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SEMINAR ON MEASURING CAPITAL – BEYOND THE TRADITIONAL MEASURES
KEYNOTE SPEECH

Innovation, intangibles and economic growth: Towards a comprehensive accounting of the knowledge economy

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INTRODUCTION

1. We live in an era of rapid, almost dizzying, innovation in products and processes. These innovations have improved consumer welfare through the introduction of new goods and services, improvements in the quality and lower costs of existing products, and greatly increasing the amount of information about available products. They also revolutionized the organization of production, not just the 'technology' of production as narrowly conceived, but also the management and global reach of corporations around the world.

2. While the impact of innovation is evident 'on the ground,' and widely supported in the academic literature, it has proved surprisingly hard to develop an overall measure of the magnitude of the macroeconomic impact. How much of the recent growth in GDP is due to this revolution?

What is the impact on living standards and worker productivity? Some progress has been made in answering these questions, particularly in measuring the impact of ICT capital on growth, but the answers tend to be piecemeal or incomplete. Various attempts have been undertaken to construct comprehensive innovation indicators, both in the U.S. (for example, at the National Academy of Science) and in Europe (for example, the Community Innovation Survey), but the lack of a coherent analytical framework within which to evaluate these indicators and the difficulty to arrive at bottom-line financial metrics, have left many questions unanswered.

3. The need for better metrics of what constitutes the knowledge economy and how it contributes to economic growth presents both a challenge and an opportunity. There is a clearly a perceived need for improvements in official national statistics and international statistical systems. There is also a need to connect the large body of microeconomic survey and interview data on innovation to the macro statistics. The size and complexity of the connection process is daunting, but it is already beginning to happen. Piecemeal efforts at 'connecting the dots' may simply produce more dots. What is needed is an ongoing program that develops and maintains a set of macroeconomic innovation accounts built on official statistics, but going beyond them.

4. In this paper we argue that in order to improve our understanding of innovation, we need a systematic and comprehensive accounting framework for the knowledge economy. Growth accounting, which has become the empirical work horse of growth economics, involves simple way of decomposing the growth rate of output per worker into its component sources, capital formation and innovation. Growth accounts are typically developed by researchers parallel to official national accounts, and can therefore be relatively easily linked to official statistics of NSI's.

5. Several national statistical institutes (NSI's) have begun to construct growth and productivity accounts in conjunction to their national income and product accounts. However, the quest for the contribution of innovation to growth needs to go beyond this – by now well-established – sources of growth model. The traditional model typically stops short of moving beyond the measurement of the contribution of tangible capital to growth. The outlays for research and development, other types of knowledge creation, organizational innovation and other economic competencies, such as branding and marketing, are usually expensed in the accounts framework. As a result, these expenses do not add to GDP and the residual growth that remains after accounting for the contribution of tangible investments, called multi factor productivity (MFP) growth, may hide the effects from unmeasured intangible investments.

6. All to the good, this has recently changed with some major attempts to capitalize the key components of intangible investments. Corrado, Hulten and Sichel (CHS, 2005) have developed an estimate of intangible investment for the past five decades in the United States. They subsequently integrated a measure of intangible capital in the growth accounts of the U.S. (CHS, 2006). This work has recently been replicated for some other countries, including the United Kingdom, Japan, and presently also for some continental European countries. Even though we are still in early days, it is clear that for a full understanding of how the knowledge economy operates in a macroeconomic

setting, the extension of growth accounts towards including intangible inputs and output is a crucial component of this work.

7. The paper proceeds as follows. In section 2 we lay out the present situation with regard to the measurement of innovation and knowledge creation in relation to economic growth and we identify the areas that urgently require attention in future work. These are (1) the use of an extended growth accounts framework that allows for a detailed decomposition of inputs (labor, capital and intermediate inputs) into its components; (2) the measurement of intangible investment, covering ICT, knowledge inputs and economic competencies; and (3) the integration of the latter in a growth accounts framework.

8. In Section 3 we briefly describe the *EU KLEMS Growth and Productivity Accounts* as an illustration of the state of the art in growth accounting. The results from EU KLEMS are summarized in Timmer, O'Mahony and van Ark (2007) and van Ark, O'Mahony and Ypma (2007).[1] EU KLEMS is one of the most recent and most comprehensive efforts to build a system of growth accounts across a wide range of European countries, as well as the U.S. and Japan, with a breakdown to industry level and a decomposition of the contributions from labor input, capital input and intermediate inputs to growth.

9. Section 4 summarizes some of the recent work in the area of measurement of intangible capital, notably the work by Corrado, Hulten and Sichel (2005, 2006) for the U.S. but also reports on some ongoing work for other countries. Finally, section 5 reviews the issues ahead of us.

I. INNOVATION AND GROWTH: HOW FAR ARE WE IN ESTABLISHING THE LINK EMPIRICALLY?

10. There is no doubt that the relationship between innovation and economic growth is not straightforward. Innovation refers to a broad range of activities aimed in part at incremental improvements to existing products, processes, services ("new ways of making current products better, faster, cheaper") and in part at revolutionary, breakthrough developments ("creating something not previously created"). The mix and relationship between incremental and radical innovations varies a lot and has very different impact on growth.

11. It has turned out very difficult not only to measure the innovation activities itself, but also to measure its relationship to economic performance. Real GDP per capita is the most widely used indicator, which is convenient because of its link to the closely related statistic on the production side, that is real GDP per worker ('labor productivity'). The productivity of labor in producing goods and services is a key determinant of the volume of products available for consumption, now or in the future, and is thus associated with the underlying utility-based standard of living. Real GDP per worker can also be linked to the economic factors that lead to increases in output per worker over time: capital formation and innovation in products and production processes. The

[1] See also the Economics Focus section on "Use IT or lose it" in *The Economist*, May19th 2007, p. 82.

relation between these factors and the resulting output is the subject of a huge theoretical literature on economic growth and development, and an even larger literature on empirical growth analysis and the estimation of production functions.

12. Growth accounting, as it developed since the early work of Tinbergen (1942), Solow (1957), Denison (1967) and Jorgenson and Griliches (1967) provides a simple way of decomposing the growth rate of output per worker into its component sources, capital formation and innovation. The measurement of the corresponding levels is also a part of this framework. Innovation appears in several forms in the sources of growth framework: through the explicit breakout of IT capital formation, through the addition of intangible capital to both the input and output sides of the source-of-growth equation, through the inclusion of human capital formation in the form of changes in labor "quality," and through the "multi factor productivity" (MFP) residual, which includes the effects of technological externalities and spontaneous improvements in organization and technology of production (although this cannot be separated from other factors in the residual, like measurement error).

13. In our view the growth accounts framework is the most promising way of developing a summary metric of the overall impact of innovation on output per worker, and through this, to changes in the standard of living. Still it is an incomplete and imperfect framework, whose defects are pointed out in various studies (see, for example, Hulten 2001), but it is by far the least incomplete and imperfect way of linking innovation to living standards in a reasonably comprehensive way.

14. Despite the significant contribution of growth accounting to our understanding of how innovation contributes to growth, the traditional growth accounts framework and the national accounts system as we have it today clearly cannot be seen as comprehensive. The lag between innovation in the economy and its appearance in the national statistics is due, in part, to the fact that innovation involves new ideas and products whose nature and significance take time to understand. However, a large part of the problem also results from the way both national statistics and firm financial data are organized. In neither case are the accounts organized to show innovation. In fact, accounting practice tends toward a conservatism that emphasizes accuracy and continuity with the past over innovation and approximation.[2] Thus, accounting practice has traditionally concentrated on market data generated by arms-length transactions and avoided making imputations where possible. One important consequence of this conservatism is that non-market intangibles like internally produced like R&D are treated as a current expense rather than as an investment in the future of the company. This means, for example, that the typical biotechnology company does not add to the GDP in the first years of its existence, nor is its research program deemed to have a long-run impact on value of the company or the economy.

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[2] The account scandals of recent years illustrate the virtues of accounting accuracy. But the obvious need for investor confidence should not obscure the need for accounting metrics that reveal the true dynamism and future prospects of a company. Accounting practice should ideally be able to accomplish both objectives.

15. The perverse treatment of intangibles is beginning to change in national accounting practice, with the decision in the late 1990s to capitalize software expenditures and include them as an investment that contributes to GDP. This treatment has recently been extended to scientific R&D in the U.S. national accounts, starting in 2010, and by the decision by the United Nations to do likewise in its System of National Accounts by 2012. Regrettably, financial accounting practice continues to be stuck in the past. Moreover, the full range of value-building intangible assets are not likely to be accorded the treatment of scientific R&D in the national accounts, even though surveys show that assets like marketing and employee-training expenditures are important coinvestments with R&D.

16. The treatment of intangibles is by no means the only problem area in understanding the link between innovation and economic growth. Product innovation is another aspect of the ongoing technological revolution but, with the exception of computer prices, it is poorly represented in official statistics. Improvements in the quality of existing products are picked up for some items (like computers), but this is not done systematically for a full range of products. The treatment of entirely new goods is even more troubling. The improvements in consumer well-being due to the introduction of cellular telephones, cholesterol–lowering drugs, and the internet are effectively ignored in the procedures used in constructing the consumer price index (see, for example, Hausman 1999). This reflects the conservatism of the statistical system noted above, which, in the case of price measurement, tends to treat product innovation as an adjustment to price indexes and not something that is valuable in its own right.[3] These price statistics are used in the national accounts to express income and product in constant prices in order to measure real GDP. The failure to capture innovation in the price statistics thus carries over to errors in the measurement of economic growth and productivity.

17. There are other problems as well. Data on research and development are one of the most important sources of information about the source of innovation in the economy. However, these data are collected for scientific R&D only and exclude research in important areas like financial services and retail distribution (the research and development of new financial products at places like Morgan Stanley and Goldman Sachs, the development of retailing models like that of Walmart or Carrefour). Significant efforts are being undertaken to fill the gaps in the data collection on innovation. For example, the European Union member states are collecting a wider range of statistics on innovation activities, including marketing and training, in their Community Innovation Survey (CIS). However, these surveys often lack important information on the euro expenses on innovation activities which seriously complicates economic analysis of its effects. The U.S. National Science Foundation (NSF) supports numerous projects that conduct surveys and interviews, and these provide an important base of information about the micro innovation process. But the consensus of a recent NSF workshop on innovation metrics was that broader innovation surveys are

[3] Amazingly, there is still a debate over the question of whether the CPI should be based on a fixed market basket of products. In this view, apparently shared by some members of the recent NRC price-statistics panel, the CPI should reflect the change in the prices of the same bundle of items year after year (the "Cost-of Goods Index" discussed in the NRC report). If the logic of this view were to prevail, and it is not the dominant view of price-measurement specialists, it would virtually remove product innovation from official price statistics.

needed to help 'connect the dots.' There is a parallel need to insure that these new metrics can be connected to the dollar and euro metrics needed to improve current accounting practice.[4]

II. EU KLEMS GROWTH AND PRODUCTIVITY ACCOUNTS[5]

18. The purpose of growth accounting is to support empirical and theoretical research in the area of economic growth, such as study of the relationship between skill formation, investment, technological progress and innovation on the one hand, and productivity, on the other. In addition, it may facilitate the conduct of policies aimed at supporting productivity growth and competitiveness. These policies require comprehensive measurement tools to monitor and evaluate progress. Growth accounts should also support the systematic production of high quality statistics on growth and productivity using the methodologies of national accounts and input-output analysis.

19. The EU KLEMS Growth and Productivity Accounts is the result of a research project, financed by the European Commission, to analyse productivity in member states of the European Union as well as Japan and the U.S. at the industry level. It includes measures of output growth, employment and skill creation, capital formation and multi factor productivity (MFP) at the industry level for individual countries from 1970 onwards. The input measures include various categories of capital (K), labour (L), energy (E), material (M) and service inputs (S).

20. Growth accounting is theoretically motivated by, among others, the seminal contribution of Jorgenson and Griliches (1967) and put in a more general input-output framework by Jorgenson, Gollop and Fraumeni (1987) and Jorgenson, Ho and Stiroh (2005). It allows one to assess the relative importance of the contributions of labor, capital and intermediate inputs to growth, and to derive measures of multi-factor productivity (MFP) growth. MFP indicates the efficiency with which inputs are being used in the production process and is an important indicator of technological change.[6] Under the assumptions of competitive factor markets, full input utilization and constant returns to scale, the growth of output in each industry is expressed as the (compensation share) weighted growth of inputs and multifactor productivity (MFP) growth.

21. Accurate measures of labor and capital input are based on a breakdown of aggregate hours worked and aggregate capital stock into various components. Hours worked are cross-classified by

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[4] Other measurement issues related to innovation include the need to improve existing measures of tangible capital, particularly in the areas of capital-embodied technical change, depreciation, and obsolescence. More emphasis on the role of human capital and 'human-embodied' technical change is also needed, as well as on developing stronger links to data for the household sector.

[5] A more detailed account of the EU KLEMS database is provided by Timmer, O'Mahony and Van Ark (2007). See also the EU KLEMS website (www.euklems.net).

[6] Under strict neo-classical assumptions, MFP growth measures disembodied technological change. In practice, MFP is derived as a residual and includes a host of effects such as improvements in allocative and technical efficiency, changes in returns to scale and mark-ups and technological change proper. All these effects can be broadly summarised as "improvements in efficiency", as they improve the productivity with which inputs are being used in the production process. In addition, being a residual measure MFP growth also includes measurement errors and the effects from unmeasured output and inputs, notably intangible output and inputs (see Section 4).

educational attainment, gender and age with the aim to proxy for differences in work experience, which provides 18 labor categories (3*2*3 types). Typically, a shift in the share of hours worked by low-skilled workers to high-skilled workers will lead to a growth of labour services which is larger than the growth in total hours worked. We refer to this difference as the labor composition effect.

22. Similarly, capital stock measures are broken down into stocks of different asset types. Importantly, we make a distinction between three ICT assets (office and computing equipment, communication equipment and software) and four non-ICT assets (transport equipment, other machinery and equipment, residential buildings and non-residential structures). Short-lived assets like computers have a much higher productivity than long-lived assets like buildings, and this should be reflected in the capital input measures. Aggregation takes into account the widely different marginal products from the heterogeneous stock of assets. The weights are related to the user cost of each asset. Finally, the contribution of intermediate inputs is broken down into the contribution of energy goods, intermediate materials and services.

23. The growth accounting analysis from the EU KLEMS Growth and Productivity Accounts concentrates on a sub-sample of eleven “old” EU countries. In Table 1, a decomposition of value added growth in the market economy is given for the periods 1980-1995 and 1995-2004. GDP growth in the EU accelerated from 1.9% before to 2.2% after 1995, completely due a strong improvement in the contribution of labour input, increasing from a zero contribution to a 0.7 percentage point contribution. About two thirds of this came from faster growth in total hours worked and one third from improved labour composition, as the overall skill level of the workforce has continued to increase significantly. GDP growth in the U.S. market economy accelerated much faster than in the EU since 1995 (from 3.0% before 1995 to 3.7% after 1995), but the contribution of labor slowed down rather than accelerated, even though it did not fall behind the European growth in labor input.

24. The contribution of capital input to value added growth has not changed much at the aggregate level, but the distribution has shifted somewhat from non-ICT capital to ICT capital. However, compared to the United States the shift towards intensive use of ICT capital has generally not been as pronounced. Notably, when comparing the ratio of capital to labour contributions to growth in the EU, there are signs of a declining capital intensity in the EU. This development is in contrast to the slightly increased US trend in capital intensity since 1995. The factor contributing most to the diverging trends in Europe and the US is the trend in multifactor productivity growth. While contributing 0.7 per cent to market economy GDP during 1980-1995 in both regions, the trend accelerated to 1.6 per cent in the US, but declined to 0.3 per cent in the EU after 1995 (see Figure 1).

25. When decomposing the growth contribution further to industry level, it appears that market services tell a major part of the divergent performance of European economies since 1995, both among themselves as well as relative to the United States. Table 1 shows that while the contribution of factor inputs to growth has generally stayed up, multi-factor productivity growth in the market services stagnated or even turned negative in many European countries. The reasons for the

slowdown in multi-factor productivity growth in market services are an important avenue for further research, not further pursued in this paper.[7] Instead the focus here is on another possible factor affecting the MFP residual, which is the impact of unmeasured inputs, notably intangible capital.

III. WHAT DOES INTANGIBLE CAPITAL ADD TO THE U.S. GROWTH STORY?

26. Despite its recognized importance, the challenges concerning the conceptualization of intangible capital, its measurement and integration into a production function or growth accounting framework are substantial (Van Ark, 2002). For example, Howitt (1996) classified some inherent measurement difficulties of intangible capital going beyond those of tangible capital as follows:

(a) The knowledge-input problem, which concerns the measurement of the resources devoted to the creation of knowledge which can often not be distinguished unambiguously from other inputs, such as labour and capital.
(b) The knowledge-investment problem, which refers to the output of the process of knowledge creation which is typically not measured at all because knowledge mostly does not directly produce a commodity or service.
(c) The quality improvement problem, which relates to the need to pick up the improvement of the goods and services which results from knowledge creation.
(d) The obsolescence problem which stresses the need with any type of capital to find a measure of depreciation, which is very difficult for intangible capital measures.

27. However, as clarified in Corrado, Hulten and Sichel (CHS, 2005), there is no clearcut distinction between tangibles and intangibles that would justify a distinction between the former being capitalized and the latter being expensed. In fact "any outlay than is intended to increase future rather than current consumption is treated as a capital investment" (CHS, 2005, p. 13). Various definitions of intangible capital are possible with different coverage of activities but most definitions are offsprings from Schumpeter's classification including the development of new products and production processes, organisational change, management, marketing and finance (Schumpeter, 1934).

28. CHS (2005) developed an estimate of a broad range of intangibles for the U.S. in the 1990s. This list is shown in Table 2 along with an annualized estimate for each category. The first general category is computer software, which has already been capitalized in the U.S. national accounts. Innovative property includes both NSF-style scientific property with what may be called 'non-scientific' R&D, although this is somewhat misleading because much of this category, which includes the development of innovative new financial products and architectural modeling, is conducted by personnel with scientific degrees. It is worth noting here that spending on nonscientific R&D exceeds the amount spent on the conventional science-lab type. The third category, firm-specific human competencies, includes three subcategories: brand equity, worker-training, and management capability. This is by far the most controversial group, and it is also the largest. The choice of what to include in this broad category was based on the studies noted in the

[7] See, for example, Inklaar, Timmer and van Ark (2007)

bibliography in CHS (2005, 2006).

29. The key finding of this research is that intangible investment by U.S. businesses averaged $1.2 trillion per year during the 1998-2000 period. This is also the amount by which U.S. GDP is increased by the capitalization of this broad list of intangibles. In percentage terms, the resulting estimate of GDP is 10 percent larger. The software portion of this is already included in current GDP estimates, but this amounts to only 13 percent of the $1.2 trillion increase. Moreover, even if scientific R&D were added to this percentage, it would only rise to 28 percent. In other words, intangibles matter.

30. The $1.2 trillion of intangible investment equals the total amount spent by businesses for their tangible plant and equipment. When these figures are extended backward in time in order to obtain a broader perspective on economic growth, it also becomes apparent that these intangibles have become more important over the last five decades. Figure 2 shows investment as a fraction of business output over this period, and compares the results for tangible and intangible investment combined with those of tangibles alone. For the latter, the share of business output is around the 12 percent for the period as a whole, while the combined share grows from 14 percent of output to more than 22 percent. Intangibles not only matter for the level of GDP, they also matter for its rate of growth as well. Figure 3 shows which intangibles have been the most dynamic growers, and surprisingly, scientific R&D has been a rather flat contributor to the overall increase (as has brand equity). Thus, the move to incorporate scientific R&D in U.S. GDP in 2010 will not lead to a boost in the growth rate of GDP, if current trends hold.

31. It is important to recognize that in a growth accounts framework the capitalization of intangibles adds to income as well as output, in the form of increased gross operating income accruing to capital. The effect of this increase on the distribution of income between labor and capital is noted in Figure 3. The share of income going to labor in the U.S. has been relatively constant at around 70 percent over the last 50 years. With intangibles, however, labor's share has fallen considerably.

32. Figures 4, 5, and 6 show the productivity effects of capitalizing intangibles. Output per hour increases from an average annual growth rate of 2.78 percent for the period 1995-2003 to 3.09 percent as a result of capitalization. This is not a huge effect, but the 2003 end point of the period saw a downturn in intangible spending, and the gap for the period 1995-2001 is quite a bit larger (more that 0.50 points versus 0.31). However, the main effect of intangibles is to restate the relative importance of the various sources of growth. Intangibles are now seen to be the most important *systematic* source of growth at 27 percent, while multifactor productivity, a non-systematic residual category or 'measure of our ignorance', falls in importance from 50 to 35 percent.

33. Figure 4 contains another message. The combined importance of intangibles, IT capital, and labor quality (which largely reflects human capital) explain nearly 60 percent of productivity growth. This reflects the importance of 'knowledge capital' – our measure of innovation – as a driver of growth. This effect is enhanced by the high probability that R&D and human capital

spillover externalities are an important component of the residual MFP measure. Conventional plant and equipment, excluding IT capital, accounts for only 8 percent.

34. Figure 6 zeroes in on the sources of growth within intangibles. Software and firm specific human competencies account for nearly two-thirds of the intangibles' effect. Brand equity and scientific R&D account for a combined 20 percent, again suggesting that the capitalization of scientific R&D will not greatly affect the sources-of-growth picture.

IV. CONCLUSIONS AND FUTURE RESEARCH

35. Achieving a rising living standard is a central objective of economic policy in nations around the world, rich and poor, and the growth in output per worker hour is a key determinant of the standard of living. If workers can produce more goods and services, they can consume more, both now and in the future. However, sustained growth in output per worker does not happen automatically or autonomously. The standard sources-of-growth model reminds us that it is the result of systematic investments in a broad range of capital assets and improvements in productive efficiency (measured as a residual). This is why it is important to count all the sources of innovation, not just those that are more easily measured.

36. The extension of the conventional sources-of-growth analysis to include intangible inputs and outputs is still in its infancy, though the literature is expanding. The recent work of Marrano and Haskell (2006) applies the CHS framework to the U.K., and reports very similar results to those for the U.S. Also, preliminary work by Fukao *et al.* (2007) for Japan also implements this framework for Japan, and finds a somewhat different pattern. Work is ongoing in Finland and at Statistics Netherlands as well as at The Conference Board (on France and Germany).

37. As research proceeds, measures of the intangible components will hopefully be refined, though this may require major changes in corporate financial accounting practice. Unfortunately, so far no parallel development has occurred in corporate financial account practice, which continues to treat R&D and other intangibles as current expenses. Preliminary research suggests that this practice has the effect of understating the net income and total assets of some of the most dynamic companies in the economy.[8] The Conference Board is presently undertaking a project to measure intangibles at the corporate level. Using the accounting model established in the research of Corrado, Hulten, and Sichel as a guide, the financial statements of a collection of U.S. and foreign corporations are being restated to include a broad range of intangibles. The preliminary work uncovered areas in which more information is needed to improve the accuracy of the estimates (for

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[8] CHS provide references to the large literature documenting both a positive rate of return to R&D spending, and its positive impact on share prices (both are tests of whether R&D should be considered as an investment or as a current expenditure with no future consequences). For specific references to the value- building effects of the other categories of intangible capital, see the papers by Abowd et. al. (2005), Black and Lynch (1996), Brynjolfsson and Yang (1999), and Brynjolfsson, Hitt, and Yang (2000), and B. Hall (1993). The recent paper by Bloom and Van Reenen (2006) is especially noteworthy, since it links one of the most controversial forms of intangible capital, corporate management practice (an important aspect of corporate "culture"), strongly and positively to the value of a company's shares.

example, the write-off periods over which intangibles are amortized, spending on human resource development and long-term strategic planning). Additionally, considerable effort will be required to develop a consistent time series, in light of the mergers and acquisitions that take place over time, and accounting changes like the recognition of employee stock options. These are challenging data problems, made all the more difficult by the fact that intangibles are not recognized on corporate financial statements, and because surveys of corporate leaders has revealed some confusion about the nature of intangibles.

38. The results from a project on corporate intangibles will not only provide richer insight into the true dynamism of firms, but will also be invaluable to national income accounting practice, which relies heavily on the data provided by the business sector.

39. This, in turn, would enrich the macroeconomic analysis of the sources and drivers of growth.

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Table 1. Gross value added growth and contributions, 1980-1995 and 1995-2004 (annual average volume growth rates, in %)

A. European Union-15 (excluding Greece, Ireland, Luxembourg, Portugal and Sweden)

	VA	L	*H*	*LC*	K	*KIT*	*KNIT*	MFP
	(1)=(2)+(5)+(8)	(2)=(3)+(4)	(3)	(4)	(5)=(6)+(7)	(6)	(7)	(8)
1980-1995								
MARKET ECONOMY	1.9	0.0	-0.3	0.3	1.1	0.4	0.7	0.7
.Electrical machinery, post and communication	3.9	-0.7	-0.8	0.2	1.6	0.9	0.8	2.9
.Manufacturing, excluding electrical	1.2	-1.3	-1.5	0.3	0.8	0.2	0.6	1.7
.Other goods producing industries	-0.2	-1.2	-1.4	0.2	0.9	0.2	0.7	0.2
.Distribution services	2.6	0.4	0.0	0.3	0.8	0.3	0.5	1.4
.Finance and business services	3.6	2.2	1.9	0.3	1.9	0.8	1.0	-0.7
.Personal and social services	1.8	1.8	1.5	0.3	1.0	0.3	0.7	-1.1
1995-2004								
MARKET ECONOMY	2.2	0.7	0.4	0.2	1.2	0.6	0.6	0.3
.Electrical machinery, post and communication	6.0	-0.4	-0.6	0.2	1.7	1.2	0.5	4.7
.Manufacturing, excluding electrical	1.0	-0.3	-0.6	0.3	0.7	0.3	0.4	0.6
.Other goods producing industries	1.2	0.0	-0.2	0.2	0.7	0.1	0.6	0.5
.Distribution services	2.3	0.7	0.6	0.1	1.2	0.5	0.7	0.4
.Finance and business services	3.5	2.1	1.9	0.3	2.3	1.3	1.0	-1.3
.Personal and social services	1.7	1.5	1.4	0.1	0.9	0.3	0.7	-0.9

B. United States

	VA	L	*H*	*LC*	K	*KIT*	*KNIT*	MFP
	(1)=(2)+(5)+(8)	(2)=(3)+(4)	(3)	(4)	(5)=(6)+(7)	(6)	(7)	(8)
1980-1995								
MARKET ECONOMY	3.0	1.2	1.0	0.2	1.1	0.5	0.6	0.7
.Electrical machinery, post and communication	6.6	0.1	-0.3	0.4	1.9	1.0	0.9	4.6
.Manufacturing, excluding electrical	1.7	0.1	-0.2	0.3	0.6	0.3	0.3	0.9
.Other goods producing industries	0.7	0.7	0.4	0.3	0.7	0.2	0.5	-0.7
.Distribution services	3.9	1.3	1.2	0.2	1.2	0.6	0.6	1.3
.Finance and business services	4.4	2.9	2.7	0.2	1.8	1.0	0.9	-0.3
.Personal and social services	2.8	2.5	2.5	0.1	0.5	0.2	0.3	-0.2
1995-2004								
MARKET ECONOMY	3.7	0.7	0.3	0.3	1.4	0.8	0.6	1.6
.Electrical machinery, post and communication	8.9	-0.3	-0.9	0.6	2.5	1.5	0.9	6.8
.Manufacturing, excluding electrical	0.7	-1.1	-1.5	0.3	0.7	0.4	0.3	1.1
.Other goods producing industries	1.6	1.0	0.9	0.1	0.9	0.2	0.6	-0.3
.Distribution services	4.7	0.5	0.2	0.3	1.4	1.0	0.4	2.8
.Finance and business services	4.9	2.0	1.6	0.4	2.0	1.2	0.7	0.9
.Personal and social services	2.6	1.7	1.4	0.2	1.0	0.4	0.6	0.0

Source: EU KLEMS Database, March 2007, http://www.euklems.net. See Timmer, O'Mahony and van Ark (2007)

Notes:

VA= Gross Value Added growth
L= Contribution of Labour input growth
H= Contribution of Total hours worked
LC= Contribution of Labour composition
K= Contribution of Capital input growth
KIT= Contribution of ICT capital
KNIT= Contribution of Non-ICT capital
MFP= Contribution of Multi factor productivity growth

Table 2: Expenditures on a Broad List of Intangible Capital U.S. Nonfarm Business Sector, 1998-200 (average) (billions of dollars)

COMPUTERIZED INFORMATION ($154)

- COMPUTER SOFT WARE ($151)
- COMPUTERIZED DATABASES ($3)

INNOVATIVE PROPERTY ($424)

- SCIENTIFIC R&D ($184)
- MINERAL EXPLORATION ($18)
- COPYRIGHT AND LICENCE COSTS ($75)
- OTHER PRODUCT DEVELOPMENT ($149)

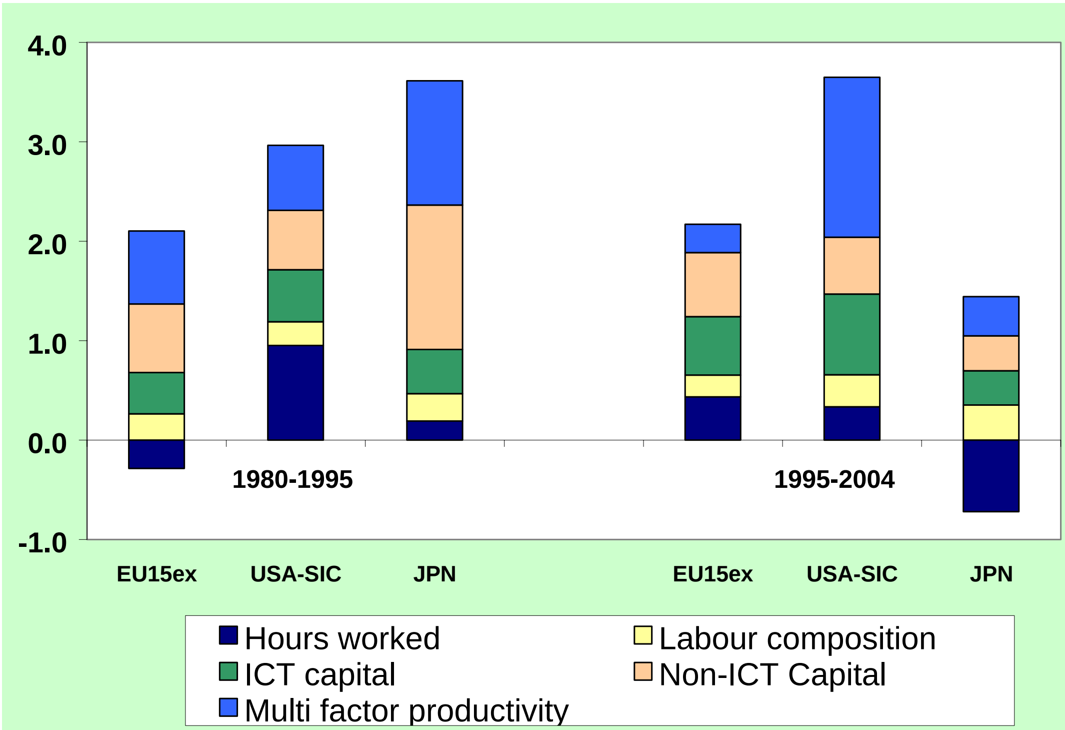
ECONOMIC COMPETENCIES ($642)*

- BRAND EQUITY (ADVERTISING) ($236)
- FIRM-SPECIFIC HUMAN CAPITAL (TRAINING) ($116)
- ORGANIZATIONAL STRUCTURE MANANGEMENT ($291)

Source: Corrado, Hulten, and Sichel (2006).

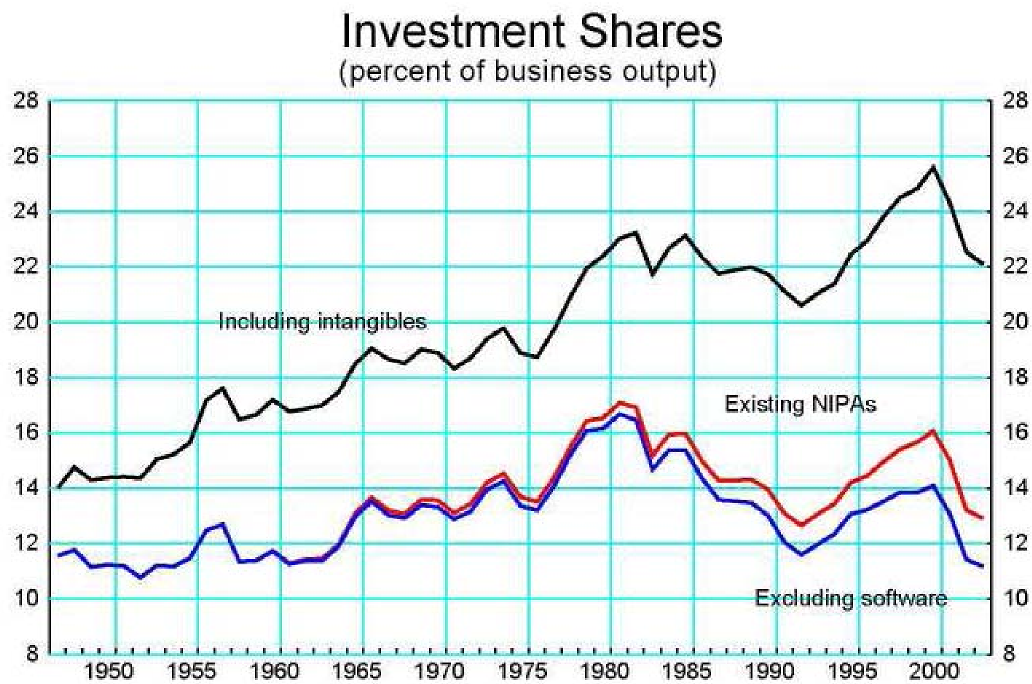
* $505 of this category is considered investment

Figure 1. Contributions to Market Economy GDP Growth 1980-1995 vs. 1995-2004 (in %), major regions



Source: EU KLEMS Database, March 2007, http://www.euklems.net. See Timmer, O'Mahony and van Ark (2007)

Figure 2. Investment Shares, United States



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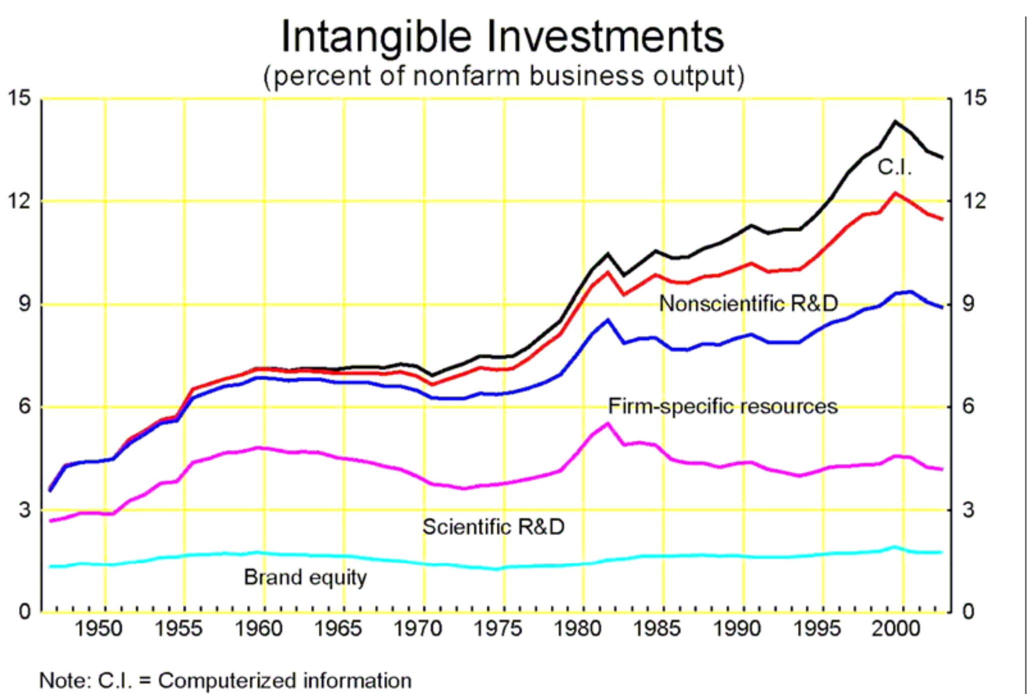

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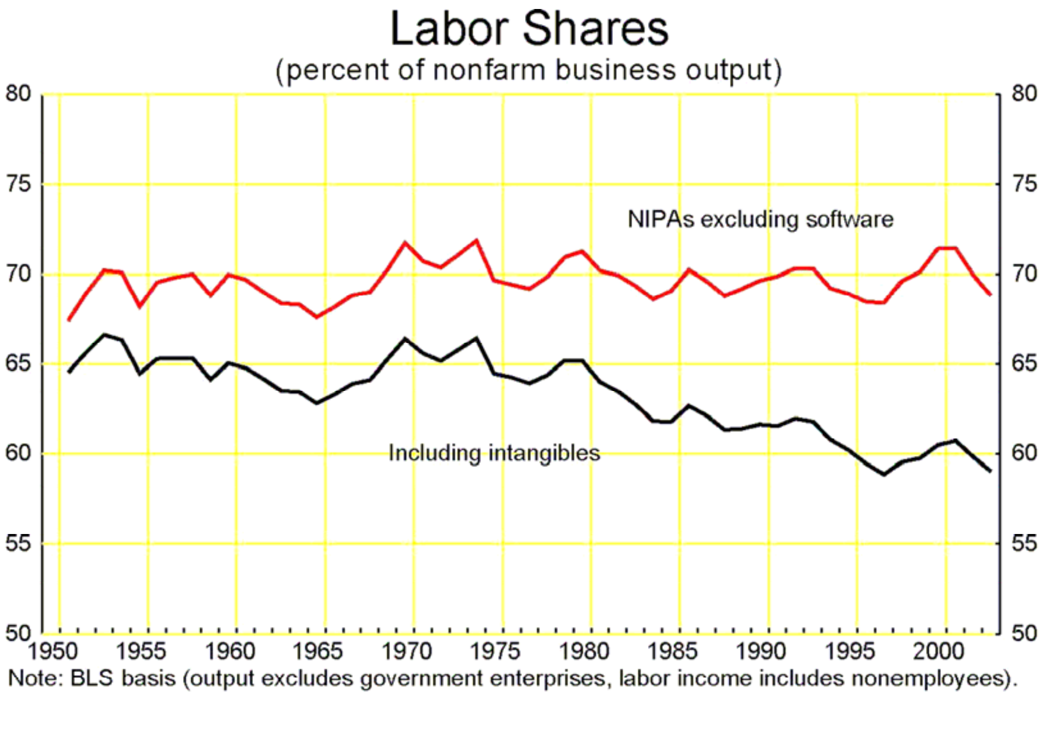

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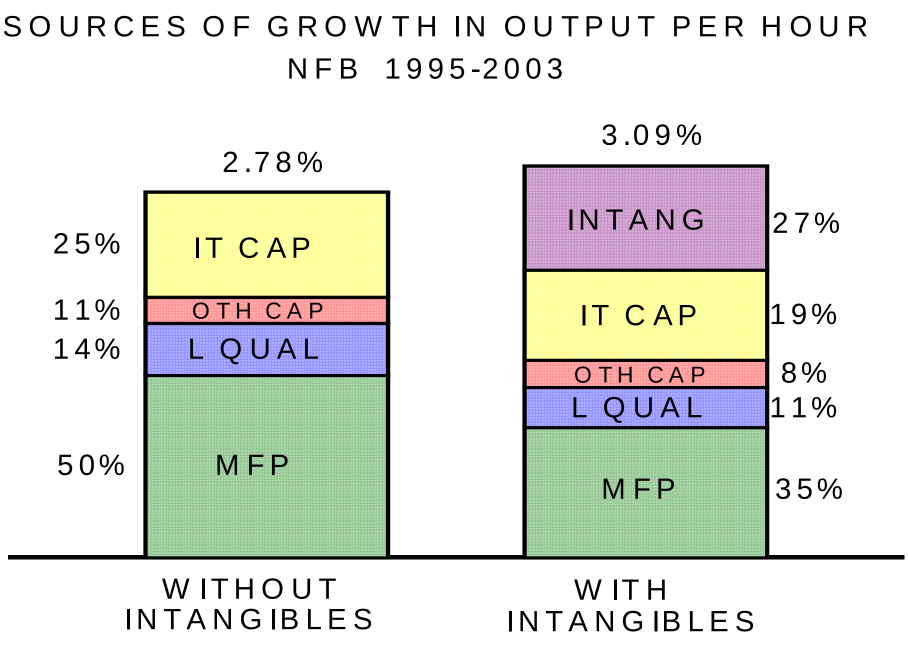

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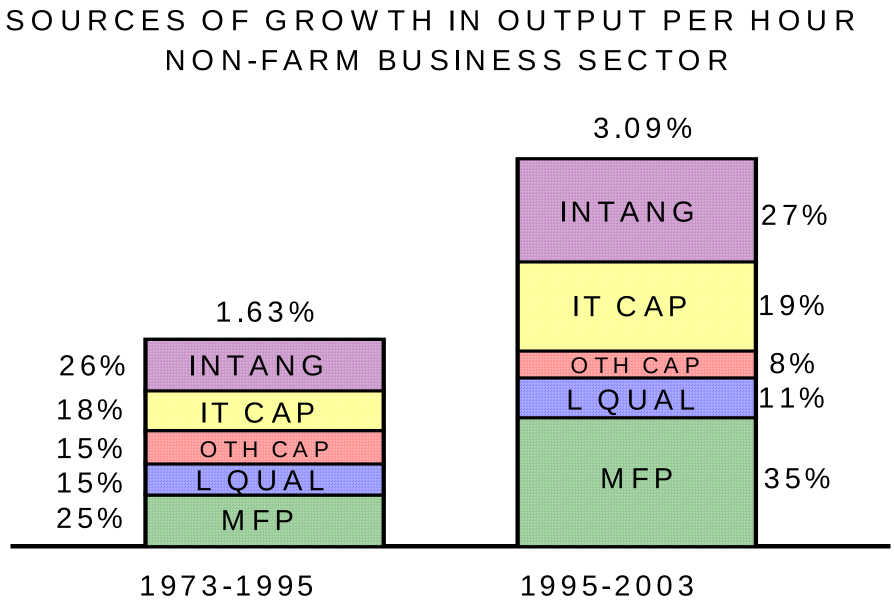

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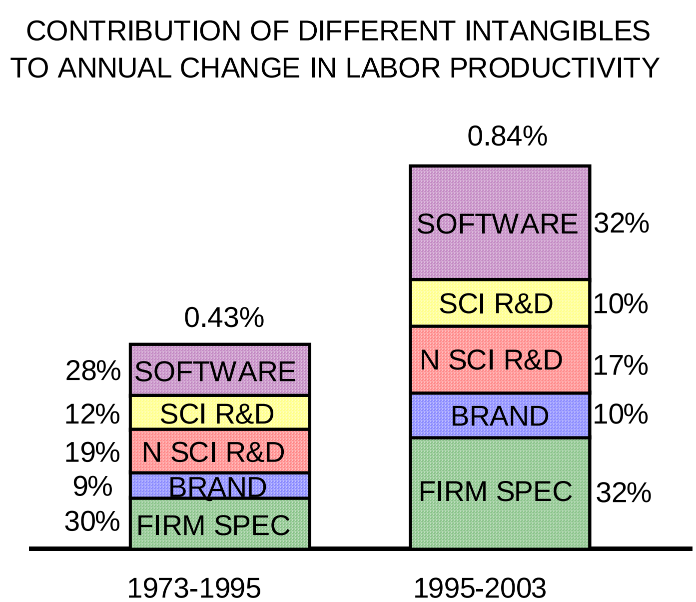

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