INNODRIVE WORKING PAPER SERIES

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April 2012

INNODRIVE Working Paper No 21.

The research leading to these results has received funding from the European Community's Seventh Framework Programme under grant agreement n° 214576

CENTRE FOR EUROPEAN POLICY STUDIES
Thinking CEPS ahead for Europe

Intangible capital in business and national accounting and economic analysis

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This paper is prepared as a contribution to a research project on "Intangible Capital and Innovations: Drivers of Growth and Location in the EU",**(INNODRIVE) -** sponsored under the EC's Framework Programme, Project no.: 214576. It constitutes a presentation of the overall context for the design and implementation of the project and provides only a summary of the results, which are presented in specific deliverables.

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Outline

The future is not there to be discovered, but must be created. There are no laws of certainty about what will happen when a human individual does this or that, but there are constraints as to what range of diverse things can happen. There is not certainty, therefore there can be decision; but there is bounded uncertainty, therefore there can be meaningful choice even in face of the absence of certainty. (G.L.S. Schackle: "Decision, order and time in human affairs", Cambridge University Press, 1961)

1. Human capital, intangibles and "the new economy"

1.1 *The new economy*

The concept of "The New Economy" was frequently referred to in the specialised press some years ago. This term, however, is a very general label on a number of features of the economic performance of the economy. Furthermore, there is hardly any agreement as to how much of recent conceptual development is really new. In addition, different, albeit not mutually exclusive, aspects of these notions are emphasised by different researchers and experts:

- The revolution in *information technology*;
- The rising importance of *knowledge*;
- The changing patterns of *resource management* at the level of firms;
- The emergence of *innovation* as the principal determinant of competitiveness.

However, whether the economic and sociological developments are viewed through the "filter" of the "information society", "the knowledge-based economy", "the network society" or "innovation" there is evidently a large common ground. This common ground we may, to simplify matters, characterise as the increasing importance of *"intellectual and human capital*" in the determination of national economic performance and enterprise competitiveness.

The concept of "information society" is most directly related to the emergence of the microchip and the huge reduction in the cost of data processing and transmission. Nevertheless, the most striking feature of recent developments is perhaps the speed with which the technological revolution has been followed closely by a change in behaviour and patterns of work of large segments of the population in the advanced and less advanced economies. It is thus the interaction between technology and culture that has entailed the emergence of the "knowledge society".

Although the importance of knowledge has been recognised for centuries, the recent technological revolution has, in fact, opened new possibilities for managing knowledge and, notably, for moving from a static to a dynamic approach to knowledge: the information society is rapidly also becoming a "learning society". The "learning society" is one where firms and institutions actively, through training and explicit codification and storing of competence, influence their "intellectual capital" (human capital and organisational competence).

Firms on the leading edge of the information society, therefore, search for new ways of managing the inter-personal relations both within the firm and between the firm and clients and suppliers. They tend to move away from the vertical hierarchical command structures towards flatter, decentralised (holistic) structures in which each element is perceived as part of a "network". Some firms even go as far as to argue that the management of inter-personal relations is the condition for

success as a business and therefore is the main task of management. All firms on the leading edge, in addition, put increasing emphasis on the reciprocal links with suppliers and clients.

However, few observers would deny that today "innovation" is the motor of competitiveness. The promotion of the capacity to *innovate*, that is, to invent new products or processes, is and must be the main purpose of investments in training, changes in organisational structures and R&D. Innovation is at the origin of the emergence of the information society. In return, the emergence of the information society has seriously enhanced both the scope and the need for innovation in order to compete in the global, liberalised market.

1.2 *Human capital formation: the theory*

The rise of the knowledge society can be considered a quantum jump in a long history of development of human skills and know-how. In fact, two centuries ago, Adam Smith, in *The Wealth of Nations*, underlined that improvement of workers' skills was a fundamental source of economic progress. He also stressed that investment in human capital and skills affects personal incomes and the structure of wages. Attempts to quantify the actuarial value of a person's knowledge and skills were made by Lotka (1880-1949)[2] and J.R. Walsh[3]. Frank Knight (1885-1962) was probably one of the first to argue that improvements in the stock of intellectual capital might allow an economy to overcome the (classical) law of diminishing returns[4].

In parallel with the analysis of the sources of economic growth an important strand of economic theory has, in fact, focussed directly on investment in and the stock of *human capital*, that is, the knowledge, skills and mobility of individuals. This strand of research took as the starting point the impact on life-cycle income and income distribution of investment in education and training. An article by J. Mincer in 1958[5] may constitute the first step towards the elaboration of a theory of investment in human capital. However, the principal contribution was made by Gary Becker in 1962 (a contribution to a NBER conference[6]) and, notably, in 1964, in a seminal volume: *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*. Fritz Machlup, also in 1962, presented a first comprehensive review (but without a theoretical discussion) of "The Production and Distribution of Knowledge in the United States"[7]. A further step was taken in 1969, by T.W. Schultz, in *Investment in Human Capital*, in E.S. Phelps (ed.) "The Goal of Economic Growth".[8]

Gary Becker's initial formalisation of a theory of human capital formation undertook a brief formulation of a theory of investment in education with the aim of providing a conceptual framework for an estimation of the rate of return on college and high-school education in the United States. As stated in the first edition of his work (page 30 in the third edition), this general analysis would offer a unified explanation of a wide range of empirical phenomena that had either been

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[2] Lotka, A.J.: *The Money Value of Man*, New York, Ronald Press Co. 1930

[3] Walsh, J.: *Capital concept applied to man*, Quarterly Journal of Economics, 49, 1935

[4] Knight, F.: *Diminishing returns from investment,* Journal of Political Economy, 52, 1944.

[5] Mincer, J.: *Investment in human capital and personal income distribution*, Journal of Political Economy, 66, 1958.

[6] Becker, G.: *Investment in Human Capital, A Theoretical Analysis* in *Investment in Human Beings, NBER Special Conference*, Supplement to Journal of Political Economy, October 1962.

[7] Machlup, F. *The Production and Distribution of Knowledge in the United States,* Princeton University Press, 1962.

[8] Schultz, T.W.: *Investment in Human Capital* in Phelps, E.S. (ed.) *The Goal of Economic Growth,* Norton New York, 1969.

given ad hoc interpretations or had confused investigators. The main thrust of the theory developed by Becker was, indeed, to apply elements of microeconomic theory to the decision-making by individuals, families and the authorities concerning investment in education and training. The second strand of research then provided comprehensive quantitative evidence and verification of the basic conceptual framework.

The formalisation of a conceptual framework for human capital formation elaborated by Gary Becker encompasses a number of different aspects of the approach of individuals and families to the question of education and accumulation of knowledge. The third edition, thus, includes the development of a framework for the analysis of the effects on earnings of, and the rate of return on, investment in human capital. With respect to the effect on earnings, different models are developed for "on-the-job training", schooling, the development of other kinds of knowledge and, somewhat unexpectedly, the effects of investing in emotional and physical health. The rate of return on investment in human capital is then analysed from different points of view: relation between earnings, costs and rate of return, the incentives to invest. The risk and "liquidity" of human capital and the relation between capital markets and knowledge are covered in special sections.

A second, and important, part of this seminal book is then devoted to a comprehensive analysis of empirical research on different categories of investment in knowledge, such as:

- Rates of return from college education
- Rates of return from high school education
- The relation between age, earnings, wealth and human capital

The main conclusion drawn from this empirical analysis is that the general theory of human capital formation developed by Becker helps to explain such diverse phenomena as interpersonal and inter-area differences in earnings, the shape of age-earnings profiles and the effects of specialisation on skill.

It also shows, however, that some investments in human capital do not affect earnings because costs are paid and returns are collected not by the persons involved but by the firm, industries or countries employing them. These investments, which Becker calls "specific" investments, range from hiring costs to executive training and are of considerable importance. They also help to explain the fact that unemployment on the whole is greater among unskilled than among skilled workers, since more specific capital is invested in the latter and employers have special incentive to continue to include them on the payroll.

According to Becker the huge differences in productivity levels between countries are largely related to the accumulation of knowledge and the maintenance of health. The concept of investment in human capital can be considered simply as a way to organise and analyse these basic truths.

In the third edition of this book, published in 1992[9], Becker added an important analysis of *economy wide-changes* providing a link between the analysis of human capital formation contained in the earlier versions and the macroeconomic analysis of sources of economic growth. Becker, in particular, formulates a formal model explaining the change in per capita income in the economy as a function of (i) the growth of human capital, (ii) the growth in technology, and (iii) the decline in co-ordination costs.

One of the most important conclusions of this analysis is that growth in knowledge is closely connected with investments in new technologies and basic research. Analysing the interaction between the division of labour, the accumulation of knowledge and economic growth, Becker states

[9] Gary Becker: *Human Capital*, Third Edition

that *knowledge is not subject to diminishing returns in the same obvious way as physical capital because greater knowledge raises the productivity of further investment in knowledge.*[10] Becker, nevertheless, argues that, as knowledge continues to grow, limited human capacities tend to make it harder to pack more knowledge into a person without running into diminishing returns.

In the conventional neo-classical model autonomous technological progress offsets the diminishing returns to a higher capital-labour ratio. In Becker's model, the induced expansion in the *division of labour* accompanying human capital formation raises the marginal product of additional knowledge. Thus, due to the effects of specialisation, the total elasticity of output with respect to human capital is higher than the elasticity calculated individually for each "team member". Greater specialisation, thus, enables workers to absorb knowledge more easily, offsetting to some extent the tendency toward diminishing returns from the accumulation of knowledge for the individual. Increasing co-ordination costs may however, to some extent, compensate this effect.[11]

Without presenting a formal conceptual framework, Fritz Machlup, in the late 1970s and early 1980s prepared, in three volumes, a comprehensive, indeed unique, assessment of many different aspects of the knowledge economy, including a review of the formalisation of conceptual frameworks presented by other authors. The third volume, in particular, published only after his death in 1983[12], contained a detailed discussion of "education production functions" and constitute an indispensable complement to the more formal approach by Becker.

In the 1990s a considerable amount of additional conceptual and quantitative research was undertaken in the field of human capital formation. A good overview of the state of the art in this field was provided at an OECD Conference on *Employment and Growth in the Knowledge-based Economy* held in Copenhagen in November 1994[13].

The OECD's work thus provides an excellent inroad into assessing the link between human capital formation and the theory and measurement of economic growth.

1.3 *Research and development, technology and innovation*

Another strand of research, mainly in the form of applied economic theory, has dealt directly with the patterns of technological development, the classification of activities, assessment of different aspects of the innovation process, etc.

Whereas Schumpeter already early on emphasised technical progress and innovation as the main factors of "creative destruction", many OECD member countries took steps, in the 1960s and 1970s, to formulate and implement policies in favour of R&D and, notably, the application of the results of scientific research. Seeking to harmonise the approach to R&D policies and data collection, the OECD, consequently, already in June 1963 held a meeting of national experts on research and development and with their assistance prepared a first version on *Proposed Standard Practice for Surveys of Research and Development* (the Frascati Manual). This manual (now in a fifth edition), consequently constitutes an important step in the direction of providing a harmonised approach to the collection and interpretation of data on R&D from the input side.

Soon it became clear, however, that the evaluation of R&D could not rely only on data on expenditure on activities classified as such or the share of staff devoted to R&D. There was a perceived need to provide some common standards for evaluating the results (the output) of

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[10] Gary Becker: *Human Capital*, Third Edition, page 312

[11] Becker, op. cit. page 312.

[12] Machlup, F.: *The Economics of Information and Human Capital,* Princeton University Press 1984.

[13] *Employment and Growth in the Knowledge-based Economy*, OECD Documents, OECD 1996.

research activities and, indeed, of all categories of intellectual capital formation. A first attempt at setting standards was made by the publication, in 1987, of an OECD report on *Evaluation of Research*. A further step was taken by the preparation, in 1996, of an OECD report on *Measuring What People Know (*by Riel Miller of the OECD Secretariat). A manual on guidelines for collecting and interpreting innovation data prepared by OECD and Eurostat in common was published in a first version in 1992 and in a new version in 1997[14].

In parallel the OECD, as indicated in the preceding section, in 1988 launched a major programme aimed at formulating an integrated approach to technological, economic and social issues (The Technology/Economy Programme, or TEP). The reports prepared in the framework of this programme provide an opportunity to examine the consequences of the qualitative changes in the knowledge intensity of production of goods and services, the role of intangibles in the economy, the forms of organisation and the management of firms.

It should also be added that a number of researchers, notably Romer[15], have argued that knowledge accumulation, while being an essential feature of economic growth, cannot be analysed *only* as an independent factor of production. This approach, under the name of *endogenous growth theory*, consequently, aims at identifying and analysing the reciprocity between tangible and intangible capital formation and the interaction between public policy and the market.

1.4 *Foresight, risks and uncertainty*

In general the neo-classical economic theory, which is the main platform for the production function and the growth accounting, is based on rather rigorous assumptions: full information and full competition. However, already Joseph Schumpeter emphasized that one of the principal roles of the "entrepreneur" was to face uncertainty and take risks and, by doing this, would enter into a sphere of "creative destruction", likely to eliminate other entrepreneurs less innovative or less efficient already present in the market place.[16]

However, in the promotion of "full information" and "perfect competition" there has clearly been a tendency to neglect the truth already underlined by Frank Knight that the key to innovation is to take certain "risks". According to Knight, the « risk » which gives rise to a profit is an uncertainty which cannot be evaluated, connected with a situation such that there is no possibility of grouping on any objective basis whatever. For while it is true that decisions made by an individual tend to approximate an objective value when considered as a group, decisions of this character reduce to routine and do not involve ultimate responsibility; in so far as the powers of the entrepreneur become evaluated, a definite return is imputed to his activity, and this return is no longer a profit, but a wage.

The only « risk » which leads to profit is a unique uncertainty resulting from an exercise of ultimate responsibility which in its very nature cannot be insured, capitalized or salaried.[17]

The entrepreneur is therefore acting in an environment of uncertainty. Thus, as stressed by G.L.S. Schackle, the future is not there to be discovered, but must be created. There are no laws of certainty about what will happen when a human individual does this or that, but there are constraints as to what range of diverse things can happen. There is not certainty, therefore there can

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[14] *Proposed Standard Practice for Surveys of Research and Experimental Development: The Frascati Manual*, OECD 1993.

[15] Romer, P.M.: *Human Capital and Growth: Theory and Evidence*, NBER Working Paper N° 3173, 1989

[16] Schumpeter, Joseph :

[17] (Frank H. Knight: *Risk, uncertainty and profits » University of Chicago Press, 1921, Cosimo Classics, 2005, page 311-312)*

be decision; but there is bounded uncertainty, therefore there can be meaningful choice even in face of the absence of certainty. [18]

The fact that accounting and reporting cannot eliminate the basic uncertainties in and the risks of undertaking entrepreneurship is frequently forgotten in the debate on accounting for intangibles.

2. Sources of economic growth and productivity

2.1 *The production function*

Classical theory of economic growth, on which much of current economic theory remains founded, considered essentially three factors of production, land, labour and capital. Each of those had its own dimension: land was a stock, labour a flow (input), and capital was money capital in the form of a stock of capital goods. The concept of capital as an "advance" of money was taken to its extreme by Böhm-Bawerk who coined the notion of "Umwegsproduction" and formulated, perhaps as the first, that "production takes time, and the time that separates the formulation of multiperiod production plans and the satisfaction of consumer demands is bridged by capital"[19].

The view of the stock of capital as an advance of money was rejected by Clark[20], arguing that (fixed) capital was a factor of production on equal footing with land and labour. The distinction between monetary capital and fixed capital has, however, throughout the history of economic analysis been blurred by the fact that at the macroeconomic level the stock of fixed capital unavoidably must be expressed as an aggregate in monetary terms, that is, as a " value".

The same is, and for the same reasons, the case for the aggregate output of the production process while the input of labour at least in the majority of cases is measured as hours or man-years worked. Consequently, a "production function", while being in the essence an expression of the relation between material input of labour and capital in practice takes the form of a relation between (three) variables of which at least two are expressed in monetary terms.

The path-breaking Harrod-Domar model saw output as being mainly determined by the amount of capital utilised in the production process and introduced the "capital/output ratio" as the key constant in economic growth. The later "neo-classical growth model" (formulated initially by Solow) dropped the assumption of a linear relation between fixed capital and output by introducing the input of labour explicitly into the production function with a scope for substitution between capital and labour (measured in hours or man years).

This analysis of the relation between factor use and output was initially largely based on a production function including capital and labour and allowing for substitution between the two factors of production presented in 1928 in an article by Cobb and Douglas[21]. Subsequently the implications and limitations of this approach were made evident and a series of alternatives proposed by a number of researchers. Nevertheless the analysis of the relation between factor use and output has been a stable of economic analysis for the whole post-war period, with the development of a branch of quantitative analysis of the growth process commonly known as "growth accounting".

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[18] G.L.S. Schackle: "Decision, order and time in human affairs", Cambridge University Press, 1961

[19] See, for example, Böhm-Bawerk, Eugen von: *Positive Theory of Capital,* Macmillan 1891. The quote is from a biography of Böhm-Bawerk by Roger W. Garrison.

[20] Clark, J.B.: *Concerning the Nature of Capital: a reply*, Quarterly Journal of Economics, May 1907, page 526-53.

[21] Cobb, C.W. and Douglas, P.H.: *A Theory of production;* American Economic Review March 1928.

Within the scope of the present paper it is not possible to go deeper into the fascinating debate on the validity of the very concept of a "production function", which was the subject of the famous "Cambridge Controversy", where the UK Cambridge economists, Joan Robinson and Piero Sraffa questioned the neo-classical approach by the US Cambridge-Massachusetts economists such as Paul Samuelson and Robert Solow. One of the main arguments of Robinson and Sraffa was, in fact, that the aggregation problem was more serious than generally assumed by the neo-classical economist and that the aggregation of a monetary value of a huge number of different capital items to generate a global figure of the "capital stock" involved a circularity operation. This basic problem does not go away and, in a way, emerges again into the debate of the extension of the concept of a "capital stock" to incorporate not just tangible capital but also and increasingly intangibles.

However, the mathematics of the neo-classical production function have proved extremely useful to undertake quantitative analysis of the determinants of economic growth and the following therefore assumes that the methodology of growth accounting is a useful, indeed unavoidable, tool of analysis even if the Cambridge Controversy in a way remains unresolved.

2.2 *Growth accounting*

Growth accounting, which aims at explaining the growth of productivity, was initiated essentially by Denison in 1962[22]. When investigating the sources of growth in the United States from 1909 to 1958 he concluded that the knowledge, skill and energy of labour were important determinants of economic growth.

Subsequent analysis by, notably, Kendrick[23], Jorgenson[24] and Griliches[25], has aimed by and large at identifying the contribution of various, mainly "intangible", factors to the overall growth in productivity, in this context defined as the combined productivity of capital and labour, generally called "total factor productivity". As recognised by Denison himself, growth accounting by definition cannot take appropriate account of the interaction among determinants and does not involve a "controlled experiment". The underlying causal relationships in the "black box", consequently, can only be approximated by detailed, careful classification of the ingredients in the production function.

The measurement of "input" of labour in terms of hours or man-years for a long time has been accepted intuitively as the relevant statistic. However, the pooling together of man years of an unskilled youngster and an engineer with a diploma from a leading institute of technology and several decades of professional experience from the point of view of economic analysis does not make more sense than to add pears and apples together in one set. In fact, by failing to make a distinction between different categories of labour input, the early production function simply assumed away an aggregation problem of the same fundamental nature as for the stock of fixed capital or output. The effect of changes in the "quality" of labour is therefore an important feature of growth accounting excercises.

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[22] Denison, E.F.: *The Sources of Economic Growth in the United States and the Alternatives before Us,* Committee for Economic Development 1962 and *Why Growth Rates Differ: Postwar Experience in Nine Western Countries*, Brookings Institution 1967. See also *Accounting for Slower Economic Growth: The United States in the 1970s*, Brookings Institution 1979.

[23] Kendrick, J.: *Productivity Trends in the United States*, Princeton Press, 1961

[24] Jorgenson, D.: *Capital Theory and Investment Behaviour*, American Economic Review, 1963 (29)

[25] For example Griliches, Z.: *Research and Development, Patents and Productivity*, Chicago University Press, 1984.

2.3 *The "residual" in growth accounting*

The mere fact of constructing and estimating a "production function" in which output and the capital stock were calculated as weighted indices of the constituent elements while the input of labour was considered to be homogeneous and uni-dimensional resulted in a "residual" between the growth in output and the growth of input: the rise in the "quality" of labour input came back into analysis as a rise in "productivity". However, as has been again and again stressed, notably, by Dale Jorgenson[26], a part of the "unexplained" residual in estimated productions functions would disappear if the input of labour were appropriately defined with due account taken of the level of education, skill and knowledge.

A residual, nevertheless, remains and, in the (relatively few) estimates based on very long time series for the United States, shows a marked tendency to rise through time: according to estimates prepared by David and Abramovitz[27], the part of the rise in output par unit of labour input which could be explained by an increase in the input of capital per unit of labour (capital intensity), during most of the XXth century was only between a half and a third of the level estimated for the XIXth century.

Analysis of productivity issues indeed often takes, as the point of departure, developments in the United States, which, as the leading economy during the last century, has been considered to be on the productivity frontier with other economies tending to follow and catch up with more or less luck. The history of productivity developments in the United States is therefore likely to throw light on later development in other countries. According to estimates prepared by a leading specialist in economic history, Angus Maddison[28], the growth in labour productivity in the United States accelerated during most of the 20th century, from some 2% per annum during the period 1870-1913 to 2.5% from 1913 to 1950. However, a large part of this apparent acceleration of the growth in productivity was in fact attributable to a pronounced increase in the ratio of fixed capital to output (capital deepening) from an estimated level of 1.71 in 1870 to as much as 3.39 in 1913. Consequently, total factor productivity during the 1870-1913 period increased by only 0.36% per annum. During these four decades most of the increase in production was, thus, ploughed back in the economy, with an only modest margin for increase in living standards.

The "sacrifice" of living standards during the late 19th and early 20th century was compensated during the subsequent decades as the capital deepening was reversed and total factor productivity accelerated substantially. The period from 1913 to 1973 (despite the 1930 depression and the Second World War) was a "golden age" with a considerably scope for an increase in living standards. However, during the next thirty years, from 1973 to 2003, total factor productivity growth, according to Maddison's estimates, and which are corroborated by official statistics, slowed down to a meager annual rate of 0.65% or only marginally above the rate experienced from 1870 to 1913 (Table 1).

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[26] See, for example, Jorgenson's speech to the Conference on Service Sector Productivity and the Productivity Paradox, Centre for the Study of Living Standards, Ottawa, 11-12 April 1997.

[27] M. Abramovitz and Paul A. David: *Economic Growth in the U.S.*, in Employment and Growth in the Knowledge-based Economy, OECD 1996.

[28] Maddison, Angus: *Contours of the world economy, I-2030 AD*, Oxford University Press, 2007.

Table 1. Capital/output ratios and productivity, United States

	1820	1870	1913	1950	1973	2003
Capital/output ratio:	0.94	1.71	3.29	2.44	2.10	2.34
Machinery and equipment	0.07	0.20	0.52	0.64	0.64	1.11
Non-residential structures	0.87	1.51	2.77	1.80	1.46	1.23
Productivity (% change)		1820-1870	1870-1913	1913-1950	1950-1973	1973-2003
Labour productivity		1.10	1.93	2.47	2.77	1.66
Total factor productivity		-0.15	0.36	1.62	1.75	0.65
Effect of capital deepening		1.25	1.57	0.85	1.02	1.01

Source: Angus Maddison

During several decades a considerable amount of research has attempted to explain the growth accounting "residual" (technological progress or productivity) by introducing various additional assumptions concerning the nature of innovation (embodied or disembodied technical change, etc.). This research has on the whole concluded that the residual could, as argued by Jorgenson, be attributed to improvements in "intellectual capital", that is, a number of factors which, in fact, constitute the main characteristics of the "knowledge society". This led leading researchers in this field to conclude that the "residual", in fact, was not an "unexplained" aspect of economic growth but essentially a result of a *gap in the understanding of the growth process* and in the availability of data. The measurement problem, thus, arises from the failure of most economists to make a clear distinction between "productivity growth" and "technological change". The solution to this measurement problem would lie in the introduction of a much broader concept of investment, including investment in R&D, in the creation of ideas, in training and education, etc.

2.4 *Reconsidering the concept of capital*

The solution to this apparent paradox from a conceptual point of view would appear to be found in a considerable broadening of the ancient concept of capital formation to include in investment also spending on education, training, research and development, software design, marketing and, even, certain kinds of expenditure on reorganisation of production and marketing aimed at making more efficient use of technology. Indeed, should, in this perspective, be considered as "investment" every kind of spending which is not directly related to current operations but constitutes a commitment of resources to ensure the survival of the firm beyond the current period.

The first estimates, notably by J.W. Kendrick[29], of the total amount of "intangible" investment in the United States during the 20th century, in fact, show a pronounced increase, reflecting in particular the important rise in resources devoted to education, training and R&D. The rise in intangible investment has, then, translated into a substantial rise in the stock of intangible capital. Furthermore, during the first half of the present century the relative prices of conventional tangible capital goods – at least those that have been used as deflators to create constant-price estimates of the capital stock – were rising more rapidly than the prices of consumer goods and real wages. This,

[29] Kendrick, J.: *Total Capital and Economic Growth*, Atlantic Economic Journal, Vol 22, 1994

and the shorter and shortening service lives of tangible reproducible assets, especially in comparison with the assumed longevity of educational and training investment embodied in the labour force, have also contributed to the differentially rapid growth of the intangible component of the total capital stock.[30]

The estimates prepared by Kendrick and reproduced by Abramovitz and David[31] and reordered somewhat by the author, presented in Table 2, show that the share of conventional tangible capital in the total stock of capital in the U.S. economy fell from 65% in 1929 to 46.5% in 1990. Correspondingly, the share of non-conventional, non-tangible capital rose from some 35% in 1929 to 53.5% in 1990 and by 1990 the total estimated value of immaterial capital was, thus, higher than that of tangible fixed capital.

Table 2. Capital stock and capital/output ratio in the U.S. 1929-1990

	1929	1948	1973	1990
Share of total capital stock, %				
Conventional tangible capital	65,1	57,8	50,2	46,5
Non-conventional, non-tangible capital	34,9	42,2	49,8	53,5
Capital/GDP ratio				
Conventional capital/GDP	7,39	6,25	5,35	5,85
Intangible capital/GDP	3,95	4,57	5,30	6,73
Total capital stock/GDP	11,35	10,82	10,65	12,58

Source: J.W. Kendrick: *Total Capital and Economic Growth* as quoted in Moses Abramovitz and Paul A. David: *Technological Change and the Rise of Intangible Investments: the US Economy's Growth-Path in the Twentieth Century*. In *Employment and Growth in the Knowledge-based Economy*, OECD 1996. Calculations by the author.

A striking conclusion emerging from these estimates is the sharp decline in the conventionally defined capital/output ratio from 7.4 in 1929 to 5.9 in 1973. However, this decline was largely compensated by a pronounced rise in the ratio of intangible capital to GDP, from about 4 in 1929 to 5.3 in 1973. The overall capital/output ratio consequently declined only moderately from 1929 to 1948 and even less from 1948 to 1973. Since 1973, furthermore, the conventionally defined capital/output ratio increased somewhat while the ratio of intangible capital to output rose strongly, resulting in a steep rise in the overall capital/output ratio, to a level preceding that of 1929.

Although the estimates compiled by other researchers may differ somewhat from those presented above, the broad conclusions in most cases are consistent with Kendrick's results: in the most advanced industrial economy, the United States, the economic weight and impact of intellectual capital now exceeds that of tangible capital. Furthermore, as already stressed above, even the conventional hardware incorporates an increasing amount of (embedded) intangible goods such as, for example, incarnated software.

These findings thus shed new light on a policy issue which was a concern for policy makers on both sides of the Atlantic during the 1970s and 1980s: the decline in fixed capital formation in proportion to GDP. In fact, in a context of the emerging "knowledge economy" and changes in the nature of

[30] See Abramovitz and David, op.cit. page 41.

[31] For full reference see note to the Table.

competition, enterprises have not reduced the overall capital formation but rather shifted more and more of resources into investment in intangibles. Since investment in intangibles from the point of view of accounting normally was not considered as "capital formation" this change in behaviour of firms and managers for a long time went unnoticed by academics and policy makers, resulting possibly in certain countries and periods in certain failures and mistakes in the design of economic policy.

A further large step in the analysis of the effect of intangibles on economic growth was made in 2002 by Corrado, Hulten and Sichel, in a paper presented at an NBER conference[32]. In what could perhaps be considered a return to Böhm-Bawerk's interpretation of capital as an "advance of money", the 2002 paper argues that the conventional production function treats capital as "predetermined" (page 16) and therefore cannot fully describe the growth process; saving and investment being "choice variables" in a complete model of growth. According to the authors, this choice dimension is important because it determines the quantity of capital available at each point in time, but it also determines what should be counted as capital. They therefore argue (page 19) that *any* use of resources that reduces current consumption in order to increase it in the future qualifies as an investment. This approach therefore requires a *symmetric treatment of all types of capital*. That is, in national accounting systems, investment in knowledge capital should be placed on the same footing as that of investment in plant and equipment. This expanded definition of capital thus includes *all* investments in human capital (not just outlays by government and not-for-profit institutions on education), research and development expenditure, and indeed any expenditure in which a business devoted resources to projects designed to increase future rather than current output, whether it is intangible or tangible.

They recognize, of course, that many practical difficulties arise in implementing the symmetry principle and that these difficulties are one reason why financial accountants prefer to expense intangibles. And they stress that, in particular, much intangible investment occurs within the company, household, or government unit that has the intellectual property right to the capital, and no arm's-length valuation of the investment exists; and they also underline that the appropriability of property rights and the spillover of externalities present problems.

In an application of this theoretical framework, they then identify a number of innovative property categories, which are not normally included in the list of intangibles established for example by Kendrick and others and undertake a recalculation of the amount of business spending on intangibles for selected periods for the United States.

The 2002 paper is then followed up and expanded with a growth accounting analysis in a Federal Reserve working paper in 2006 and which fully confirm and reinforce the earlier analysis by Kendrick.[33]

Stressing that published macroeconomic data traditionally exclude most intangible investment from measured GDP (they suggest that as much as $800 billion are still excluded from U.S. published data as of 2003), Corrado, Hulten and Sichel find that this, conventional, approach leads to the exclusion of more than $3 trillion of business intangible capital stock. To assess the importance of this omission, they produce a new estimate of intangible capital. They add this to the standard sources-of-growth framework used by the Bureau of Labour Statistics and find that the inclusion of

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[32] Corrado, Carol, Charles Hulten and Daniel Sichel: *Measuring Capital and Technology: An Expanded Framework*, in Carol Corrado, John Haltiwanger and Daniel Sichel (ed.) : *Measuring Capital in the New Economy*, University of Chicago Press, August 2005 (Conference April 26-27 2002).

[33] Corrado, C. Hulten, C. and D. Sichel (2006), "The Contribution of Intangible Investments to US Economic Growth: A Sources-of-growth Analysis", NBER Working Paper 11948. (or Federal Reserve, staff working paper in Finance and Economics, 2006-24: Intangible Capital and Economic Growth.

intangible assets thus defined makes a significant difference in the observed patterns of U.S. economic growth. The rate of change of output per worker increases more rapidly, when intangibles are counted as capital and capital deepening becomes the unambiguously dominant source of growth in labour productivity. The role of multifactor productivity is correspondingly diminished, and labour's income share is found to have decreased significantly over the last 50 years.

The work by Corrado, Hulten and Sichel was followed up by Marrano and Haskel[34] for the United Kingdom and presented in a working paper in 2006. They find that the UK private sector in 2004 spent about 10% of GDP on investment in intangibles, an amount equal to the investment in tangible assets. They thus confirm the huge importance for growth in the UK of intangible investment, although marginally less than what CHS found for the US.

The preceding sections and the "impressionistic" overview of features of the production process suggest that in the approach to intangibles there is a need to move from the general, generic concept to a consideration of the different categories of intangibles, the problems of measurement and accounting at the micro and macro level, the potential role in economic analysis and the ways to handling the management of information for each of those categories.

3. Accounting for and reporting on intellectual capital

3.1 *The basic issues*

From a purely theoretical point of view, the key question is, as underlined by Corrado, Hulten and Sichel, whether a certain amount of expenditure at the level of the firm or a nation is to be classified as an intermediate expenditure (input) in the production process or as an "investment" designed to produce services in a future production process. This distinction does not present problems when a machine or a computer is bought and installed, since this is clearly done with the aim of ensuring the provision of future services from this machine.

In order to ensure a smooth and efficient insertion of this machine or robot into the production process, the workers or clerks who will work with this new equipment may need to attend training courses extending over days or weeks, and during this period they are not involved in the ordinary production process. The firm is thus spending to enhance their knowledge and productive capacity and there is every reason to consider this spending as an investment in the *human capital* of the employees.

However, the human capital thus generated, even if it is absolutely necessary to ensure an efficient production process, is not controlled by the firm and would disappear if the employees went to another firm. Consequently, there would be good reasons not to consider this spending on training as an "investment" – although it is a part of the process of renewal of the fixed equipment. So it could well be argued that it should not be counted as an ordinary current production cost but neither should it be counted as an investment equivalent to the purchase of the machine.

Another, more evident example, is the case where the firm is actually spending directly on research aimed at creating new product or inventing new ways of producing existing goods or services. To the extent that this R&D actually results in the acquisition of patents or the marketing of a new product, the spending should clearly be identified as being an "investment" and not as a spending related to the current production process.

But what if, in addition to undertaking R&D and directly training employees to ensure that they make appropriate use of the new equipment, the firm encounters the need to undertake an important

[34] Marrano, Mauro Giorgio and Jonathan Haskel: *How much does the UK invest in intangible assets?*, Queen Mary, University of London, Working Paper No. 578; November 2006.

reorganisation of the system of production with the help of external consultants? This may involve an important investment of working time of the employees to attend meetings and training sessions with the aim of introducing new methods of work, new internal security systems and a more "horizontal" organisation of communication lines and with more autonomy for the production teams.

There is also in this case a generation of intellectual capital and of course a certain enhancement of the human capital of the employees concerned. However, by and large, the intellectual capital thus generated will constitute an integrated (incarnated) part of the intellectual capital of the firm and thus of the individual persons concerned. It could be classified as a spending on an invisible (intangible) new part of the production system of the firm, a *structural intangible capital.*

However, while the "structural capital" thus generated will contribute (hopefully) to strengthening of the competitiveness of the firm and to the profitability of the own capital, it basically exists only in the firm as a "going concern" and would disintegrate from one day to another if the firm went bankrupt.

Nevertheless, it constitutes a kind of invisible intangible asset which would not fade away, or at least be maintained to some extent, if the firm, instead of going bankrupt, would be sold to or merged with another firm. In this case, the value of the firm would clearly not be just the value of the machines and equipment installed but represent also the whole complex of structural intangible capital which is an integrate part of the identity of this particular firm.

But, of course, the value of the firm involved in this process of merging or acquisition is most unlikely to be determined by the cost of the machinery and equipment possibly adjusted to take account of past spending on training, research and development, generation of "structural capital" and other categories of spending on intellectual capital or intangibles. The acquisition value of the firm will, of course, also take account of the existence of patents and the general "image" in the market in relation to clients and suppliers.

From the very beginning of the growth accounting exercises in the 1960s it has, indeed, been recognised that conventional business accounts and statistical data could provide only scant and incomplete evidence of the presence of "intangibles". Firstly, there was a perceived need to distinguish more clearly between, on one side, investment in (expenditure on) intangibles and, on the other, the resulting improvement in the *stock of intellectual capital*. Secondly, the classifications utilised in national and business accounts in general did not allow a separate identification of investment in intangibles. Thirdly, the general failure to distinguish between "services" and "intangibles" creates a fundamental problem of perception and taxonomy in the analysis of economic performance. While there is broad recognition that intellectual capital formation has become a decisive factor of economic growth and welfare, our knowledge of the process has, therefore, remained elusive, subjective and scattered.

The very fact that intangibles are only incompletely revealed in available statistical data and company accounting and reporting, furthermore, may, as stressed most forcefully by Baruch Lev[35], be at the origin of several potential distortions of resource allocation and policy making:

- Capital markets – in part due to prudential rules and regulations – still put an excessive emphasis on fixed capital: intellectual capital can rarely be recognised as collateral for bank loans and the cost of capital is frequently higher for companies relying heavily on intellectual capital.

[35] Lev, Baruch: *Intangibles: Management, Measurement and reporting,* Brookings Institutions Press, Washington DC, 2001 and Hand, John and Baruch Lev (ed.): *Intangible Assets: Values, Measures, and Risks*, Oxford Management Readers, Oxford University Press 2003.

- The widely applied mandatory expensing of investment in intangibles is the cause of under-reporting of profits in early-stage companies and overstatement of profits in the later phase of exploitation of intangible assets. This will strengthen the hands of managers and insiders, in possession of efficient information but weaken the position of shareholders and increase the volatility of share prices.
- Even inside companies insufficient information on the level and evolution of intellectual capital may create the risk of distortion of management decisions and formulation of an adequate company strategy.
- Overemphasis on fixed investment and inadequate reporting of intangible investment and intellectual capital may be a source of distortions of public policy, for example on taxation of company profits, rules of deprecation of different kinds of capital, etc.

There is, therefore, a large and increasing need for improving the insight into the role of intangibles in the economy by generating new indicators at all levels of decision making and economic analysis.

In growth accounting the response has in general, as indicated above, been to move beyond the original elementary definition of capital and labour as homogenous entities. In its place has been introduced a detailed classification of capital by category and vintage and of labour by level of education and skill and to take account of hours worked etc. This analysis has, however, not involved modification of the traditional statistical data but has mainly relied on the search for additional indicators, frequently through ad hoc surveys or education statistics, etc.

In fact, as recognized by Corrado, Hulten and Sichel (2002), the accountants, whether in national or business accounting, have been very reluctant to fundamentally reform the basic principles of accounting as practised throughout most of the 20th century. Indeed, as argued by senior accountants throughout the industrial countries, there has been a broad consensus in the profession that the purpose of company balance sheets cannot and should not be to show the *market value* of a company as a going concern. The aim should be to provide a record of transactions and an evaluation of individual, identifiable and separable assets according to their market value if detached from the reporting company. The accounting profession has, consequently, refused to extend the concept of assets to include the estimated value of a company's "organisational competence" or its command of the human capital invested in the staff members, etc.

At the level of the enterprise a number of firms in the early 1990s took steps to improve their insight into the management and development of intellectual capital. Certain companies took the initiative to publish their findings in regular annual or ad hoc reports and thereby contributed to giving a more concrete and operational thrust to the debate. The experience gained at the level of business management and institutional investors, including new methods of reporting to and interfacing with capital markets, at the end of the 1990s constituted a most fertile ground for the development of a new approach to the compilation of indicators on various aspects of "intangibles".

However, even in 2010, at the time of writing, the various stakeholders and researchers have not reached a consensus with respect to the approach to the handling of intangibles in business accounting. In particular, as emphasised most strongly by Douglas Skinner[36]:

1. Many intangibles are not separate, saleable or discrete items;

[36] Source: Douglas J. Skinner: Accounting for Intangibles – A critical review of Policy recommendations (University of Chicago, December 2007) and

2. Well-defined property rights associated with most tangible and financial resources often do not extend to intangibles;
3. There are no liquid secondary markets for many intangibles, making it difficult to reliably measure the value of these resources;
4. It is often difficult to write fully-specified contracts for intangibles

In fact, there is thus still a heated debate with respect to the nature of the whole process of production of intangibles, through inputs transformed through a process into an output in an asset, raising finally also the question as to the extent to which the asset is identifiable and "marketable". Furthermore evaluation and definition of intangibles remain at stake, and will be different for different basic categories of intangibles

- Acquired intangibles
- Internally generated intangibles (notably through R&D)
- Externally generated intangibles (notably through brands, reputation and generation of consumer confidence etc.)

Moreover, as stressed strongly by Leonard Nakamura[37], whereas there is an increasingly urgent need to consider intangible assets as an integral part of productive assets, intangibles also have a number of particular characteristics which must be taken into account when assessing their weight in the economy and their contribution to economic growth:

- Intangible assets in general are "non-rival", meaning that their utilisation by one producer or worker does not exclude their utilisation elsewhere or by another worker. As an illustration of this particularity of intangibles, a personal computer is normally, at a particular moment, used by one person but the software imbedded in the PC is most often impersonal, in the sense that, for example, the operation system can be common to an unlimited number of PCs. Furthermore, unlawful duplication of copyrighted software or music may reduce the private value of that intangible but not per se reduce the scope for its continued utilisation.
- Whereas an intangible asset may lose its value due to the emergence of alternative, competing products, for example due to the arrival on the market of a new operating system for PCs, it is not subject to the same physical wear and tear as a tangible asset. Both intangible and tangible assets may become obsolete but the timing and process of determining this obsolescence (and consequent depreciation) is different for the two categories of assets.
- Due to this non-rival nature of intangible assets their value for the society as a whole will not necessarily be the aggregate of their market value for the individual producers and, users. Truly, there are externalities for both tangibles and intangibles which may influence both their private and social value. As for the classical telephone example (one telephone is useless but as more users sign up the utility increases) the social value of certain inventions will rise with the increase in the number of users and with the expansion of the knowledge of how to use the product and with the capacity of diagnosis (electronics, medical products etc.).
- The units of measurement of intangible investments in "real" terms are not intrinsic. Even when results of R&D are patented, the links between the original R&D spending and the

[37] Nakamura, Leonard : *Intangible assets and national income accounting : Measuring a scientific revolution*, Research Department, Federal Reserve Bank of Philadelphia, Working Paper No. 09-11, May 8 2009.

value of a patent are weak or inexistent and for these and other categories of intangibles the units of measurement must be "extrinsic"[38] or must depend on a research projects future success.

- As the other side of the coin of the task of measuring the "volume" of intangible investment, the determination of the price is also, by analogy, likely to be based on "extrinsic" assessments. This involves determination in the first instance of whether an intangible is "new" or just an improvement or modification of an existing product.

Before digging further into the problem of generating data on intangibles, the following two sections will briefly examine the past and existing approach to accounting standards in, respectively, business accounting and national accounting.

3.2 *Standards for business accounting for intangibles*

General rules for the handling of intangibles in business accounting are provided in standard IAS38 of the International Accounting Standards Board. This standard defines an intangible asset as an identifiable non-monetary asset without physical substance and is by EC Regulation[39] adopted as the standard for publicly traded companies, which are, "under certain conditions" requested to prepare their consolidated accounts following these rules.

The criteria for recognition of an "item" as an intangible asset are in fact rather rigorous. The entity must demonstrate that it:

a) Is separable, i.e. is capable of being separated or divided from the entity and sold, transferred, licensed, rented or exchanged, either individually or together with a related contract, asset or liability; or

b) Arises from contractual or other legal rights regardless of whether those rights are transferable or separable from the entity or from other rights and obligations.

IAS 38 provides detailed guidelines for separately acquired assets, for assets acquired as part of a business combination, acquisition by way of a government grant or exchange of assets and for internally generated intangible assets. Furthermore, it specifies detailed criteria for recognising an expense as an investment and rules for determining useful life and amortisation of an intangible asset.

In general, when disclosing the value of intangible assets an entity is requested to distinguish between internally generated and other intangible assets and to indicate the amortisation rates used.

Among the classes of intangible assets, IAS 38 mentions the following:

a) Brand names;

b) Mastheads and publishing titles;

c) Computer software;

d) Licenses and franchises;

e) Copyrights, patents and other industrial property rights, services and operating rights;

f) Recipes, formulae, models, designs and prototypes; and

g) Intangible assets under development.

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[38] Nakamura, op. cit. page 3.

[39] Commission Regulation (EC) No 1126/2008, Annex (notably page 252-269 on intangible assets).

Furthermore, IAS38 requires an entity to disclose the aggregate amount of research and development expenditure recognised as an expense during the period.

Whereas, as indicated, IAS38 is adopted as the accounting standard for publicly traded firms, the United States still apply specific standards provided in U.S. General Accepted Accounting Standards (U.S. GAAP) and which on certain important points differ from IAS38. In fact, according to GAAP, all R&D costs shall be charged to expense when incurred, the argument being that considerable judgment is required to identify the point in the R&D process at which a new or improved product is defined and determined to be technologically feasible, marketable or useful.[40]

The core difference between GAAP and IAS38 is, thus, that the latter assumes that in some instances the enterprise is able to identify expenditures during the development phase of a project that fulfil the requirement to be recognised as an intangible asset while according to the former this approach introduces an unacceptable element of uncertainty in the accounting procedure.

3.3 *Intangibles in national accounts*

As underlined in 2003 in an important review of basic national accounts issues by Brent R. Moulton, of the US Bureau of Economic Analysis[41], several important statistical issues were up for consideration within the framework of the work undertaken in the international forum with the aim of agreeing on a revision of the 1993 System of National Accounts (SNA), which has served as a major milestone in creating international standards for compiling a fully integrated set of accounts measuring a nation's production, income, and wealth.

Among the issues identified by Moulton, the following are particularly relevant for the estimation of the economic role of intangibles:

- The taxonomy and classification of production accounts so as to create a firmer basis for the calculation of multi-factor productivity;
- The definition of the "borderline (asset boundary) between gross fixed asset formation and consumption, whether intermediate or final.

3.3.1 Production accounts

In the traditional formulations of the production function, the "input" of capital is measured as the deflated stock of capital. However, as a matter of principle, estimation of multi-factor productivity would require an estimate not of the "immobile" stock of capital but of the "services" delivered by the capital stock. Already in 1973, in the context of debates on improving the basis for productivity analysis in the US national accounts, Christensen and Jorgenson proposed the introduction of a set of accounts incorporating indices of input volume by sector. Furthermore, in 1983, Jorgenson, Gollop and Fraumeni extended the accounting system to measuring the output, with measures of multi-factor productivity, an element not included in the SNA[42]. Both Peter Hill and Dale Jorgenson in 1999 proposed to modify the production accounts of the SNA recognizing and adding volume measures of capital services. This idea was again promoted in 2004 in an extensive and rich

[40] Millan, Miguel A. *Accounting for research and development costs: a comparison of U.S. and international standards*, Review of Business, March 2005.

[41] Moulton, Brent R. : *The system of national accounts for the New Economy*, Bureau of Economic Analysis, US Department of Commerce, October 2003.

[42] The following discussion is largely based on a paper by Brent R. Moulton: *The System of National Accounts for the New Economy"*, a BEA working paper later published in Review of Income and Wealth: http://www.roiw.org/2004/261.pdf .

contribution to an NBER conference in 2004.[43] The authors here stated as their initial goal to integrate the multifactor productivity measures prepared by the Bureau of Labor Statistics into the national income and production accounts prepared by the BEA.

However, these proposals did not meet full approval. As stressed by Moulton (op.cit.) source data on capital – service lives, depreciation schedules, and constant-price indices by type of assets and by industry – are generally considered to be less reliable than data measuring most of the other flows of SNA. Measurement of capital services involves the introduction of a rental equivalence of rate-of-return calculation that may be controversial, notably for non-market producers. And more generally, many observers argue that multi-factor productivity needs not necessarily to be part of the core SNA accounts and may be more appropriately dealt with as part of a satellite account.

In fact, the revised version of SNA, published in 2008, contains a new chapter on capital services and which proposes that, for statistical institutes interested in providing material for a deeper analysis of productivity issues, a table supplementary to the standard accounts (a satellite account) could be prepared to display the implicit services provided by non-financial assets.[44] The SNA, however, does not provide explicit guidelines on the approach to these, analytically essential, methodological issues.

3.3.2 Asset boundary

As already stressed above, there is already a vast literature demonstrating the increasing impact on the economy of intangible investment and assets and associated calls for improvement of the data on intangibles in the existing national accounts.

However, as underlined for example by Moulton (op.cit.), a number of important weaknesses are apparent in the available data on intangibles and asset values. The accounts of business enterprises are not designed to provide information on intangible capital formation, especially when the capital formation consists of production for own final use. For some types of intangible investment, especially organisational capital, it is not often directly apparent whether expenditures have an expected service life of less than one year – in which case they should be treated as current costs – or more than one year – in which case they arguably should be classified as capital formation.

Furthermore, intangible expenditures are generally not adequately measured in official price statistics, so there is a lack of adequate information for producing quality-adjusted price or volume indices (Moulton, page 9). Other problems concern valuation, as current costs of production may not be the most appropriate indicator for the value. This is the case for R&D products but possibly even more so for software and artistic originals.

The revised SNA undertakes to expand somewhat the asset boundary and also to refine the definition of intangible assets but, as could perhaps be expected, abstains from incorporating all of the intangibles identified by Corrado, Hulten and Sichel as intangibles.

The identification of intangibles in the national accounts is, nevertheless, improved and expanded in several ways[45]:

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[43] Jorgenson, Dale W., J. Steven Landefeld, and William Nordhaus : *A New Architecture for the U.S. National Accounts*, University of Chicago Press, http://www.nber.org/books/jorg06-1

[44] System of National Accounts 2008 (EU, IMF, OECD, UN and World Bank), New York 2009, Chapter 20: Capital services and the national accounts. The chapter usefully underlines that capital "services" are not to be assimilated with conventional services such as transport services but rather as the term "for the way in which the changes in the value of assets used in production are captured in the production account and the balance sheet". The chapter also refers to two OECD manuals, *Measuring Capital* and *Measuring Productivity* for further technical details.

[45] See SNA 2008, op.cit. annex on the changes compared to the 1993 version.

1. The information, computer and telecommunications (ICT) equipment is included as a new category under machinery and equipment. Since ICT equipment embodies a considerably amount of intangibles it should become easier to identify the latter.
2. The term "intangible fixed assets" has been renamed "intellectual property products". The word "products" is included to make it clear that it does not include third-party rights which are non-produced assets in the SNA. Research and development products are included within intellectual property products. Consequently, patented entities no longer appear as non-produced assets and are "subsumed" in research and development.
3. The term "mineral exploration" has been renamed "mineral exploration and evaluation" to emphasize that the coverage conforms to international accounting standards.
4. Computer software has been modified to include databases; software and databases are two sub-components of this category.
5. The term "other intellectual property products" replaces "other intangible fixed assets".
6. This general category thus now includes: research and development, mineral exploration and evaluation, computer software and databases, literary or artistic originals and "other intellectual property products.

It can thus be concluded that, pending further examination of the interpretation of the new SNA, several of the intangibles identified, for example, in the seminal paper by Carrado, Hulten and Sichel, are not considered "assets" alongside "intellectual property products". This would include for example advertising and spending on organisational investment as such spending would not directly give rise to a "marketable" product. In this respect the new SNA thus involves some degree of alignment to the standard for business accounts, in so far as the latter attach a considerable importance to the scope for "attachment" of an asset and to the scope for marketing separately from the general capitalization of the firm.

The new SNA thus, for fully understandable reasons, has therefore not solved (and could not solve) one of the basic problems in business accounting: the accounting treatment of assets obtained by merging and acquisition and which obviously include organisational capital, which, in other cases may be produced in-house.

All in all, the analysts are thus still coping with a number of major issues and obstacles in the process towards obtaining a better understanding of the new economy.

4. Remaining obstacles to understanding the New Economy

A provisional conclusion therefore seems to be that:

- No reform of business accounting can eliminate uncertainty and risk
- So we should respect the basic criteria for sound accounting: record of transactions
- We should accept that investment in intangibles is an important determinant of competitiveness and that, consequently, firms are not necessarily ready to reveal this spending to the general public or investors.
- But economic analysis and national accounting must clearly pay a lot of attention to the "immaterial parts" of the economy and, to the extent that this information is not directly available in the core national accounts there is an increasing need for satellite accounts showing these and other selected aspects of the economy.

So we need to find new and innovative ways of measuring intangibles, organisational and human capital, that is to search for the missing data on intangibles.

In addition to exploring alternative data sources covering the intangibles not identified as such in business accounting and the SNA, other tasks to be coped with include such daunting challenges as:

- Measuring, and in which units, new products' contribution to growth?
- Amortization of intangible assets
- Deflation of the current-price values?
- Measuring the social value of intangible assets, which may differ from the private value whereas the social value is the relevant measure to explain growth.