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HUMAN CAPITAL, KNOWLEDGE, AND INNOVATIONS**

Founded on Heinrich von Storch's theory of "inner goods", the paper develops the concept of a person's or an economy's stock of human capital, which comprises the competences of health, of skills, of gaining insight, of adequate social, cultural and political behaviour. Knowledge in a wide definition is the total of all these competences. Knowledge in a narrow definition is the competence of gaining insight; its application includes the activity of making an invention. A Schumpeterian entrepreneur uses an invention to develop and to introduce a new profitable product. The new knowledge contained in the product is, in a process of dynamic competition, first used as a private good, then it is regularly exposed by "open knowledge disclosure" to a club or network of users, and finally, it becomes available to everybody as a public good.

Keywords: history of economic thought, human capital, knowledge, inventions, innovations.

INTRODUCTION

To my own surprise, human capital and knowledge in the literature are, as a rule, two different objects of research. This contradicts to obvious evidence that a person's knowledge is contained in and evolves from his or her human capital. My intent is to root explicitly human knowledge in the humus of human capital.

I will start in *section 1* with the concept of inner goods, published nearly 200 years ago by my favourite in the history of economics, Heinrich von Storch, in his *Cours d'économie politique* 1816 (in German translation: *Handbuch der Nationalwirthschaftslehre* 1819). In *section 2*, I will reformulate Storch's concept in more contemporary terms. The aggregate of inner goods of an economy, called by Storch the population's civilization,

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will be identified as the human capital of the population. In *section 3*, this human capital is interpreted as knowledge in a wide definition, comprising six types or components. One of the components of knowledge in the wide definition is knowledge in a narrow definition. In *section 4*, I will focus on this latter component of knowledge, which is able to produce new knowledge and may induce inventions and innovations. The dissemination of the new knowledge and innovations over the economy is sketched in the process of Schumpeterian entrepreneurial dynamics: An innovator uses an invention as a private good to produce a new product, which he will sell in the market as a monopolist gaining extra profit. The monopolist may be inclined to disclose his knowledge to a club of users; the new knowledge incorporated in the invention is then applied as a club asset in the innovation network of club members. When the club by competition of more imitators finally collapses, there will be cost-free dissemination of the new knowledge contained in the invention, which now has become a public good.

1. STORCH'S CONCEPT OF "INNER GOODS"

In Storch's terminology, the economy of a country has at its disposal two stocks of goods: Firstly, a stock of "outer goods" or physical goods; secondly, a stock of "inner goods" or non-physical goods. The two stocks can be used either for production to gain income ("Erwerbsstamm") or for consumption ("Verbrauchsvorrat").

Inner or non-physical goods are part of the human beings forming the population. In the columns of Table 1, Storch's six types of "inner goods" are mentioned: health, skills, knowledge, aesthetics, morals, and religious belief. Storch calls the aggregate of all "inner goods" the "civilization" of the population. "Inner goods" are, partly, the result of genetical factors of the population; they are, however, mainly produced by labour-service inputs. In Table 1, as examples, services of medical doctors, teachers, artists, moralists etc. are mentioned. It is necessary that the service inputs supplied are accepted by those receiving them. For the inner goods to come into existence, a cooperative effort is necessary by receivers and suppliers of the services.

The three left hand side columns of Table 1 are headlined by "mainly commercial orientation", which means that health, skills, and knowledge are

stocks of inner goods accumulated primarily with the intent of income gaining. The last three right hand side columns of Table 1 list inner goods mainly used with non-commercial orientation. The word “mainly” is important, because, in principle, an inner good may be devoted to both commercial and non-commercial ends.

Table 1
Heinrich von Storch’s Concept of „Inner Goods“

	Mainly commercial orientation			Mainly non-commercial orientation			Aggregate
Types of „Inner Goods“	Health	Skills	Knowledge	Aesthetics	Morals	Religious Belief	Civilization
Formation of „Inner Goods“: Services of, for instance,	Medical Doctors	Craftsmen	Academic Teachers	Artists	Moralists	Clergymen	

Source: Storch, Heinrich von: *Cours d’économie politique*, 5 vols., St. Petersburg 1816. German edition: *Handbuch der Nationalwirthschaftslehre*, 3 Bde., Hamburg 1819.

Storch is unique in explicitly including such intangible, non-physical assets like aesthetics, morals, and religious belief into his concept of civilization. He was an admirer of Adam Smith, but he refused to follow him in his concentration on physical production. Recent authors on human capital, like Theodore Schultz (1961) and Gary Becker (1964), still focus on human capital formation intended to enlarge the capacity of income generation. This tendency is also dominant in the contemporary human capital discussion. Storch’s point is to put an emphasis also on non-commercial inner goods. It should be evident that inner goods and a corresponding wide concept of human capital hint to more than the capacities of income gaining. The population’s ability to estimate the aesthetics of arts, the rules of moral conduct and of religious belief are also the most important aspects of inner goods and of human capital.

Intangible assets incorporated in human beings have special problems of measurement, durability, and price formation:

As concerns measurement, Storch gives no hints on how to measure the quantity and the quality of an inner good. Nothing is said on how to aggregate over the different types of inner goods and over different persons

of a population. Before rejecting Storch's concept because of difficulties in measuring and aggregating, it should be recalled that there are similar problems with real capital – nevertheless we are used to speak of an economy's real capital stock in macroeconomics.

As concerns durability of inner goods, Storch rejected his contemporaries' opinion that services cannot have enduring effects but will disappear the moment they are delivered. He insists that inner goods are the enduring result of service inputs, and that these goods possibly have a long-term existence. Their life times frequently would be longer than those of physical assets.

As concerns price formation of inner goods, Storch in his *Handbuch* argued that those goods cannot have a price of exchange because there can be no exchange of inner goods. In a later publication, *Betrachtungen über die Natur des Nationaleinkommens* (1825), he states, however, that there are prices of inner goods applied in commercial orientation, which would include remuneration of the service inputs. For example, handicraft products of craftsmen will have prices which include remuneration of teachers of handicraft skills. Inner goods in non-commercial orientation are not sold for prices, though they contribute to the population's utility. The capacity of estimating the aesthetics of works of art is not sold in a market, though this capacity contributes to the utility of spectators of the works of art. The capacities to estimate aesthetics, morals or religious belief do not have market prices on which a remuneration of those who contribute by their services to the formation of the capacities would have to rely.

2. REFORMULATION OF STORCH'S CONCEPT: HUMAN CAPITAL

In the upper part of Table 2, Storch's concept has been adapted to contemporary standards. It has been revised und supplemented by change of names and by change of contents in order to arrive at a comprehensive concept of a country's human capital.

Table 2
The Concept of a Country's Human Capital

	Mainly commercial orientation			Mainly non-commercial orientation			Aggregate
Components of Human Capital	Physical competence	Mental competence		Social competence	Cultural competence	Political competence	Human Capital
		Skills	Knowledge, Inventions,				
Formation of Human Capital by:							
Labour services of, for example,	Medical Doctors	Craftsmen, Engineers	Academic Teachers, Researchers	Social Workers	Artists, Musicians	Politicians	
Other Inputs, for example,	Medicines, Hospital Services	Tools, Machine-Services	Books, University Services	Services of the Social Infrastructure	Services of the Cultural Infrastructure	Services of the Political Infrastructure	
Affected by:							
Learning by schooling	Investment aiming at income gaining with increasing returns to scale			Expenditure aiming at progress of social, of cultural and of political standards with increasing returns to scale			
Learning by doing	With cost-free external vertical and horizontal spill-over effects						

Source: Own arrangement based on Storch's (1816) concept and completed by Lucas' (1988) „Learning by schooling“ and Romer's (1986) „Learning by doing“.

Inner goods have become “components of human capital”. Health was changed into “physical competence”. Skills and knowledge are seen as “mental competence”. Knowledge has been supplemented by “inventions”. Aesthetics, morals, and religious belief have been substituted by “social competence”, by “cultural competence”, and by “political competence”; they all contribute to the cooperative standards of social, of cultural and of political life. The three competences on the left hand side again are declared as mainly commercially oriented; the three competences on the right hand side are mainly non-commercially oriented; but in principle, all competences may serve both types of orientation.

As concerns the formation of human capital, the examples of labour services inputs have been complemented by examples of inputs of physical goods. There are material inputs like medicines for health, tools for skills, books for knowledge. There are also inputs of services of physical stocks like hospitals for health, machines for skills, universities for knowledge; there are also services of the social, cultural and political infrastructures.

The lower part of Table 2 supports the revised and supplemented Storchian concept by two important human capital formation characteristics of the “New Growth Theory”:

- Lucas (1988) stresses human capital formation by investment in “learning by schooling”. Educational expenditure in his theory results in human capital formation with increasing returns to scale. Lucas focuses on human capital investment having commercial orientation. But “learning by schooling” may also be true for expenditure having a non-commercial orientation, i.e., being destined to develop the social, cultural and political competences of the population.

- Romer (1986) accentuates formation of human capital via “learning by doing”, when labour learns to handle technically new machines and equipment. This learning of advanced techniques will finally be available without extra cost everywhere in the economy. The “learning by doing” formation of human capital therefore is, considerably, a matter of external effects. Like most of the other authors, Romer concentrated on human capital having commercial orientation, but this concept can equally well be applied to learning by doing in social, cultural and political competences. In Table 2, Romer’s concept means vertical spill-over effects when learning by doing happens in the same component of human capital, and horizontal spill-over effects when it happens in other components of human capital. For example, horizontal external effects are given when mental competences of the population spill over to social and political competence.

The sketch of a wide concept of human capital given in Table 2 is, of course, not more than a definitional framework. To fill the frame with theory, one should have information on the production functions of the various components of human capital. This would imply to know more about the strength of Lucas’ increasing returns and about the network of Romer’s external effects – both are most important for the volume and the structure of a country’s human capital.

The human capital in Table 2 should be interpreted as a flow concept relating to additional human capital per period, produced by inputs per period, effected by investment and expenditure per period, reinforced by increasing returns and by spill-over effects per period.

I will now proceed to human capital as a stock concept. This means, the population’s present stocks of physical competence, of mental competences, of social, of cultural and of political competence are seen as the result of past accumulation. In other words, the six components represent capabilities of the population to produce output of human capital which either may be used

for income earning or for promoting, in one way or another, the population's well-being:

- Physical competence is the capability given by health.
- Skills are the capability to do things expertly.
- Knowledge is the capability to apply imagination and information, for example by making an invention.
- Social competence is the capability to help others.
- Cultural competence is the capability to indulge in and to estimate works of art.
- Political competence is the capability to use and to accept institutions of politics, of jurisdiction and of administration.

3. KNOWLEDGE IN THE WIDE DEFINITION: COMPETENCES OF CIVILIZATION

The aggregate of the six competences or capabilities of the population correspond to what Storch called "civilization". This aggregate represents the population's knowledge in a wide definition. What is true for human capital, is also true for knowledge in this wide definition: Civilization knowledge is not only knowledge of the physical and mental competences which qualify labour and improve commercial prospects of income earning. It is also knowledge which qualifies people to accept and to estimate social, cultural and political assets.

Among the competences of civilization representing knowledge in the wide definition, there is the mental competence of knowledge in the traditional meaning which I will call knowledge in the narrow definition. It was already present as one of Storch's "inner goods". In his original French language *Cours d'économie politique* (1816), this knowledge was characterized by the word "lumières", which meant the human capability to get things clear or to get insight into complicated facts and structures. I will return to this concept of knowledge in the next section.

Let me first mention and explain two concepts relating to knowledge in the wide definition, firstly actual and non-actual knowledge, secondly general and special knowledge:

Actual and non-actual knowledge: In contrast to the stocks of real capital, the competences of the non-physical stocks of human capital do not have a certain technical or economic time of life and cannot be amortized according to their life time. However, part of the knowledge represented by human

capital may become obsolete or non-actual. As a rule, only the most modern additions to the capabilities currently applied will be actual knowledge. As time goes by, this knowledge will be substituted by even newer knowledge; the old knowledge will not disappear but will become obsolete. For example, the application of horse power in the rural economy of the past was actual knowledge; it was superseded and became non-actual knowledge when the capability developed to apply machines and computers in the industrial economy.

Knowledge in commercial orientation mostly becomes obsolete and out of date by technical progress which is brought about by inventions and introduced by innovations. Knowledge in non-commercial orientation may become outdated by change of traditional values of thinking and of acting.

General and special knowledge: Knowledge is not distributed evenly among the members of a population. In our context, it seems appropriate to distinguish general knowledge and special knowledge. General knowledge relates to capabilities of a lower degree of precision; it is good enough to carry out everyday applications of actual knowledge. For example: General knowledge of skills is sufficient to handle motors or computers; one does not have to know how a motor or a computer works. General cultural competence is knowledge sufficient to accept and to estimate works of art; it is not necessary to understand their construction and their effect of getting attention. Special actual knowledge is, in contrast, that of an expert who knows the details of construction and of application.

4. KNOWLEDGE IN THE NARROW DEFINITION: INVENTIONS AND THEIR USE BY ENTREPRENEURS

I now return to the mental competence of knowledge in the narrow definition, i.e., the human capability to get insight into complicated facts and structures. The most important example of up-to-date and special expert knowledge of this type is new knowledge of an invention. The human capability to get insight leads an inventor to a blueprint of a new useful combination of resources.

In Schumpeter's evergreen theory of economic development (first published in 1912), a dynamic entrepreneur uses the knowledge of an invention to carry out an innovation. This means, he is ready to apply the blueprint of the new combination of economic resources by organizing production of a new good. The entrepreneur is motivated to do so if he

expects the new good to be successful in the market and to give him extra profit. Because he cannot be certain about market success and extra profit, there is risk in his decision to be an innovator. If he is successful, he will, at first, be a monopolist for the new good. The monopolist's profit induces imitators to start competition by offering copies of the new good in order to participate in the profit. The innovator may try to prevent entrance of imitators into the market for the new good, for example, by getting the innovation patented. This will, as a rule, not help him for a long time: Imitators' competition will increase supply of the new good and lower its price. The monopolist's profit will turn out to have been a temporary, risky profit of the first supplier, which in the competition with imitating followers gradually fades away.

The dissemination of the new knowledge in the course of Schumpeterian dynamics in modern terms is sketched in Table 3.

The new blueprint knowledge of the inventor in a first period is transferred to the innovator. In the market for application of this knowledge, there is the inventor as a supplier and the innovator as a demander. In principle, the new knowledge in this period is a private good, for which the two criteria of private goods, rivalry and excludability, apply. Rivalry means that more than one user of the new knowledge would harm the first user's position by reducing his innovator's profit. Excludability means that it is possible to transfer the knowledge to one demander – the innovator – and to exclude others.

In a second period of Schumpeterian dynamics, it happens that some imitators enter the process. Imitators get the new knowledge contained in the invention not in a market by paying a price; they rather imitate the good produced with the new knowledge by offering a copy or a similar variant of it in the market for the new good. The new knowledge remains a private good.

However, in modern economies, the second period of Schumpeterian dynamics regularly follows a different pattern: Being confronted with the impending market entrance of imitators, the hitherto monopolistic innovator will be inclined to accept cooperation with potential imitators in an innovation network. The present literature on innovation dissemination speaks of "open knowledge disclosure" (Muller/Pénin 2006). The question of why an innovator might be ready for "open knowledge disclosure" is central in contemporary research. One answer is that for an innovator it is more profitable to sell licenses to members of a network than to cope with the uncertain effects of imitators' competition. A second answer is that an

innovator by knowledge disclosure to network members earns a reputation for his own business, which again seems to him preferable to imitators' competition.

Table 3
Dissemination of new knowledge in the narrow definition
in Schumpeterian entrepreneurial dynamics

	Market process	Dissemination of new knowledge contained in invention in the form of
1st period	Invention used in risky investment by innovator who earns monopolist's profit and tries to prevent entry of others	Private good used by innovator
2nd period	- Entry of some imitators looking for participation in profit - Innovator decides for "open knowledge disclosure" to club members of an innovation network	Private good used by innovator and some imitators Club good used by members of club network
3rd period	Many imitators who may or actually will enter the market	Public good used without cost by many

Source: own arrangement

In an innovation network, an inventor's up-to-date specific expert knowledge is applied by an innovator and is made available to the members of the innovation network. These members succeed to get at their disposal the new knowledge without being rivals. That will happen, for example, by giving to everyone of the club-members the knowledge for only one of the links in the production chain of the new good. Non-members are excluded from using the knowledge. Non-rivalry and excludability are the two criteria defining the new knowledge as a club good of the members of the innovation network.

In a third period of Schumpeterian dynamics, the time of a limited number of imitators or of club members has come to an end. The new knowledge for producing the new good has now become available, without extra cost, to a practically unlimited number of imitators. None of the many is a perceptible rival of all the others; there is non-rivalry in application of the new knowledge. None of the many can be excluded from using the new knowledge; there is non-excludability. Therefore, in the third and final period, making use of the new knowledge has become a public good.

The three periods serve to sketch the pattern of the process of innovation and dissemination of new knowledge. The more the process of dissemination proceeds, the stronger is its influence on the economy's development and growth.

Schumpeter (1912) does not answer the question of how the up-to-date special new knowledge evolves. There is no analysis of the generation of the inventor's capability to apply imagination and information in order to get the insight necessary for an invention. Schumpeter assumed that, as a rule, there is a pool of inventions, and that an entrepreneur may acquire an invention from this pool.

Let us return to Table 2, where the column "Knowledge, Inventions" gives some hints on inputs that matter in the generation of new knowledge. There are labour services, for example of academic teachers and of researchers; there are other inputs, for example, books and university services. Apart of this, the lower part of Table 2 hints to increasing returns to scale and to vertical and horizontal spill-over effects; their influences will, of course, be present in the generation of new knowledge and of inventions.

But some pieces of information on labour inputs and other inputs, on increasing returns and spill-over effects are not sufficient to identify an economy's production function with all its properties, which would explain the formation of capabilities of new knowledge and of generating inventions.

A country trying to promote development and growth by Schumpeterian processes cannot hope, by just spending money on education, to accumulate knowledge in the narrow definition and, thereby, to generate inventions. The production process of this knowledge is, largely, unknown or indeterminate. There is, further, no guarantee that inventions will be used by innovators. All the country can do is to improve conditions for the accumulation of human capital and knowledge in the wide as well as in the narrow definition.

CONCLUSIONS

The paper has tried to connect systematically concepts of human capital, of knowledge, and of innovations in a unifying framework based on Heinrich von Storch's almost 200 years old seminal contribution on inner goods.

In this framework, two characteristics of human capital come out which frequently do not receive proper attention:

- the stock aspects of existing human capital capabilities *versus* the flow aspects of human capital formation;
- the orientation of human capital either toward income gaining activity or toward non-commercial uses.

Knowledge, firstly, in a wide definition comprises all types of physical, mental, social, cultural and political human capital competences. Knowledge, secondly, in a narrow definition focuses on the mental capability of getting insight into complicated facts and structures.

The capability of knowledge in the narrow definition includes the new knowledge of an invention. This is where the unifying framework of human capital and knowledge is ready for connection with Schumpeterian processes of economic innovations. The new knowledge will first be used by an innovator as a private good. As a rule, it will then be used in a dissemination process as a club good of an innovation network. Finally, it may be used by everybody as a cost-free public good.

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