governing economic interactions among them. Seldadyo, Nugroho and de Haan (2007, 279-280, 288) construct an index applying factor analysis to a given dataset on indicators of governance, namely, democratic accountability, government stability, bureaucracy quality, corruption, and rule of law. They find their index to be positively and significantly related to economic growth. Besides this general approach, governance may have influence on the output of particular material infrastructure categories. For example, good governance has a positive impact on the quality of the health care sector (cf. Klomp/de Haan 2008).

Why are *democratically organized market economies* characterized by different institutional arrangements? Voigt (2007) indicates that, for example, a majority voting system or a proportional representation of votes has different significant economic effects (see also Alesina 2006). Under majority voting the central state's expenditures and budget deficits turn out to be relatively smaller than in countries with proportional representation. Why do societies not eliminate institutional barriers to growth? One plausible explanation is that institutions create distribution effects which powerful actors strive to influence to their advantage so that the power of individuals is the reason for the persistence of institutions. So the problem of installing desirable institutions regulating societal interactions remains.

Are there reciprocal effects of different types of institutions so that various combinations of rules and institutions emerge? One possible answer may be found in the distinction of two types of political economies, liberal market economies and coordinated market economies as ideal types at the poles of a broad spectrum of economic orders. Their characteristics resulting from differentiation of institutions such as labor markets, availability of risk capital or educational structures can be summarized as follows (cf. Hall/Soskice 2001, 8).

Liberal market economies (example: USA)

- coordination of firms' activities via competitive markets and hierarchies characterized by institutions of super-ordinate instances,

- exchange of goods or services in a context of competition and formal contracting,
- adjustment of actors' willingness to supply and demand outputs in response to market prices,
- market institutions as effective means for coordinating the plans of economic agents.

Coordinated market economies (example: Germany)

- firms' partial dependence on non-market relationships to coordinate their endeavors with other actors and to construct their core competencies,
- non-market modes of coordination: more extensive relational or incomplete contracting, network monitoring based on the exchange of private information inside networks, and more reliance on collaborative relationships to form the competencies of the firm,
- market equilibria on which enterprises coordinate their plans more often the result of strategic interaction among economic agents.

Looking specifically at problems of coordination in the principal spheres of enterprise endeavors in liberal and coordinated market economies, the institutional complementarities present in each political economy may be thoroughly discussed (for the cases of Germany and the United States cf. Hall/Soskice 2001, 21-33). With reference to comparative institutional advantage we also find essential differences in the economic and political consequences of the two institutional infrastructures. For example, while firms in liberal market economies tend to innovate disproportionately in fields where radical innovation is important, firms in coordinated market economies seem to have more active innovators in fields mainly characterized by incremental innovation. Many liberal market economies have majority voting systems of government that concentrate power in the political executive, while coordinated market economies often are typified by proportional representation of votes and are governed by coalitional or quasi-corporatist regimes (cf. Hall/Soskice 2001, 41-44, 49). To understand the deeper causes of these facts will require more research in the future.

A fruitful approach for future research on the impact of institutional infrastructure on economic growth will also be the study of *changes of rules and institutions* or institutional reforms. Here a number of difficulties exist: exact definition of the reforms, (quantifiable) effects of reforms, maintenance of reforms, inter-country comparability of reforms and their

effects. As an example compare the recent study on institutional change and economic policy reforms using the institutions climate index by Ochel and Osterkamp (2007).

An active policy of institutional change may concern the improved implementation of given rules (and norms) and the creation of new rules. As to the problems of implementing given rules more adequately than before let us look at some selected examples. Recently Hennis, a political scientist, interviewed by Bahners and Kaube (2008, 36), thoroughly and correctly criticized that Germany's reconstruction after 1945 did not take place under the formula of restoring the constitutional and lawful state, but backing "democratization" in all respects; thereby democracy was not understood as a form of government in which the supreme power is vested in the people and exercised by them, but as a life pattern practiced in many spheres of society. This approach has been reinforced by the misunderstanding that all opinions have the same weight in a democracy, since all people are equal under the law. The consequences have been sophisticated impediments to institutional decision processes of all kinds. Another important example refers to competition policy. According to the reformulated EU-Treaty of Lisbon, essentially the former draft of an EU Constitution, the intensification of competition in the sense of economic order policy is no longer an expressively stated economic objective of the European Union. Issues of competition policy shall now be settled by individual case decisions. For the sake of consumers' interests the state is obliged to protect and reinforce competition processes. At present the very opposite of this insight occurs in Germany's network industries. Every intervention into the old monopolies (general access of competitors to technically modern networks, creation of competition at the operation level etc.) creates resistance from the trade unions and those politicians who fear for the loss of jobs and their privileges. Thirdly, we may mention the finally failed attempt of constructing an integrated business planning and coordination system of the German federal government (cf. Jochimsen 1970). A fourth example may be given with reference to the now necessary international financial regulation. The strict enforcement and perhaps reconsideration of global rules is certainly one policy of repair. Other lessons from the crisis lie at home in the individual states. Inadequate national supervision and also outdated financial systems have been the main reasons of financial disasters (United States' failure to supervise the subprime mortgage market, Britain's collapse of her bank Northern Rock, France's catastrophe at the bank Société Générale and also Germany's near-bankruptcy of several state banks (Landesbanken)). And a final example, taken from history, refers to the co-evolution of the chemical industry, particularly the production of synthetic colors, and the university chemistry education in Germany

before World War I. Nowadays co-evolution of industries and national institutions can be found in the fields of computer science and bio-technology, for instance, in the United States of America.

Independent of the type of market economy, the institutionalization of new markets is advisable. Price formation indicates scarcity of goods and services so that demand and supply can react. Road pricing, e.g., may stimulate private road investments so that congestion will be reduced. Compared with public road construction being restricted by a mostly insufficient public budget situation, the private approach will probably result in an additional increase of road capacities. Thus -- as this result is generally considered desirable (cf. Goudzwaard/ de Lange 1990) -- more emphasis is put on satisfying existence needs in relation to the satisfaction of other economic desires.

Constitutional economics Starting from an overview of developments after World War II, a broad range of institutional infrastructure is covered by constitutional economics. It may be taken as an intersecting set of several research programs, all of which have roots in classical political economy. "By both contrast and comparison, constitutional economic analysis attempts to explain the working properties of alternative sets of legal-institutional-constitutional rules that constrain the choices and activities of economic and political agents, the rules that define the framework within which the ordinary choices of economic and political agents are made" (Buchanan 1998, p. 585). The set of subdivisions includes (1) new institutional economics (including transactions costs economics, principal-agent theory, contract theory); (2) public choice theory; (3) economics of property rights; (4) economic analysis of law; (5) political economy of regulation; and (6) the new economic history (cf. Buchanan 1998, p. 586). The new institutional economics has been determined by the old institutionalism, organization theory, law and neoclassical economics. Especially, the synthesis of the new institutional economics with ordo-liberal thinking in economic orders remains an outstanding task for future research and policy implementation (as a starting point cf. Evers 2003).

As to the creation of new rules and institutions, in the widest sense, we may refer to the results of constitutional economics, especially institutional economics, considering the given specific context of problem analysis.

(c) Personal infrastructure

A definition of personal infrastructure Personal (or human) infrastructure covers the number (and the structure) and the relevant properties (physique, characteristics) of the working population, the labor supply of an economy, independent of whether the workforce is employed or unemployed (for detailed aspects and conditions of employment cf. Lazear/Shaw 2007). That is, we have to consider population as a stock variable and the labor participation rate. Both are changed over time by the birth rate, death rate and migration (quantitative aspect of personal infrastructure). We must also be concerned with the value of productive capacities of the workforce, the human capital or labor quality, determined by investment in general and special education and in learning from experience, research and development, given the inbred qualities of the human beings as income producing actors (qualitative aspect of personal infrastructure).

The separation of the quantitative and qualitative aspects of personal infrastructure follows the tradition of neoclassical macroeconomic growth theory where the variables quantity of labor and human capital appear in a multiplicative form (cf. Barro/Sala-i-Martin 2004, 66, 213, 214). This approach was chosen for the sake of simplicity of presentation. The alternative is a microeconomic approach of disaggregation hard to realize in practical time-oriented research. It would mean disaggregating the data on the national workforce according to selected criteria of human capital such as educational achievements, job experiences and duration of employment.

Personal infrastructure also has specific mobilizing and safeguarding functions similar to those indicated with respect to material infrastructure; they shall not be studied here in detail.

Population *Why does the population or the workforce belong to the infrastructure* of a market economy? Population and its growth form the vital center part of the economic growth framework that is called infrastructure. Population is the hook on which all economic activities hang (on demography cf. Keyfitz 1998). In a static or dynamic view of microeconomics and macroeconomics, households -- as holders of labor services -- determine labor supply and consumption that is the sole end of all types of production activities. National product is the result of human activities, leaving aside other supporting factors of production. Changes of labor supply and consumption due to population changes such as population shrinkage and ageing will result in further effects on many other economic variables (cf. Birg 2005a).

In addition, the individuals and the families are the holders, producers and main financiers of human capital investments. How these investments turn out depends on the character properties of the individual human beings. These properties form one bridge between the supplied quantity of labor and the quality of labor or human capital. Economically relevant personal qualities are, e.g., the ability and eagerness to apprehend, degree of intelligence, will to work, readiness to perform, work motivation, reaction to incentives, alertness and preparedness on the job, efficiency of actions, accountability, solid living and health, propensity to do without certain goods, readiness to accept risk, aspiration to financial success, achievement of independence and creativity, urge to innovate and entrepreneurial initiative (cf. the figure of a dynamic entrepreneur as described by Schumpeter 1912; see also Block/Koellinger 2009). Nearly all of these factors can be modified by training and outward influences (educational environment, changing religious beliefs) due to the plasticity of the human brain in the medium and long run. Given a certain status of health (reference to material infrastructure), a second bridge is built by human bodily activities that mobilize pertinacity, strength and coordination as main forms of strain, as general indicators of productivity, in the professional life of economic agents (cf. Hollmann 2002).

In the long run we may assume that, in industrialized countries, the size of population positively influences the amount of invention and innovation so that productivity changes and thus human capital increases (cf. Simon 1977, 10; Simon 1986; Simon 1992, 78-88; Giersch 1993, 67; Ehrlich/Lui 1997, 224-231). Moreover, Rosen (1998, 688-689) points out two important recent research developments. One of them is related to large changes in the age structure of the US population in the post-war period ("baby boom" in the United States). Beginning in the late 1960s a decline in the rate of return on human capital investment and a later gradual return to its prior level was identified as a consequence of an enormous increase in education over the preceding thirty-year period. The most convincing explanation refers to increased competition for jobs within cohorts as a function of their size.

In Germany, population issues found little attention in the past decades (on the general population development cf. Birg 2003), even when the birth rate started to drop in the middle of the sixties of the last century, ceteris paribus, below the replacement level of population (on the decline in fertility cf. Feichtinger 1977, 626-628; Coale 1998, 794 – 796). Leaving positive net migration (i.e., there are more arrivals than departures) aside, population figures fell since 1972. So national population (and workforce) development (on population decline cf.

Kröhnert/Medicus/Klingholz 2006 and Tivig/Hetze 2007) has been characterized by insufficient reproduction, a low fertility rate (= average number of births per woman), and ageing, an increasing old dependency ratio (= number of persons older than 65 years in relation to the number of persons aged 15 to 64 years). Positive net migration sufficed to compensate the growing birth deficit (= difference between the number of deaths and births) until about the turn of the century. In 2003 the German population started to shrink despite net in-migration (the data in this paragraph go back to a private note of Birg (2008)).

The decreased and low fertility rate is an outstanding issue of personal infrastructure in Germany because of its negative effects on economic growth. This issue must be regarded as an aspect of the "*demographic-economic paradox*" (Birg 2005, 42-52) that can be observed for most of the developed countries since the middle of the 20th century. This paradox refers to the fact that the birth rate is inversely correlated with the level and growth rate of per capita income: the higher per capita income, the lower the birth rate. If we assume this relationship thoroughly to hold, thus taking the birth rate as an endogenous variable, modern growth theory would collapse, since it insufficiently takes account of population problems.

Moreover, we may point out another major behavioral puzzle. The past decades have seen a considerable convergence of per capita incomes among the states and regions of the United States without being accompanied by a corresponding convergence of regional fertility rates (for an explanation cf. Alonso 1980).

The most convincing approach explaining the demographic-economic paradox is Birg's biographic theory of generative behavior (cf. Birg/Flöthmann/Reiter 1991). The transition from the phase of childlessness to the phase of parenthood is one of the very important long-term commitments in a human being's course of life. Whether and how many children a family will have, if any, is determined by the rationality and logic of biographic developments and by the personally expected risks resulting from the requirements of the labor market. There is a sharp contrast between the flexibility and mobility of individuals required at their jobs, on the one hand, and the acceptance of long-term responsibility for a life partner and children, on the other hand. The existence of children reduces the adjustability to the requirements of the labor market. Fixing the mode of education and then selecting a vocation leads to the polarization of the courses of life into two groups: women with or without children. Starting with the birth cohort 1965, the main reason for the low number of births per woman in Germany is the high

proportion of about one-third of women remaining childless for their entire lives. Empirical evidence also confirms that the effects of family-political measures (cf. also Feichtinger 1977, 628-629) on the probability of a birth will be the higher, the more children a woman had already born. These measures should be understood as a bundle: provision of maternal infrastructure and care (day-nurseries, kindergartens, all-day schooling), financial support such as child allowance, supply of part-time working arrangements, and creation of more societal appreciation of parents' rearing children (cf. Birg 2005b, 64-82). In addition, in the years to come young females will project into the future society's lack of support for women in the solution of their problems of matching their roles as housewife and mother with their occupational aspirations. Such projections will be modified by the general attitude towards children (e.g., children hostility), the degree of political stability in the future and the persistence of grave demographic and economic problems such as population decline, unemployment and stagnation. In all, the question as to the determinants of the birth rate will remain a research topic for the future.

Natural population growth and migration form the basis for the creation and the development of the working population (defined as workers in the age of 15 to 65 years) and labor supply (cf. Oppenländer 1988, 60-68), considering the human capital accumulated by the workforce which will subsequently be discussed. There are three determinants of the potential workforce with respect to the *labor participation rates*. These rates specified as to age and sex result directly from the characteristics of the existing population pyramid (population component). Moreover, a number of measures initiated by the legislator and the social partners (e.g., prolonged industrial training times, earlier retirements) also influence the labor participation rates (legal component). And finally, the magnitude of the rates is determined by the behavior of workers, for instance, by women who desire to resume their former jobs (behavioral component) (cf. Killingsworth 1998). In order to derive labor supply expressed as the available working hours we have additionally to consider legal and labor agreement norms on the duration of the working week, on the one hand, and behavioral influences particularly related to the individuals' evaluation of their leisure time, on the other hand (cf. Bender 1977).

Regarding our definition of personal infrastructure, we have implicitly assumed that we can distinguish between the individual within whom the ability to perform labor services is embodied and labor input as a sequence of services performed that could be traded in an open market. Most of these services will require some learning through training. "Human capital

theory treats this process of training and skill acquisition as investment by the individual in a capability which can be taken to the market place and traded" (Tarling 1998, 86).

Human capital With reference to human capital, the *value of the productive capacities of human beings* as income generating agents, we must include the above mentioned *inherent character qualities* of the working population shaping its productivity (this important aspect is neglected in Rosen 1998, 681-682; cf. also Blaug 1976, 828-833). In other words: Human capital includes cognitive abilities (linguistic and quantitatively analytical competencies, capability of applying specific technologies and procedures, technical and economic knowledge) and non-cognitive abilities, among them job-related virtues such as reliability, working discipline and capability for team work (cf. Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung 2004, 423). The characteristics of the workforce determine the agents' inherent values, preferences and interests which are also influenced by activity specialization. On this basis, intrinsic motivation and incentive reception (cf. Ellingsen/Johannesson 2008) arise, assuming that agents ponder and care about the outcomes of their activities (cf. Prendergast 2008), particularly with respect to ethical values.

Character qualities, motives, and reaction to incentives -- in brief the personality traits -- originally affect the magnitude and quality of realized human capital investments. These investments referring to the economic agents' character qualities and thus changing labor quality include expenditures on education, job search, in-service training, information retrieval, labor migration (cf. Shaw 1991), research and development, health care, and other human capital accumulation. Regard that "from the earliest formulations of the human-capital model ... it was on-the-job training and not formal schooling that was taken to be the paradigm case of self-investment" (Blaug 1976, 836). Today, human capital as the major source of technological progress is understood to be formed by (1) education in the widest sense (family education, schooling, vocational training) as moulding characters, cultivating minds and good breeding with regard to the present young generation and generations to come (cf. Wößmann 2000, Johnes/Johnes 2004), (2) learning from experience (on-the-job training, learning by doing, general experiences) qualifying the existing labor force, and (3) learning from research and development as the main source of the production of new knowledge (the loss of knowledge is neglected here). Thus we are able to identify human capital to represent the existing total body of abilities, skills and knowledge, a capital stock. The way in which these abilities, skills and knowledge develop shapes our perceptions of the world around us and in turn those

perceptions influence our search for capabilities and knowledge forming simultaneously our motives and incentives (on the existence conditions of incentives cf. Auriol/Renault 2008).

Whether economic growth is primarily driven by the stock of human capital or the accumulation of human capital shall be left here to theoretical and empirical growth research (cf. Aghion/Howitt 1998, Ch. 10). The fundamental insight of human capital theory is the compensatory nature of earnings on prior human capital investments, equivalent to a rate of return (cf. Rosen 1998, 683). Learning as the change of knowledge is the breeding-ground for inventions which, as applied, may result in innovations. As to the statements to follow the bearing on personal infrastructure is essential here, although they have institutional connotations.

As far as *education within the families* is concerned, parents, especially their status and wealth, take on an important role in determining the economic success of children. The inherent issues range from a reduction in child mortality and improved child health, to the devotion of greater resources to children in the home, to the impression of diverse ethical values and abilities on children's memory and behavior produced by parents, social milieu, kindergartens and pre-school teaching, and finally to general schooling and vocational training (as to investing in disadvantaged young children cf. Heckman 2008).

The German educational system consists of general compulsory schooling (for an international study of schooling with reference to the quality of human capital cf. Wößmann 2002), on the one hand, and vocational training, on the other hand. Leaving aside all differentiations of the current *school system* (as to the German states (Länder), public and private schools, special schools etc.) we may say: "In structural terms, the school system in Germany is at best a 'partly integrated system' that, after a relatively unitary elementary and primary level, splits into different parts at lower and upper secondary levels, at higher-education level, and at the level of further education" (Döbert 2007, 312). The upper secondary level refers, e.g., to the upper level of grammar schools or to high schools (Gymnasien), the higher-education level, e.g., to universities, universities of applied sciences and initial teacher training facilities, and the level of further education, e.g., to continuing teacher training arrangements.

Vocational education " ... has been organized according to the so-called 'dual system', which is characterized by vocational-practice training in an apprenticeship with accompanying instruction in vocational full-time schools, while the core education is traditionally provided in

the working environment. Dual system means co-operation between two 'learning locations' (vocational school and on-the-job instruction)" (Döbert 2007, 318). In addition, we must mention adult education in the form of familiarization with new jobs, advanced part-time vocational training or full-time retraining (cf. Hofbauer/Stoß 1977, 475-476).

Since the 1960s *educational policy* has been controversially discussed *in Germany* leading to various and repeated reforms without ending the dispute. There have been numerous criticisms, new proposals and realized approaches which resulted in new criticisms etc.

-- a permanent spiral of political engagement and endeavors up to the present time (cf. Edding 1980; Schnuer 1986; Kerber 1998, 345-359; Fuchs/Reuter 2000). Subsequently, some selected examples shall be given to describe the scope of the issues discussed.

Several general questions underlie the controversy, questions such as to the equal access to education for underprivileged sections of the population, the government emphasis on primary and secondary education or on higher education, the concentration of government finance on general or vocational education, the bias of educational policy towards elitist or broadly based education (cf. Schlotter 1997, 50-56) and the degree of autonomy in decision-making of all educational institutions as to, e.g., selecting teaching material and hiring personnel. The most important question concentrates on the scope of public and private education, respectively. This is a vital issue of economic order policy with respect to education. Why should public funds not be restricted to finance only elementary education in order to introduce and reinforce basic norms of behavior necessary for attending a job and to guarantee the development of fundamental capabilities of communication among the members of society mobilizing the external effects of education? (cf. Woll 1988, p. 160). Anyway, the dominance of the state in the field of education (on education planning cf. Mäding 1978) cannot be justified on economic grounds (cf. Kerber 1998, 358).

Now a list of issues under discussion will be assembled by way of selecting examples with reference to the different levels of education.

Pre-school education level: extent and form of education, incessant transfer to elementary education, raising private funds and improved allotment of public means, support of disadvantaged children with respect to encouragement of learning and care (cf. also Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung 2004, 422-458).

School education level: degree of perviousness between different types of schools, optimal time of distributing pupils to different types of schools, qualification of teachers and quality of teaching (size of classes, pupils-teacher relationship), purposeful assignment of financial means by independent decision-making, separation of management responsibilities and financing (cf. Wößmann 2007).

Vocational education level: low propensity of firms to educate apprentices, evaluation of vocational training as compared to general schooling (status of vocation-practical training in the upper level of grammar schools or high schools, transfer to universities), lack of skilled workers (cf. Kottmann/Kriegesmann/Striewe 2008), quality of education in the professions (law, medicine, management, information technology, politics), supply of improved employees and adult education continuous in space as part-time education of special institutions and universities (for an international assessment of vocational education cf. Baethge/Arends 2008).

University education level: lack of financial means (on the implications for planning institutions at the higher-education level cf. Brinkmann et al. 1976) as a result of politicians' disinterest in university education; quality of teaching; general introduction of education fees supported by students' access to credit finance and of a scholarship system for talented students; reinforced differentiation of courses of studies and types of academies, schools, colleges and universities (e.g., priority for the enlargement of universities of applied sciences) (cf. Donges et al. (Kronberger Kreis) 1993, see also Donges et al. (Kronberger Kreis 1997, 45-85); reform of the Bologna reform of university education (introduction of bachelor degrees, master degrees); emigration of highly qualified graduates from universities; specific deregulation (e.g., reduction of public regulations and financial autonomy for universities) and general introduction of the principles of competition (cf. Woll 1973, 1992a, 2001) up to the realization of a market model of university education as an ideal possibility of solving management problems of a modern university (cf. von Weizsäcker 1971).

With respect to *learning from experience* two aspects are of interest: on the one hand, on-the-job training and, on the other hand, learning by doing. On-the-job training was already mentioned in the context of formal training programs and apprenticeship education. Its broad interpretation in the literature is supported by empirical observations on the development of earnings over the life-cycle. "The age structure of earnings shows remarkably systematic patterns. Earnings rise rapidly in the first several years of working life, but the rate of growth

falls toward mid-career and tends to turn negative toward retirement"; the increase in earnings with work experience is interpreted to be " ... due to increasing productivity and human capital accumulation over the entire life cycle" (Rosen 1998, 687).

While on-the-job training of employees usually is organized by others -- masters, superiors, heads of work-groups -- learning by doing is experienced by perceptive individuals during production processes on the job. Learning by doing econometrically measured by past activity like past cumulative output or investment is taken to be one of the reasons stimulating dynamic economies of scale, because firms assume that increasing current production may reduce future average costs (on the economic implications of learning by doing cf. Christiaans 1997).

Without implicit agreements for long-term employment and real wage stability workers may be reluctant to invest in specific transferable skills (firm-specific, industry-specific or general skills). "Employers who rely on specific skills to compete effectively in international markets therefore need to institutionalize some sort of guarantee to insure workers against potential risks" (Estevez-Abe/Iversen/Soskice 2001, 145). Here we have a link to institutional infrastructure.

The reference to *research and development* as a source of learning needs some explanation. While research generally is understood as creation of new knowledge, development means " ... purposeful utilization and application of research results and experiences particularly of a technological and economic kind, in order to obtain systems, processes, substances, objects and tools (new development) or to improve those already existing (further development)" (Bundesbericht Forschung II 1967, quotation according to Kirsch 1977, 609). Learning from research and development may now be understood to comprise basic research and applied research (including utilization and application of fundamental research results).

In Germany the origin and expenditures of financial means for research and development mainly concern enterprises (e.g., tax incentives) and the state. Most research activities of industrial firms are internal affairs related to the objectives of the firms. In the literature on business administration, the question as to the determinants of research within firms has been discussed with respect to the production functions of new knowledge. Given the research organization, the variables of these functions are differently qualified labor and quantities of

other specific factors such as usage factors (cf. Brockhoff 1977, 594-599). As far as the organization of firm research is concerned, a number of issues must be settled; they are related, e.g., to the appropriate balance of basic and applied research, the vertical integration of research with manufacturing activities or the setting up of research joint ventures (cf. Aghion/Howitt 1998, 449-450).

Public research policy encompasses traditional state assistance of the sciences (particularly the universities) as well as modern state advancement of research and technology. Public aid may occur as direct state participation in research projects, subsidization of projects or support of the foundations of basic research and technology transfer. In Germany, the present furtherance of research and technology concentrates on the improvement of technical competitiveness, the assistance for new firms, the reinforcement of innovative small business and the extension of the fundement for research and development. The essential two problems of public research policy are the orientation of state research activities at the specific interests of firms, at the needs of subsidy recipients, and the regulating influence of the state on the production of new knowledge whereby the state claims to have superior knowledge about industries or technologies relevant for the future. Both arguments imply public industry policy emphasizing media-effective big projects and top, key or future technologies of large-scale enterprises (cf. Kerber 1998, 331-345).

It has been traditional to accept Schumpeter's (1912, 1942) threefold distinction between invention, innovation and diffusion of innovation which has then been summarized under the heading of *technical change* or progress (cf. Metcalfe 1998). In a wider sense, technological progress as the creation of new knowledge characterized, to a substantial extent, by non-excludability and non-rivalry, does not only originate from learning from research and development, but also from learning from experience. On developing a conceptual framework that emphasizes the endogeneity of technology cf. Acemoglu (2009, Part 4). *Invention* refers to the creation of new ideas, new products or processes (cf. Biais/Perotti 2008); *innovation* means the transfer of invention to commercial application and diffusion is defined as the *spread of innovation* into the economic sphere (cf. Freeman 1998, 858).

There is a substantial number of issues related to the creation of *innovations* which are generally taken to be the main source of dynamism in capitalist development; think of jet airplanes, personal computers, satellite communication, or laser surgery (on innovation in relationship to

education cf. Wößmann 2008 and related papers there). Subsequently, some of the issues shall be sketched. The emergence of innovations within firms has been analyzed in the context of specific production functions (cf. Brockhoff 1977, 599-609). Here we must keep in mind that " ... any new product, process, or market is created not by one innovation but by a whole sequence of innovations. Some of those innovations are more fundamental than others ... " (Aghion/Howitt 1998, 173). Also the structure of organization may be important. Hierarchical organizations often perform poorly in inducing the adoption of innovations. Increasing the rate of adoption of an innovation in a principal-agents context may cause the incentive costs of adoption of an innovation to rise at an increasing rate (cf. Dearden/Ickes/Samuelson 1990).

Phelps' (2006, 30) suggestion to encourage the creation of innovations markets is particularly interesting. At these markets " ... the entrepreneurs supplied to the market compete for an experienced financier to provide financing and advice on their project and the financiers try to match up with a likeminded entrepreneur through interviews and the offer of a contract. A match between entrepreneur and financier permits them to develop the entrepreneur's new idea." Such markets may overcome a lack of innovation which results from insufficient stimulation, engagement and intellectual challenge in the workplace as causes of poor economic performance (cf. Phelps 2006, 25; generally cf. Heckman 2008).

Public innovation policy may suffer from overregulation (e.g., loss of motivation of innovators due to excessively long periods until official sanctions will be received or to superfluous administrative restrictions) and misguided regulation (e.g., resulting from negative market effects of state project aid or reduction of competition due to enterprise merger on the basis of the concentration of public research assistance). This means: reduce state influences on innovation processes in favor of constructing a legal framework that stimulates innovations! Substitute process policy by order policy (cf. Kirsch 1977, 613-617; Schlotter 1997, 56-61)!

As far as statistical records of the private sector of the economy are observed, at least three innovation indicators are of importance: (1) the share of innovators, i.e., the percentage of firms with product or process innovations in the total number of firms; (2) the expenditures for innovations, possibly by industries; and (3) the innovation intensity, i.e., the quotient of innovation expenditures and turnover.

The appropriation of innovation advantages depends also on specific institutional regulations, particularly on patent law. The duration of the patents, possibilities of patent evasion, the emission of licenses and the deficiencies of patent protection are to be noticed in order to evaluate patent effects in relation to restrictive competition practices. Since we must also protect existing knowledge, we have to consider additionally copyrights, trademark laws, design patent laws and the law against unfair methods of competition (protection of trade secrets or avoidance of collaborators' bribery).

In the economic growth literature, innovations do not only enact an important part in endogenous growth theory (cf. Aghion/Howitt 1998) but also in growth policy. Oppenländer (1988, 224-299) proposes to pursue an innovation-related growth policy that simultaneously concentrates on the stabilization of expectations (necessity of a new business cycle policy), advancement of structural change by dynamic competition and provision of material infrastructure to support the production potential. The reference is here to institutional and material infrastructure.

3. Infrastructure in a Synoptic View

A definition of infrastructure We shall now summarize the definitions of the infrastructure categories given above in order to merge them into a general definition of infrastructure of the market economy.

Material infrastructure as the capital component of an economy's landscape structure comprises those immobile capital goods that essentially contribute to the production of infrastructure goods and services needed to satisfy basic physical and social requirements of economic agents and unavailable to the individual economic agents for production and cost reasons so that mass production is economically cogent; the fulfillment of these requirements entails the activation of the functions of material infrastructure.

Institutional infrastructure encompasses all customary and established formal rules and informal constraints (conventions, norms of behavior) of society as well as the procedures of enforcement to guarantee and to implement these rules by the state.

Personal infrastructure covers the size and the structure of the working population (quantitative aspect of personal infrastructure) as well as the value of productive capacities of the workforce, the human capital (qualitative aspect of personal infrastructure).

In an aggregated view, the term infrastructure of a country's economy refers to its specified labor force as personal infrastructure whose working and operability are guaranteed by existential goods and services which immobile capital stocks as material infrastructure produce within the framework of generally valid, binding social rules and constraints as institutional infrastructure.

This *definition* may be reformulated *in a disaggregated way* as follows. A country's infrastructure seizes on

- the material infrastructure: the part of man-made landscape structure that is represented by immobile capital goods whose outputs, serving basic physical and social needs of economic agents, are otherwise unavailable to individual actors for production and cost reasons,
- the personal infrastructure: the working population characterized by different aspects of human capital which pursues its activities in space ordered by material infrastructure, and
- the institutional infrastructure: the formal rules and informal constraints essentially determining the course of economic activities in space as well as the public and societal procedures of their enforcement.

If we look at one person (quantitative aspect of personal infrastructure) and her productive capacities (qualitative aspect of personal infrastructure), take this person's well-being to be provided against a shortage of existential goods and services (supplied by material infrastructure) and assume this person to enter into economic interactions with other economic agents according to certain rules (institutional infrastructure) which also radiate back to personal and material infrastructure, we comprehend the core of the term infrastructure as the growth framework of the market economy. This framework makes possible income growth, on the one hand, and changes of infrastructure, on the other hand, thus again stimulating growth.

Additional comments Referring to this sketch of the core contents of the term infrastructure we may state that if the *state* is understood to represent a relief order against chaos and thus its effective monopoly of coercive power is to be limited to the enforcement of general rules of just conduct (take Streit/Wohlgemuth 2000 as background), the political influences on the individual must be minimized. This remark is especially valid for personal infrastructure, public impacts on generative behavior of the population (population policy) and on human capital formation (particularly education policy) and for material infrastructure, especially public efforts to secure the individual's existence. Observe that these statements refer to a "normal" economic situation which is not given when economic agents representing a particular sector, e. g., the banking sector, jeopardize public welfare and then ask the state for financial assistance to overcome their economic problems, for the creation of which they are to be blamed.

The general situation is different, looking at social interrelationships of individuals governed by institutional infrastructure, with respect to the rules that set the limits for market choice through political-collective action, leaving here aside constitutional choices among sets of rules (cf. Buchanan/Yoon 2008). The state's comprehensive obligation of maintaining institutional infrastructure is beyond any discussion. The production of genuine public goods such as legislation and judiciary, administration of the community, in particular internal national security, safeguard of the value of money, and outward defense is of general interest, especially so since the state again and again fails to fulfill its obligations.

With respect to personal and material infrastructure, the reduction of the frequencies of political or government failures and the implementation of reforms are the dominant topics today. As far as material infrastructure is concerned the following principles should be accepted: (1) reconsideration of historically determined influences supporting public production of material infrastructure goods and services, (2) exclusive introduction of the doctrine of regulatory responsibility to guarantee the future provision of basic necessities for life, and (3) agreement to the application of the Tinbergen rule on organizing the division of labor between the public and private spheres of investment activities. In this context, also deregulation and privatization (considering necessary regulation) of state activities are essential issues. Mismanagement in these fields is no justification for rejecting pertinent efforts undertaken. In reality, criticisms of deregulation and privatization (misgivings as to the reduction of the number of jobs, increase of prices, loss of output quality) are expressions of mistrust in the performance of a weak state (on actual problems of privatization in Germany cf. Donges et al. (Kronberger

Kreis) 1997, 7-44). And finally, reinforced initiatives at creating public-private partnerships are desirable for economic reasons.

In an atmosphere of general controversy, two basic approaches as to personal infrastructure are imaginable in Germany: on the one hand, the nearly total withdrawal of the state, especially from education policy and, on the other hand, realistic piecemeal modifications of the present education system in view of its unsuccessful efforts undertaken for decades. The withdrawal policy may leave elementary schools in the hands of the state, whereas the remaining education system is to be run by private schooling activities under the condition of public regulatory control. Today, this alternative is unrealistic so that the second approach of some basic modifications may lead to a limited progress. These modifications could concern longer pre-school education, late tracking into different school types, and public financing and private provision of school services; all of these three alterations would result in more equality of opportunity for the young people (cf. Schütz/Ursprung/Wößmann 2008). If these changes would be supported by an increasing social esteem of the teaching profession, this second approach may turn out to be unexpectedly successful.

In the theoretical literature on microeconomics, one reference point of infrastructure in the market economy is the *Walrasian equilibrium model*, the microeconomic model of total equilibrium of competition (cf. Mas-Colell/Whinston/Green 1995, Ch. 17; Schumann/Meyer/Ströbele 1999, 234-245). Here households and firms (in the ownership of households) pursuing their specific functions of consumption and production, respectively, represent personal infrastructure. From the viewpoint of material infrastructure output supply, the existence of the households and firms by assumption is guaranteed so that the final equilibrium of competition can be realized. Households' initial endowment of goods encompasses labor, consumption goods and other goods relevant for production so that material infrastructure goods and services may be taken to be represented. Since the time reference of capital goods has no effect in static theory, material infrastructure is only indirectly considered via its initially disposable and produced goods or services. Institutional infrastructure is symbolized by a system of markets that equalizes the demand for and the supply of the goods considered, respectively, thus finally determining equilibrium goods prices and quantities.

In the market economy, outstanding characteristics of infrastructure are its *complementarities* to the non-infrastructure factors of production capital and land in the non-infrastructure sphere

(e.g., infrastructure as location factor) and among its material, personal and institutional categories. The non-infrastructure production sphere is provided by institutional and personal infrastructure and sustains material infrastructure formation. Substitution is possible; it may occur between personal infrastructure and material infrastructure in a few cases (e.g., substitution of pipe services by human labor) or non-infrastructure capital as we already know. Also substitution between non-infrastructure capital and (outputs of) material infrastructure occurs, e.g., capital-energy substitution; here energy efficiency is increased by investment in capital goods (cf. Erdmann/Zweifel 2008, 112-117).

There are many cases of complementarities between material, personal and institutional infrastructure. To mention a few: a hospital and its staff working according to health care regulations; a town-hall accommodating the city council that meets and works on the basis of communal law; human capital of politicians who are able to neglect unjustified requests of interest groups and guarantee the quality of lawmaking in parliament; regulations of institutional infrastructure to operate material infrastructure projects such as airports, harbors or road tunnels. A historical example: The positive effects of structural municipal reform (e.g., institution of civil service in U.S. cities (1900-1920)) on the share of municipal expenditures allocated to investment in material infrastructure (road, sewer and water investment) (cf. Rauch 1995). See also the above given definition of an organization! The coordination of human labor in action is the result of a combination of personal and institutional infrastructure; especially the institutional aspect is an outstanding problem of modern life, much more so than the number of daily working hours.

The *comprehensive view of infrastructure* is often neglected. At least in Germany it must be stated, at the level of economics, that there is a segmentation of the field into demography, labor economics, education economics, economic order policy, and networked material infrastructure (cf. wip.tu-berlin.de; keywords: Veranstaltungen, Conference on Applied Infrastructure Research (INFRADAY), Archive). The reasons obviously are specialization in research and application of preferred research methods. An integrating effort is missing. As to politics, the main barriers towards a unifying view of infrastructure are the establishment of political agreements by taking steps towards consensual democracy, "fire brigade" approach to the solution of actual problems, deficiencies of coordinating and planning the ministers' activities, patchwork economic policy, and concentration on mainly one category of infrastructure (e.g.,

emphasis on material infrastructure in the case of the reconstruction of East Germany)(cf. also Siebert 2005).

It is useful and popular in the political and economic discussion to concentrate on *infrastructure clusters* including, taken together, the material, institutional and personal aspects of particular fields of infrastructure. An emphasis on material and institutional infrastructure can be stated for the clusters transportation, energy, and housing, whereas the clusters health care, education, information technology, and environment are typified by the emphasis on institutional and personal infrastructure.

Finally, complementarities of material, institutional and personal infrastructure emerge while planning and constructing larger *infrastructure investment projects*, e.g., in the field of traffic and transportation (cf. Buhr 1975, 187-202; Boyce 2007). A presently impressive example is the planned deep water container terminal JadeWeserPort now under construction at the German Bight (North Sea) near Wilhelmshaven/Germany.

III. Infrastructure in the Growing Market Economy

A brief retrospective view into economic history *Future growth policy* in the form of infrastructure policy runs into *a dilemma*. On the one hand, we must be aware of our far-reaching lack of knowledge on future economic growth processes. On the other hand, at least as parents we are keen on designing the future long-term chances of success in the lives of our children and grandchildren as concrete as possible. Have in mind that a general policy friendly to future generations does not only provide available positions in day-time nurseries and kindergartens, but also creates education and employment prospects for our children.

The dilemma can be diminished in importance by formulating an infrastructure strategy for the future indicating the essential time references of the different categories of infrastructure in relation to economic growth. For this purpose we shall at first look back into economic history and then deal with future economic development.

Oriented at the life-time of human beings, the period of occupying employees and the life of capital goods, the following *growth periods* will roughly be distinguished: the medium term

(up to 15 years), the long term (up to 60 years), and the very long term (up to 90 years and more). Short-term growth, e.g., year-to-year growth, will not be of interest. Observe also that the social market economy as the economic order of Germany is valid in the long run.

These periods are relevant for analysis, since the categories of infrastructure have different references to time. For example, expenditures on education may only become fully effective in the long run or even very long run, with varying degrees of efficacy over time.

Although there is a number of papers on *economic growth over the very long run* we shall select, for our purposes, only one representative contribution, namely that of Jones (1999) raising and answering the question whether an industrial revolution was inevitable. See also Acemoglu (2009, Ch. 24.2).

The Industrial Revolution started in England about 1785 and spread from there to continental Western Europe and the USA. Thousands of years little change in the standard of living occurred, despite increases in the level of technology and substantial changes in the level of population. Then, initiated by the Industrial Revolution, per capita consumption grew dramatically in less than two centuries accompanied by a rise in population growth, then accompanied by population transition as well as the development of science and technology on the philosophic background of the Enlightenment (with reference to material infrastructure see Grübler (1990) on technological change in transport) stimulating human capital formation (cf. Mokyr 2005).

Two factors are central to understanding history. The first factor is a *virtuous circle*: More people (labor) produce more ideas (nonrivalrous knowledge, cf. also Tsoukis/Miller 2008) which in turn make additional population growth possible via the increased production of consumption goods (cf. Fogel 1990, Jones 2005).

The second factor is the *improvement in institutions* that create incentives and thus promote innovation such as intellectual and more general kinds of property rights (cf. de Soto 2002, 2003; Mokyr 2009). Today we would also consider three additional pillars of legal empowerment: access to justice and the rule of law, labor rights, and business rights (cf. United Nations, Commission on Legal Empowerment of the Poor, 2008). In history, property rights initiated the advent of science-based research guaranteeing the compensation of inventors for the

fruits of their labor. In general, economic institutions (in detail cf. Acemoglu/Johnson/Robinson 2005, 448-451) make the realization of ideas possible in the form of innovations.

In the present context we must discuss the relationship between the *creation of institutions and human capital formation*. According to North and Thomas (1973, p. 2) human capital is not a source of growth, it is growth. Focusing on the causes of economic growth, they stipulate that "growth will simply not occur unless the existing economic organization is efficient."

We must critically point out that economic organization established by sets of persisting rules as institutions (cf. North 1990, 3) is created by citizens, the result of human capital services, the productive capacities of human beings including the inherent character qualities of the working population (similarly North 1990, 5; 107: institutions " ... are constructs of the human mind"). In former times, nobility, clergy and other patrons were the outstanding representatives and holders of human capital who created institutions ranging from awarding temporary monopoly power through patents to the support of teaching and research at newly founded universities.

Going back to human beings' capability of thinking that enables man to create a specific order relative to a given rule, we are confronted with the question as to what was first: the rule or our capability of thinking, the institution or our human capital. In view of the complexity of the issue (cf. e.g., Haken/Haken-Krell 1997, 197-211) at this level of discussion, we cannot help perceiving a hen-egg-problem when we look for advice at the results of modern brain research.

Here our result of the previous considerations is the dominance of human capital formation over the creation of institutions. Institutions are essentially an output of human capital services.

Our historical analysis amounts to the conclusion that personal infrastructure, its quantitative aspect (population) and its qualitative aspect (human capital), is of central relevance to the creation of self-sustained economic growth processes in a general atmosphere of stimulating growth dynamics. No doubt, the permanence and strength of these processes will decisively

be supported by constituting an adequate and incentive-creating institutional infrastructure (cf. also Mantzavinos 2007).

Future economic development Drawing attention to *the future*, the national income growth rate of every future period will directly depend on the growth rate of the capital stock, the growth rate of labor and the rate of technological progress (growth accounting). This type of progress that materializes as innovations is taken to be related to human capital being determined by education, by learning from experience as well as by research and development. Above all, endogenous growth theory attempts to explain the rate of technological progress in terms of learning by doing, investment in human capital, in particular education, and as a result of imperfect competition (with reference to research and development) (cf. Barro/Sala-i-Martin 2004, Ch. 4, 5; Aghion/Howitt 1998; Christiaans 2004, Ch. 4). One of the outstanding and controversial research results (as a general summary on results cf. Stiroh 2001) led to the empirically derived conjecture that long-run growth is independent of structural characteristics of the economy and, thereby, independent of policy changes (semi-endogenous growth) such as an increase in average years of schooling or an increase in research and development levels (cf. Aghion/Howitt 1998, 404-406). We may firstly raise here questions as to the design of the underlying empirical research in view of often unavailable data (e.g., as to the different timing of the capacity effects of education (long term) or learning from experience (medium term)) (cf. Jorgenson/Fraumeni 1996; Barro 1997, 15) and the coordination of policy measures with respect to changing structural parameters (e.g., the rate of savings depending on public subsidies and taxes and the combined policy approach of altering different parameters). Secondly, it is more important that many testable implications of endogenous growth theory are still awaiting serious empirical assessment (cf. also Klenow/Rodriguez-Clare 1997). Now more and more evidence comes up to stress again the importance of human capital formation for economic growth. Compare the empirical research by Hanushek and Wößmann (cf. Hanushek/Woessmann 2007, 2008, 2009, Hanushek et al. 2008) in the case of education resulting in an actual increase of cognitive knowledge.

Another critical issue of the reasoning refers to the summarized form of its statement. Not only the magnitude of expenditures on human capital formation is important, but also whether changes of motivation of the working population or of incentives generated by institutions are simultaneously initiated, given the necessary constancy of economic policy. The present lack of young people studying mint-subjects (mathematics, information science, natural sciences,

technology (engineering)) in Germany may have many (also interdependent) reasons, one of the important causes, however, is the inadequate will to work of potentially qualified students in the present and the past. If expenditures on human capital formation are increased (e.g., augmenting the number of average years of schooling), stimulating the reaction to incentives of the working population that arises from the workforce's personality traits, then structural parameters such as the rate of labor force growth, productivity of knowledge in deriving new ideas, and the proportion of time individuals dedicate to education may change to bring about economic growth. If the incentives remain unchanged (or are negatively influenced), the structural parameters and the rate of growth remain constant. This statement may explain the observation that an increase in the rate of productivity growth was not generated, although the number of scientists and engineers has tripled as a fraction of the US labor force since 1950 (income level effect, no growth rate effect) (cf. Aghion/Howitt 1998, p. 434). This empirical fact corresponds to the theory of semi-endogenous growth.

The *structural parameters of an economy* are essentially determined by behavioral parameters, taking also account of technical and institutional parameters. The examples of behavioral parameters are the rate of savings, birth rate, death rate, labor force participation ratio, organizational parameters of creating inventions, and quotient of expenditures of unskilled labor on education and amount of unskilled labor. These parameters depend on the workforce's character qualities and their distribution over the working population. Let us take the propensity to invest as a behavioral parameter. It may be underpinned by the following motives or characteristic features (including ethical values): independence, urge to realize profits, readiness to discover, to be creative, and to implement change, take risk and seek after credits, struggle for appreciation, religious motive of doing something good (e.g., creating employment for others), desire to undertake or to participate in the sense of engaging in an entrepreneurial project as a charge.

If *capital accumulation and innovation* -- occasionally with particular emphasis on capital formation reducing the influence of technical change (cf. Jorgenson 1996, Young 1995) -- both are taken to be the key drivers of economic growth (cf. Aghion/Howitt 1998, 7), the question arises as to what determines capital accumulation and technological progress. This question is not too much related to the basic problem that traditional economic growth theory deals with: *how* does an economy grow, *if* specific assumptions are realized? Rather the issue at hand is: *why* does an economy grow?

Searching for the *determinants of capital accumulation* we must regard the broad heterogeneity of the capital stock and its permanently changing composition during the growth process. The most important direct determinant of capital formation is net investment in non-infrastructure capital and material infrastructure which is identical to capital growth. If we stick to this type of investment as private net investment we find that it depends on monetary variables of individual decision-making such as expected profits, turnovers, interest rates as well as the availability of credits and on real magnitudes of the entire economy such as savings and capital imports. In addition, institutional determinants take part in the formulation of investment strategies such as investment evaluation methods and tax laws (for a general reference in the context of development economics cf. Zilibotti 2008). Going further backwards in asking for the original determinants of net investment, we end up in our preceding discussion of the determinants of the propensity to invest: technical parameters, institutional parameters, and above all behavioral parameters being based on the entrepreneurs' motives. The same argument basically applies to public net investment. However, there are different kinds of parameters involved. Many behavioral parameters refer to politicians and administrators and institutional parameters also to the peculiarities of political and administrative processes.

The same methodic procedure may be accepted to analyze the *determinants of technological progress* (concerning, e. g., demand-induced technical progress). With respect to autonomous capital embodied technical progress (different machine vintages) and investment induced technical progress we may turn to the above derived statements. In the case of technical change as a function of human capital formation (education or research and development related technical progress (stock of patents, licensing agreements with foreign companies), autonomous disembodied technical progress (organizational technical progress, progress of information and communication in telecommunications, cf. Jungmittag/Welfens 2002) we discover direct relationships to personal and material infrastructure. If technical progress changes production techniques, then technical parameters alter. Institutional parameters may change when technical progress is supported by public policy measures.

Results of analysis The main result of our discussion is the *dominance of personal infrastructure* (especially human capital including the personality traits of the working population) at structuring growth of national income. The development of personal infrastructure decisively influences the evolution of institutional and material infrastructure. This statement is valid as to a backward look at economic history and with an eye to future economic growth:

there are *symmetric past and future growth processes*. The dominance of personal infrastructure becomes also plausible if we compare the time span elapsing between planning and operating a new material infrastructure capital good (let us say 15 years) and the time span elapsing between formulating and accepting a specific law (approximately 10 years) with a manager's or politician's life-long time of work (about 40 years), neglecting possible modifying features such as overlapping of events. In addition, the useful life of an asset or a law regularly is shorter than the working time of an economic agent. Material and institutional infrastructure change more frequently than personal infrastructure. In other words: a politician may work on and experience the emergence of a number of successively created laws during his active time in parliament. Personal infrastructure of today will determine economic growth of tomorrow, in the medium, long, and very long term (considering also interpersonal effects) -- an insight very often neglected. Economic growth will essentially be caused and shaped by economic agents' motives or character qualities and their distribution over the working population.

In the growth process, the *categories of infrastructure* must be regarded as being *interrelated* what is subsequently demonstrated through recourse to selected examples. Basically, while personal infrastructure is characterized by capacity effects ranging into the very long term supported by medium-term and long-term effective institutional infrastructure, material infrastructure, already in the medium term, must be controlled and upheld period after period. The reason is the particularly existence-safeguarding function of material infrastructure (first criterion); think of the necessity of permanently maintaining human health. On the costs and consequences of prevented and delayed infrastructure projects for Austria cf.

Gutschik/Horvath/Weinzierl (2007). This view of the time implications of infrastructure is supported by an empirical cross-country growth study on fundamental sources of long-run growth (cf. Sachs/Warner 1997). Thus we need an ongoing comprehensive and balanced infrastructure policy approach to settle the growth problems of the market economy.

Personal infrastructure is supported by institutional infrastructure through, e.g., measures of population and education policy. Personal qualitative infrastructure (human capital) shapes the qualifications of economic and political decision-makers in the framework of institutional infrastructure. It also maintains and develops an economic order such as the social market economy concept (cf. Krüsselberg 1994). The working of the social security system (group annuity insurance, health care insurance, nursing care insurance) as a part of institutional in-

infrastructure is decisively affected by the dependency ratio of population which, in turn, depends on the birth rate, just to emphasize important magnitudes of personal quantitative infrastructure. Material infrastructure is influenced (1) by institutional infrastructure (e.g., regulation (cf., e.g., Hahn/Tetlock 2008), deregulation, economically relevant laws (such as tax laws) and techniques (such as investment evaluation approaches)), (2) by personal qualitative infrastructure as far as its management is concerned, and (3) by personal quantitative infrastructure with respect to population change as a major determinant of investment decisions.

The income circular flow of the economy is determined by (a) material infrastructure (observe its effects such as its contribution to national income (cf. Biehl 1986; Buhr 2003, 17-21)), (b) personal infrastructure (qualified labor force as production input), and (c) institutional infrastructure (with particular respect to the economic order).

We discover *infrastructure of the market economy* to constitute *a system*. It is an entity of elements that are related to each other and interact. Systems organize and maintain themselves by structures which indicate patterns and interrelationships of system elements or subsystems. In our context, these subsystems are material, institutional and personal infrastructure which may again be divided into several parts (cf. Baetge 1977, Helbing 2008).

In the preceding sections there were a number of references to the *effects and determinants of infrastructure* which interact in a spiral moving through time in the economic growth process (cf., e.g., Buhr 1981). For instance, a population change initiates economic growth that requires additional material infrastructure. Most of its effects materialize in the form of technological or pecuniary external effects (reference to the price mechanism) or come up in the circular flow of income (cf., e.g., Buhr 1975, 30-38; see also Morrison/Schwartz 1996). In many cases, the question as to the determinants of infrastructure raises issues of investment decision-making in a broad sense. Concentrating mainly on material infrastructure we may distinguish different cases of capital growth: case of "harmonious" structure of non-infrastructure and infrastructure capital stocks, case of material infrastructure as growth incentive (especially excess supply of infrastructure), case of externally induced "fast" growth of infrastructure capital stock ("bathtub" case: trust in substantial future economic growth unrelated to infrastructure investments), case of infrastructure capital stock as growth barrier (especially excess demand for infrastructure (cf. Buhr 2003, 17-20)). In addition, problems of

financing infrastructure (private finance, monetary resources from state budgets, infrastructure funds (cf. Blankart/Knieps 1996)) are of particular interest.

With respect to the *population variable* of personal infrastructure, the question concerning its desirable and actual magnitude in a given context comes up (cf. Meadows et al. 1972 and the pertaining subsequently published literature). We stated that population growth has a beneficial effect on human capital formation. Here a main conclusion of population research should be taken into account. Moderate population growth has much stronger long-run economic effects than a stationary population or very fast population growth (cf. Simon 1977, 11). In the case of population decline as already experienced in Germany, the negative effect of shrinking population on human capital accumulation and its growth contribution must be compensated by specific additional efforts to stimulate human capital growth.

IV. Infrastructure Policy

We derive infrastructure policy to constitute the essence of economic growth policy in the framework of the social market economy as an indirect approach to growth, oriented at the given definition of infrastructure. Accordingly, the access-points of infrastructure policy are (a) changes of population and (b) increases in human capital by education and learning, initiating and establishing (c) the economic agents' guarantee of a continued existence by material infrastructure investments and (d) necessary alterations of the economic and state order and its pertaining institutions. These four aspects may be interrelated. The details of the problem of identifying possible starting-points and delimiting the extent of specific policy measures shall not be discussed here.

The basic assumption underlying our analysis is future economic growth to be unpredictable, especially regarding the structural implications of growth. Paying regard to the natural environment, infrastructure policy must be comprehensive and balanced over time with respect to all categories of infrastructure. Such a long-term policy would facilitate the successful implementation of short-term economic policy, e.g., in the case of lasting unemployment. A good example of a deficient development policy has been given by infrastructure policy as applied to the five eastern German states (Länder); here the emphasis has been on material infrastructure, widely neglecting specific necessities of personal and institutional infrastructure.

Decision-making in all categories of infrastructure must basically follow the principles of the economic and state order. The leading principle thus is order conformity. This statement is valid for the organization of the health care sector according to economic order policy inasmuch as it is for the distribution of new political tasks according to the principle of subsidiarity as a state order policy principle. Exceptions from this rule must be justified. Can the provision of drinking water by a private supplier sufficiently be checked for its quality? The answer depends on the given circumstances.

Concerning *material infrastructure* the principle of regulatory responsibility must be exclusively and consistently pursued by the state, accompanied by a solid increase in provision efficiency and a substantial withdrawal from public investment and ownership. In this sense, in Germany, especially in the fields of health care, energy supply and transport -- to concentrate on the most urgent cases -- substantive progress is needed. The frequency and extent of government failures has to be reduced remarkably.

Reforms of German *institutional infrastructure* are on the agenda at all levels (e.g., regarding the political system, the federal constitution, and the existing laws). With respect to the necessary reform of the political system, a good indicator of system quality is the size of the national debt. One possible reform step would be to ban re-election of politicians. More attention must be dedicated to the interplay of the rule of law and economic growth. The principle of causation should be newly evaluated. Private profit realization is not compatible with socialization of losses in the same context. Complementing the necessary rules is often demanded, however, success will only be guaranteed if the spirit of the rules will guide action. The need of the hour requires advancement of order policy, economic order policy and state order policy. We realize that the distinction between these two fields is that economic order policy is undertaken in favor of third parties, whereas, with regard to state order policy, politicians commit themselves to follow certain rules of behavior or to apply specific maxims of conduct in the political process. A solution of the implied problems may be to separate strictly the decision-processes of economic order policy and state order policy as to persons, institutions and functions involved (cf. Cassel 1988, 321, 322). Last, but not least, we need a reduction of public obligations, the formulation of adequate laws, a decrease in the number of civil employees and politicians and powerful state authorities. Most urgent right away are a reduction of subsidies of all kinds, a retrenchment of the distended social welfare system and a reformulation of the tax laws.

Regarding *personal infrastructure*, lack of reforms in the sense of supporting and stimulating economic growth is a dominant topic in Germany. Population policy (especially family policy in the sense of Birg's biographic theory of generative behavior) and education policy (in a liberalized sense) are of importance for the future. Particularly relevant would be the introduction of the objective of population sustainability (cf. Birg 2005, 59). At the present time, in order to increase the number of births in the future, an approach must be found to make economic dynamics guaranteeing a high level of welfare compatible with the stability conditions of creating and maintaining families. Possibilities arise, in many respects, from giving priority to parents and people who are engaged in family services (cf. Birg 2009).

With respect to education, the qualifications of managers responsible for the governance of big (oligopolistic) firms become vital in times of economic recession, particularly regarding the maintenance of endangered employees' and workers' jobs. Management failure should be detected earlier and strictly counteracted right away, possibly under expert supervision. Serious doubts have arisen whether managers and politicians are sufficiently competent to settle the present problems of the financial and economic crisis. Let us have in mind that, in a long-term perspective, today's qualifications of managers, also of politicians, technicians and representatives of the professions, are the result of yesterday's higher education. It makes no sense to complain about the poorly founded decisions of the political class and, at the same time, to neglect the historical references of the criticized political reality. The often existing silence about personal infrastructure problems should come to a close. Furthermore, raising a final issue with reference to the present personal infrastructure situation, e.g., reforms of the personnel employment aspect of government administration (reforms of service laws, cooperation of government units, reduction of bureaucracy (cf. Jochimsen 2009)), on the one hand, are urgently needed. On the other hand, the mobilization of private initiatives would be desirable, particularly stimulating private self-help.

Infrastructure forms a system of its interrelated categories that must be further developed to invigorate economic growth in the future (for some first approaches cf. Pitsoulis 2004). In this sense, what must be the major changes of the present economic policy? (1) We should develop a long-term perspective concentrating on the indirect growth approach of infrastructure policy. (2) The center of attention in the field of institutional infrastructure is the economic order of the market economy embedded in an adequately supporting state order. (3) On this basis all aspects of material infrastructure must be organized according to the principle of

guaranteeing a continued existence of economic agents. (4) Priority must be given to personal infrastructure: (a) introduction and pursuance of the objective of population sustainability; (b) substantial investment in human capital; especially the low level of education at all levels of education must be overcome; (c) reinforced supervision and control of the performance and achievement of all political and economic decision-makers.

The result of implementing these changes would be the revision of the present economic order of the social market economy -- an economic order then solidly based on a long-term lasting fundament, on its infrastructure as a growth framework. How to initiate and to organize necessary policy changes is a topic not to be dealt with here.

V. Concluding Remarks

Obligation of learning We now live under the obligation of *learning*, possibly life-long learning, to improve our human capital as a factor of production, to stabilize population, to guard our existence and to improve human economic interaction. Since one of the basic postulates of the social market economy concept is economic freedom, we must be able to make decisions in the sense of this principle. If the moral obligation to submit to the social objective of freedom is no longer accepted, its implications such as the responsibility for one's own life and activities must be taught again and understood. To enjoy the advantages of a free life means to accept the implications of the privilege of economic liberty. This insight must be learned, as is generally possible at any age (brain modularity, neuro-plasticity) according to neuroscience research (cf. Brocas/Carrillo 2008; Kempermann 2008a, 2008b; Opitz/Friederici 2007).

There must be much more emphasis on *long-term thinking* in economic affairs. The excuse that long-run considerations do not fit into parliamentary work restricted by the four-year duration of the legislative period is simply superficial. This is a matter of organization to be learned!

Among others, especially politicians are rarely inclined to evaluate the *consequences of policy measures* they suggest and realize. In Germany, financing public officials' pensions and reducing national debt will be outstanding problems to be settled in the future, both problems

being created by rash political acts over many years in the past. Errors and mistakes should be corrected before a regulation becomes effective, particularly when complex subjects are dealt with (cf. Dörner 2007). Complex *systems* as they are investigated, for instance, in network analysis need special attention of qualified staff able to learn about how to operate these systems owing to the multitude of interdependencies of variables inherent in the models. The best algorithm for problem solving is of little use, if the successive solution steps are not understood. In both cases, analytical progress will only be forthcoming by more intensive learning about the magnitude, structure, and relevance of the systems (cf. Vester 2007).

Economics as a discipline of teaching and research has the *social obligation of educating* especially young people, in how the economy works. University education in economics not only serves the training of future researchers, but must also enable students later to do a good job as economists in diverse occupations. Up to now this social obligation was poorly fulfilled with respect to a general education of all segments of the population, at differing levels, respectively, and a specific education of particular groups such as politicians and lawyers. Suitable literature on basic economics is sparse (cf., e.g., Heilbroner/Thurow 1998).

International aspects Many aspects of the preceding statements have *international references*. We are confronted with a wide field of research, therefore only a few examples expressed in key words shall be mentioned. In the international monetary sector, in view of the 2007 world financial crisis, important issues of institutional infrastructure (creation of a satisfactory world finance order) and personal infrastructure must be settled in the future. With respect to the real sector a list of problems must be solved. (a) Concerning material infrastructure: enduring finance of the EU cohesion fund dedicated to specific infrastructure projects, development and implementation of network strategies (transport and ICT networks) for Europe and beyond (cf. Giaoutzi/Nijkamp 2008, Bröcker et al. 2005, Wegener 2008); (b) concerning institutional infrastructure: formulation of a comprehensive and consistent European economic constitution (cf. Busch 2008) and world trade order; (c) concerning personal infrastructure: worldwide exchange of information and knowledge, support of international collaborative innovation (via Internet and co-location of team members), improved international division of labor, in particular availability of and access to specific talents.

A final word We learn that the focal reference point of infrastructure is *personal infrastructure*. It refers to the central position of the human being in its economic, social and natural

environment, meaning the economic agent and its productive capacities typified by its specific interactions of body, mind and character.

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