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Macroeconomic Indicators and Policies for Intangible Assets: Measurement Problem or More Fundamental Economic Change?

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Macroeconomic Indicators and Policies for Intangible Assets: Measurement Problem or More Fundamental Economic Change? ♥

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Abstract

The aim of this paper is to review and evaluate existing policies towards intangible assets in order to derive first insights as to the policy implications of the intangible economy. We first present the current and main indicators of intangible assets used for policy-making; we outline their limitations, and show in a second step that the limitation results from a lack of (or imperfect) account for intangible assets in economic theory. The same limitations explain the limited effects of current policies towards intangibles.

At present, there is no single policy towards intangible investments; rather, existing policies aimed at favouring the development of intangible investments have been separated into different fields, corresponding to different intangible assets: policies that favour innovation, policies that favour employment and human capital, policies that favour the development of knowledge-intensive sectors, trade policy, competition and competitiveness policies. Various categories of intangible assets have been proposed and mainly include as intangibles innovation, human capital, organisational capital and knowledge.

We subsequently present what the rise in the intangible economy really means. It is not just that firms are trying to measure some assets that were previously neglected, and that national accounts and consequently policy should be adapted accordingly if better measures are found. The real meaning of the rise in intangible assets is that a new paradigm, a new way of organising production and creating value has appeared and has important implications for the policy framework defined in economic theory and therefore for policy recommendations.

Hence the importance for national and European policy makers to understand the new paradigm and adapt policy accordingly.

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1. Introduction

The aim of this chapter is to review and evaluate existing policies towards intangible assets in order to derive first insights as to the policy implications of the intangible economy. We first present the current and main indicators of intangible assets used for policy-making; we outline their limitations, and show in a second step that the limitation results from a lack (or imperfect) account for intangible assets in economic theory. The same limitations explain the limited effects of current policies towards intangibles.

At present, there is no single policy towards intangible investments; rather, existing policies aimed at favouring the development of intangible investments have so far been separated into different fields, corresponding to different intangible assets: policies that favour innovation, policies that favour employment and human capital, policies that favour the development of knowledge-intensive sectors, trade policy, competition and competitiveness policies. Various categories of intangible assets have been proposed (OECD, 1998; Buigues et al., 2000; Lev, 2000; HLEG, 2000), and mainly include as intangibles innovation, human capital, organisational capital, knowledge.

We subsequently present what the rise in the intangible economy really means. It is not just that firms are trying to measure some assets that were previously neglected, and that national accounts and consequently policy should be adapted accordingly if better measures are found. The real meaning of the rise in intangible assets is that a new paradigm, a new way of organising production and creating value, that has important implications for the policy framework defined in economic theory and therefore for policy recommendations.

Hence the importance for national and European policy makers to understand the new paradigm and adapt policy accordingly.

Given that a number of studies (see Abernethy et al., 2002, for a review) have discussed measurement problems at length, we only provide here a summary of such problems, through the presentation of the main currently used policy indicators. We focus instead on existing policies towards intangibles and their evaluation.

2. Measurement of intangibles at macro level: main policy indicators

2.1. Indicators of intangible assets

At the macroeconomic level there are four main intangible assets: knowledge, human capital, innovation and organisation (Bianchi - Labory, 2002a). This section reviews methods used at the macro level in order to measure these intangibles in the EU, USA and Australia[1].

- **Knowledge** has been defined as "*the cumulative stock of information and skills derived from the use of information by the recipient. Where the recipient is a human being, knowledge thus reflects the processing by the brain of the "raw material" supplied in the form of information*" (Burton-Jones, 1999). Information is defined as data which are intelligible to the recipient, while data are defined as any signals which can be sent by an originator to a recipient.

[1] When data are available.

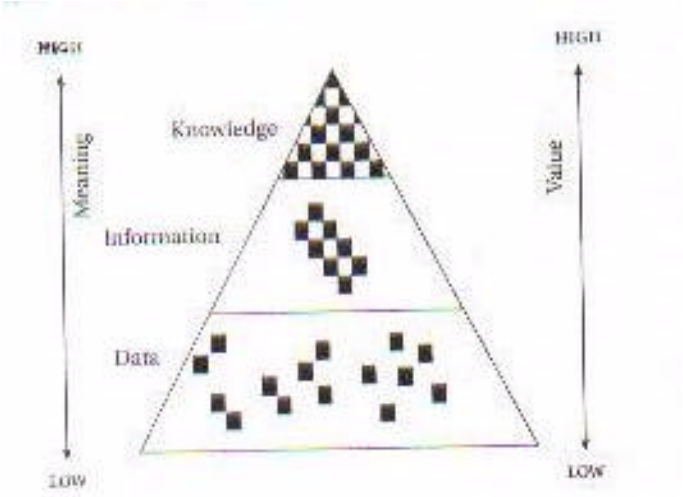


Figure 1: Data, Information and Knowledge

This working definition shows that knowledge subsumes information, which represents both the input to knowledge development and the form in which knowledge is transferred - its "*circulatory system*". The traditional economic view has tended to reduce knowledge to information only (see below section 3.4.); however, a number of scholars have shown that they are different and strongly complementary (Polanyi, 1958, 1966; Von Tunzelman, 1995; Fransman, 1998).

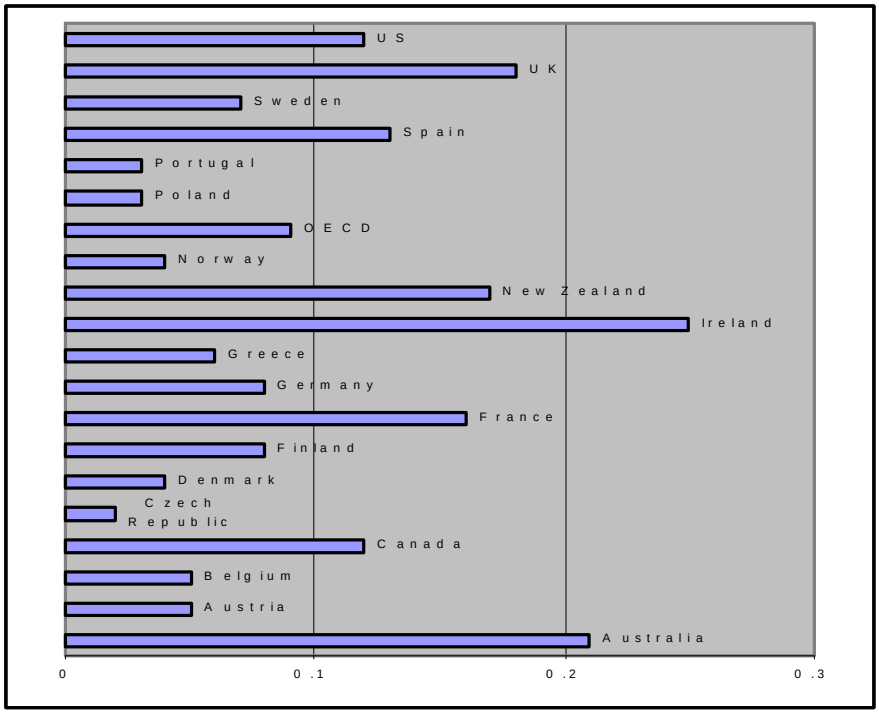
Knowledge acquisition (*learning*) and creation (*invention, innovation*) can only occur to any significant degree in the human brain, so that it is primarily individually specific. However, knowledge is "reflected" in other ways: a firm's knowledge capital, often referred to as its intellectual capital or intellectual assets, can be identified in its workforce (human capital), its customers' demands and preferences (customer capital), and its systems, products, processes and capabilities (structural capital).

Therefore, knowledge is not easily and clearly measured, although it is generally considered as a key intangible asset. Only indirect measures of knowledge exist: intensity of knowledge incorporated in goods and services measured by the degree to which the good or service in question is high tech; the knowledge stock of a country measured by the stock of R&D (for instance, Romer, 1990); and the proportion of highly skilled employees in particular industries or countries. In short, knowledge is either measured by the inputs to knowledge creation (years of schooling, manuals, etc.) or by the output of knowledge creation (human capital, patents, and so on). For instance, the Innovation Scoreboard of the European Commission measures knowledge creation by three indicators: government R&D funding as a percentage of GDP; business expenditure on R&D as a percentage of GDP; and number of patent applications in high tech per million population. The first two measures exclude knowledge creation that occurs in firms outside R&D activities, while the third measure excludes non patented innovation, process innovation and organisational innovations. The transmission and application of knowledge is also measured by three indicators: the percentage of manufacturing SMEs that innovate in-house; the percentage of manufacturing SMEs involved in cooperative innovation; and the innovation expenditures in the manufacturing sector as a percentage of total turnover. Of course, it is easy to criticise these indicators, without suggesting improvements. The European Commission itself recognises the difficulty in providing appropriate measures for the scoreboards (European Commission, 2000b). Our point here is just to outline the difficulty in providing adequate policy indicators regarding intangible assets and knowledge in particular.

Maybe as a result, policies towards knowledge diffusion and creation are mainly defined in terms of policies towards human capital (education and employment) and research and technology (innovation policy).

• **Human Capital** has two dimension: quantity and quality. At macro level, the quantity of labour gives an idea of the dimension of the labour market, while the quality of the workforce gives an idea of the skills of the working population. The former indicator was important at the beginning of the first industrial revolution, when the number of available workers determined how much would be produced (and is still important in some developing countries affected by a high mortality rate and high poverty). It was also important during mass production, since what mattered for production was the number of workers rather than their skills, production being increased by increasing the number of workers employed, and the average skills of the workforce being rather low (but enough to perform simple, repetitive tasks). The quality of labour means the level of skills reached by the population, and is becoming the most important dimension of human capital: the quality of human resources has been argued to be the major factor behind the invention and diffusion of technology and behind growth.[2] Such quality has generally been measured at macro level by educational attainment: the percentage of the workforce holding a given level of education, the proportion of graduates in the different types of universities, such as engineering, management, and so on. Thus for instance figure 2 below shoes the flows of graduates to science and engineering, in 1996.

Figure 2. Flows of graduate in science and engineering as % of total employment 1996 or latest available year



Source: OECD, 1998

In addition, the distribution of the workforce in the different sectors of the economy is often used as an indicator of the availability of human capital and of the potential for competitiveness of the economy. In particular, a high share of labour and highly skilled labour in so-called "knowledge-intensive sectors" (generally, high tech manufacturing and service sectors) is taken to be a good sign for the performance of the economy since these sectors are the currently booming ones.

In the EU in 1999, more than 31,5 million employees were working in the manufacturing industry, i.e. only about a fifth of total employment, whilst almost two thirds working in the service sector. In the same year, roughly 50 million people were in knowledge intensive services in the

[2] For instance, Rajan - Zingales (2000), Garicano (2000); also European Commission (2001).

broader sense, with one in ten (5 million) in the Information and Communication oriented services. In fact, employment in KIS (knowledge intensive services) rose in the course of 1995 to 1999. Europe-wide, about 5.3 million jobs (gains of 2.9% on average per year) were created in this sector, and more than 700.000 of these in Information and Communication sectors. Furthermore, 122 million people were employed in research intensive industries in 1999, with more than 50% of these in mechanical/automotive engineering, nearly 30% in electro-technology/information and communication and almost 20% in chemicals (European Commission, 2001).

Nonetheless, the share of S&T graduates in all post-secondary graduates in Europe is 37%, while the percentage of employment in medium and high-tech manufacturing sector is 7.7 and only 3% for high-tech services (OECD, 2000).

In fact, the analysis of the reservoir of skills in the labour force should bear interesting clues to two initial aspects. First of all, to the functional division of labour (for instance, between knowledge intensive services, Information and communication services and research intensive industries). Secondly, to the capacity of nations to attract innovative companies (via resource advantages, such as the educational qualification of employees), which favours their competitiveness. Table 1 shows the relative contributions of different skill types to value added in total manufacturing in the EU, USA and Japan.

Table 1. Value added shares in total manufacturing 1997 (%) : *Skills types*

Country	Low skilled	Medium Skilled/ Blue Collar	Medium Skilled/ White Collar	High Skilled
Germany	23,65	27,32	30,69	18,35
France	29,15	21,37	32,92	16,56
Italy	35,87	19,19	26,89	18,05
Netherlands	33,55	14,7	39,88	11,87
United Kingdom	32,07	17,9	32,77	17,26
Ireland	28,38	6,17	39,08	26,37
Denmark	34,96	19,48	23,51	22,05
Greece	51,09	15,32	26,33	7,26
Spain	40,31	25,51	24,35	9,82
Portugal	52,52	19,02	22,68	5,79
Austria	33,01	22,84	31,83	12,32
Sweden	19,07	24,58	38,02	18,33
Finland	23,4	15,25	46,3	15,05
Japan	29,15	21,71	33,67	15,46
USA	25,5	17,44	38,88	18,19
Belgium	36,42	20,68	31,19	11,71

Source: Buigues, P., Jacquemin, A., Marchipont, J-F.(2000).

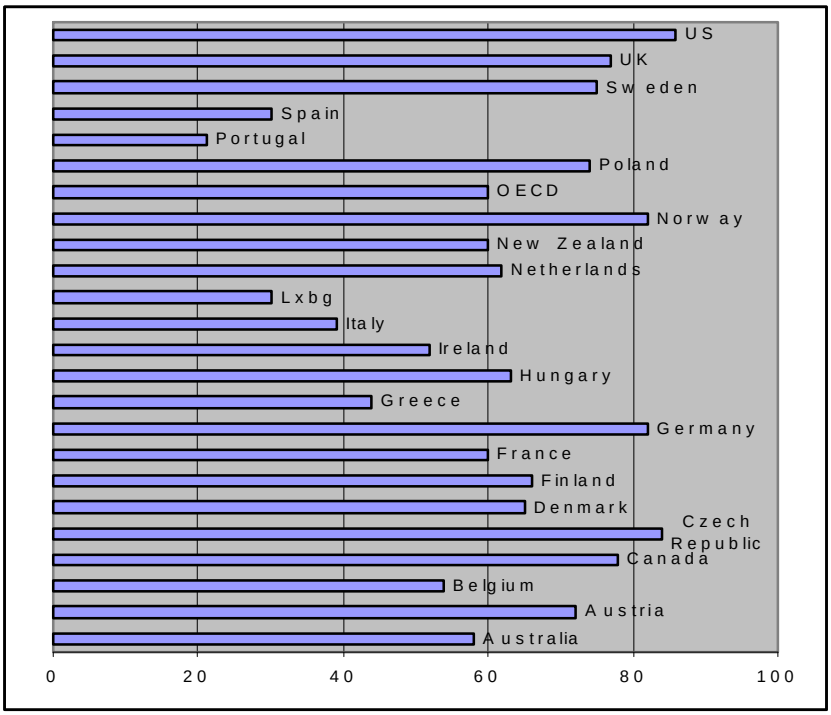
Looking at the value added shares within the triad, Japan exhibits an even distribution, whereas the USA enjoys significantly higher shares in both high-skilled and medium skilled white-collar industries. For the European Union as a whole, the opposite holds true. Nevertheless, countries such as Sweden, Finland, Denmark, the Netherlands, UK and Ireland show the highest shares of the EU-15 in the value added in the group of medium skilled/white collar - high skilled industries. Furthermore, in 1998, Sweden and Denmark showed the biggest share of total labour force in knowledge-intensive sector (40%) followed by the other Nordic countries, Germany, France and the UK. In Sweden 5% of total employment is in the Information-Communication Technology sector, followed by Denmark, Finland and the United Kingdom (4%) (European Commission, 2001). In Finland, information-communication Technology investments accounted for over 50% of non residential investments growth in the most recent year. At the same time, according to the "*Global*

Competitiveness Report 2000" (World Economic Forum and Centre for International Development, 2000), the most competitive nation is Finland. The Nordic countries were in lead in expenditure on R&D (covered by the business and government sector) and showed the most significant gains of R&D personnel numbers over the period 1985-1998.

In general, the quality of labour, as measured by the educational attainment of workers, has risen steadily, albeit slowly, across the OECD by between half a year and a whole year each decade since 1970. Figure 3 reports the educational attainment of the population as a percentage of the total population aged 25-64, in 1996, in tertiary education only. While many European Countries have displayed quality improvements, these have generally been accompanied by sluggish employment growth. In 1999, the unemployment rate for the European Union was more than double that of the United States. France, Italy, Belgium and the Netherlands have high labour productivity, but their lower employment rates and shorter working hours nevertheless account for an income gap with the United States (OECD, 2000). In other words, US workers are less productive than workers in some countries, but this may be because a greater proportion of the population works, especially the young and low-skilled who tend to be less productive. The end result is more income on average for the population as a whole.

Figure 3. Educational attainment of the population, as % of pop aged 25-64, 1996 or latest available year (tertiary education)

Source: OECD, 1998



These methods of measurement contain several imperfections, as they do not cover quality of schooling and formal or on-the-job training. For instance, Germany is characterised by high training within enterprises, and this is not captured in the data. The USA have a high rate of educational attainment in tertiary education but have poor education for intermediate levels of qualifications. Hence there are difficulties in measuring the quality of human resources at the level of country, in the same way as firms incur difficulties in measuring the quality of their human resources (see previous chapters). In fact, educational attainment should help to explain differences in access to Information

and Communication Technologies. In general, the higher the level of education, the more likely individuals are to have access to and use ICT both at home and in the workplace. Moreover, education attainment and income are strongly related, and education is a differentiating factor, largely through its effects on income. However, education also has some independent explanatory power; some groups with high levels of educational attainment and relatively low income (i.e. teachers, some public sector workers) have high levels of ICT use (OECD, 2001).

Training during the working life, both on-the-job and off-the-job, is difficult to estimate, especially the former kind, on-the-job training. At firm level, the only available measurement method is through surveys of employers or employees. Thus the OECD (2001) estimates that about two thirds of adult population in OECD countries do not receive any formal training. Concerning participation in training programmes in the 1990s, the OECD (2001) reviews the major sources of data on training, without however mentioning the precise year in which the surveys were conducted. The sourves are the International Adult Literacy Survey (IALS), the European Labour Force Survey (ELFS), Indicators of Education Systems (OECD/INES), and Continuing Vocational Training Survey (CVTS). All these surveys contain questions as to the extent of training received, such as "took one or more education and training courses for career or job-related purpose" or "received education and training for other than secondary education or initial vocational training". The rating of countries according to the percentage of the labour force receiving such training differs across surveys, but countries like Sweden, Denmark, Finland, the UK, France and Australia tend to always stand among the highest percentages, while Italy, Portugal, Greece and Belgium tend to have the lowest rates.

In addition, such surveys do not say about the content of training. Receiving training in the firm to learn about the safety and health rules is different from receiving training to be able to work in different work positions or to use new machines. Black and Lynch (1995) analyse training in firms on the basis of the NES survey (National Employer Survey), a survey of workplace characteristics of a representative sample of US firms. The firms in the sample have 20 employees or more, and Black and Lynch choose to retain only those with more than 50 employees. They find that smaller firms are less likely to provide training; countries with a high proportion of small firms, such as Italy, are therefore less likely to have workers trained during their working life. Another result is that firms which have adopted organisational changes, and in particular the new work practices including team work, a higher autonomy and involvement of workers and job rotation, are more likely to provide training; therefore, training needs are associated with changes in the firm, be they organisational or technological (high investment in physical capital and in computers are also associated with higher training). The type of training provided is important to distinguish. Most firms provide training in new hire orientation and health and safety, which are not that much of a sign of increased stock of human capital, but rather normal training for new hires on the one hand, and information of safety procedures and health questions on the other. Cross-training, training in teamwork or the use of new machines is more a sign of increased human capital: cross-training means training in another job than the one actually occupied (enable to do job rotation); teamwork requires relational skills in addition to technical skills so means an increase in competence for employees; and using new machines means learning new skills.

Overall, there is some evidence (Black - Lynch, 1995; Bartel, 1992) that training is associated with higher firm productivity (but the causation is not clear), and more evidence that training is associated with higher wages (Bartel, 1992; Krueger, 1993).

• **Innovation**: The *Community Innovation Survey* (CIS) defined “innovation” as “*the introduction onto the market of a technologically new or significantly improved product or the implementation of a technologically new or significantly improved process*”. Therefore, the number of innovators in a country could be considered as an indicator of innovation.

The Community Innovation Survey, organised by the European Commission and conducted in 1992, was replaced by the Community Innovation Survey 2 (CIS2) conducted during 1997/1998 in 17 EEA countries and based on the 1997 Oslo Manual. The focus of CIS2 is mainly on firm, with emphasis on the innovation in the manufacturing industry. However, it also extends to cover the service sector, which is now considered as the main user of innovation generated from the manufacturing industries[3].

As result of CIS2, on average 51% and 40% of enterprises in the manufacturing and service sectors respectively were innovative in the period 1994-1996. The proportion of innovating enterprises increases with the size class in both the manufacturing and service sectors. In the service sector, 73% of large enterprises were innovative compared to only 48% and 36% in the medium size and small size classes[4]. In the EU countries, 62% of innovating enterprises are both product and process innovators; 24% are product innovators and only 14% are process innovators only. Among all the enterprises in the manufacturing sector, 44% developed new products and 39% developed new processes. Of the enterprises, 21% were novel innovators, that is, their products were not only new to the firm but also new to the market. On average a quarter of the innovators in the EU countries has established a co-operation with another partner in developing new products and processes. The actual proportion stands at 28% in the manufacturing sector with a marginally lower proportion of 26% in the service sector (European Commission, 2001). Among innovators with cooperation, the highest proportion in both sectors (58% for manufacturing and 67% for service) has established a joint partnership with enterprises within a group. Vertical cooperation in the manufacturing sector is most common with clients and customers (47%) and suppliers of equipment (46%). On the other hand, in the service sector the highest proportion of vertical cooperation occurs with competitors (41%) and suppliers (39%). In both sectors, one third of innovating enterprises have innovation cooperation with either government or private non-profit institutions or universities.

Another important indicator of the impact of innovation activities is the relative share of the turnover due to new or improved products (European Commission, 2001). The Community innovation Survey 2 revealed that 32% of turnover in the EU in the enterprises of the manufacturing sector was due to new or improved products. However, only 6% of this turnover was due to products which were also new to the market. Moreover, it can be seen that the turnover due to products new to firms increases with size class, from 15% for the small enterprise, to 21% for the medium enterprises and 38% for the large enterprises.

Patents[5] are widely used as indicators of technological activity, and these indicators are alternatives to direct measurement of the output of scientific and technological research activity (European Commission, 2001). An analysis of the evolution in applications for European patents in the EU between 1989 and 1998 reveals an annual average increase of 3.2%. In 1998, 82.969 EPO (European Patent Office) patents applications were filed by European, Japanese and American firms. The EU predominates with 48% of applications. Japan and the United States account for 18 and 34% respectively. Relative to 1990, when 64.838 patents were applied for, the shares of the EU and

[3] Oslo Manual, pg. 44, section 4.2.3

[4] The results are based on answers from 39500 enterprises. The following size bands, based on number of employees, have been used to characterise enterprises:

- *Manufacturing*

Small: 20 to 49 employees,
Medium: 50 to 249
Large: 250 or more

- *Services*

Small: 10 to 49
Medium: 50 to 249,
Large: 250 or more

[5] A patent is a public title of industrial property conferring on its owner the exclusive right to use his invention for a limited number of years.

Japan have fallen by 2 and 3 points respectively to the benefit of the United States. This is explained by vigorous growth in the number of applications filed by the United States, which averaged 4.8% between 1990 and 1998 as against 2.7 and 1.3% respectively for Europe and Japan.

However, while patent data clearly represent a powerful measure of innovation, it is nevertheless important to treat the overall significance of patent filings with some caution (Griliches, 1990; Patel-Pavitt, 1995; Schwander, 2000; Bianchi et al., 2002b). In fact, different enterprises, sectors, and countries, for instance, will display a varying propensity to use the patent system - with the result that patent statistics will not always pick up innovation in a uniform manner. The statistics are based on objective comparisons and lead to the conclusion that Europe is lagging behind its competitors. However, for a more complete picture it is necessary to deepen the analysis.

In arriving at the European patent output most of the studies only count the regional filings of the European Patent (EP) or Patent Co-operation Treaty (PCT) patents. To obtain a more objective comparison of Europe with the other major economies, however, one needs to consider all the European filings, i.e. not only those made on a regional basis, but also those filed at a national level. For instance, a study published in 1998[6] reported that the member states of the EU filed nearly 35.000 patent application in 1996. It is clear, however, that these figures relate to the regional European filings, not national applications. Such an approach cannot be viewed as precise enough since it does not properly reflect the European situation. An alternative approach can be found in the statistics published by the World Intellectual Property Organisation (WIPO), which regularly collects these data from all over the world[7]. WIPO's tables make a distinction between domestic and foreign applicants, and also between national filings and European and PCT designation or validation. This approach has the advantage of avoiding double counting, i.e. a patent filed by a French company in France will not be counted twice, simply because a further filing in another EU country will not be taken into account, since it would be made abroad by a French applicant and not a domestic applicant.

Given that there is no precise definition of intangible assets and that their nature and characteristics are not clear, there are no perfect indicators. Intangible assets have been partially measured using a number of proxies, including R&D spending, employment in information and communication technologies, public spending in education, and so on, by all major statistical offices or organisations. The measures reported above are primarily from the OECD, which reflects the state-of-the-art of measurement in its member countries; together with measures used by the European Commission, major European countries, the USA and Australia.

Besides the measures of the individual intangible assets, namely knowledge, human capital and innovation, estimates are also given for the total stock of intangible assets in the economy. For instance, estimates prepared by Kendrick and reproduced by Abramovitz and David (OECD, 1996) show that the share of tangible capital in the total stock of capital in the US economy fell from 65% to 46.5% over the period 1929 to 1990, while the share of intangible capital rose from about 35% to 54%. More recent estimates show that the increasing trend has continued throughout the 1990s, as shown in figure 4.

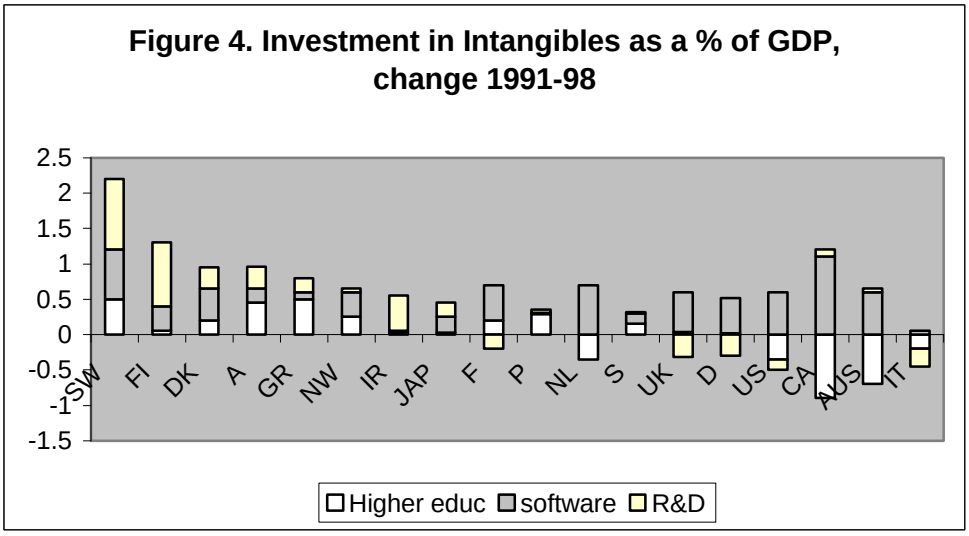
[6] http://www.findarticles.com/m0WX/36_23/50204793/p1/article.jhtml
[7] http://www.wipo.org

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

	1929	1948	1973	1990
Share of total capital stock %				
Tangible capital	65.1	57.8	50.2	46.5
Intangible capital	34.9	42.2	49.8	53.5
Capital/GDP ratio				
Tangible capital/GDP	7.4	6.3	5.4	5.9
Intangible capital/GDP	4.0	4.6	5.3	6.7
Total capital/GDP	11.4	10.8	10.7	12.6

Source: OECD, 1996

Figure 4 compares investment in intangible assets across OECD countries, in terms of change between 1991 and 1998, as a percentage of GDP. The countries investing most in intangible assets, as measured (only) by total R&D spending, public spending in education and software, are Sweden, Finland and Denmark, the Scandinavian countries. The US has a high level of intangible assets but in terms of change, it appears to be reducing investment, since both R&D spending and public spending in education are reducing. Since the Scandinavian countries are particularly well performing in high tech industries, especially ICT industries, the below figure raises the suspicion that the current measure of intangible investment may just capture investment in high tech.



Note: Intangibles are knowledge-related assets, i.e. R&D, public spending in education and software. (source: Khan, 2001).

The value of high technology exports from OECD countries has grown considerably over the last decade, exceeding the growth rates in other manufacturing areas. Between 1990 and 1996, exports by OECD countries of high-tech industries (aerospace, computers, electronics, pharmaceuticals) and medium-high-tech industries (cars, chemicals) grew by 7% a year, as compared to 5% for other types of goods. Investment in information and communication technologies (ICT: hardware, software, services and telecommunications expenditure) averaged 7% of GDP in OECD countries in 1997. The bulk of such expenditure are accounted by telecommunications. Both in terms of employment in the ICT sector and value added created in that sector, the US is taking the lead, as shown in the below table.

Table 3. Share of country in total OECD

	Employment	Value added
Australia	1.5	1.2
Austria	1.3	0.8
Belgium	1.0	0.8
Canada	3.4	2.9
Czech Republic	1.2	0.5
Finland	0.7	0.5
France	5.3	3.9
Germany	7.6	7.5
Hungary	1.2	0.6
Italy	5.2	4.5
Japan	**16.1**	**12.8**
Korea	3.6	5.3
Netherlands	1.6	1.2
Norway (1995)	0.6	0.3
Portugal	0.7	0.5
Sweden	1.4	1.0
UK	8.7	6.9
US	**35.3**	**48.8**
EU	**34.7**	**27.6**
OECD	100.0	100.0

Source: OECD ICT Report, 1998.

As a conclusion, intangibles are difficult to measure and only imperfect proxies are used to give an idea about their extent; in our view, this reflects the lack of underlying economic theory of intangibles. As shown in the next section, economics has considered intangibles but not in a unified manner.

2.2. The case of indicators for competitiveness policy

Following the launch of the benchmarking exercise by the Lisbon Council, the European Commission has implemented a number of scoreboards, aiming at benchmarking the performance of the different Member States in different areas. The European Innovation Scoreboard (European Commission, 2000a) compares a number of indicators of innovation activities in the different countries, including human resources, financial markets, output and markets. Member States now also realise an annual innovation scoreboard (for instance, see DiGITIP, 2001). What we could call the competitiveness scoreboard (with indicators complementary to those provided in the Competitiveness Report) compares a number of indicators related to enterprise policy, in particular its three pillars, entrepreneurship, innovation and market access.

The 2000 competitiveness scoreboard for instance compares the relative performance of the different Member States according to a total of 31 indicators: about 7 indicators of each of the main areas, namely entrepreneurial dynamism (sum of real birth and death of enterprises as a percentage of total enterprise stock; number of net births; survival rate after three years, time and costs involved in setting up a company; the number of new graduates in commercial and business administration); capital market and financing conditions (venture capital, new market capitalisation, and so on); innovative capacity (public and private R&D, high tech patents, share of high tech products in total exports); and the knowledge-based economy (installed computer power per capita; internet penetration, number of schools connected to internet, cellular phone subscribers, etc.). Apart from the limitations of each individual measure outlined by the Commission itself (European Commission, 2000b, p 6), the scoreboards raise the question of the use of indicators in policy-making. Policy-makers looking at the scoreboards can compare the performance of their country relative to others in

terms of net real birth of enterprises, expenditure on R&D, the time to register a new company, and so on. However, if the country performs badly in terms of one indicator, does it mean it is good or bad for the country? Does it mean the competitiveness of the country is less than that of other countries?

We think that rather than a list of indicators, what is needed is a reflection on what factors determine competitiveness or innovation and more importantly on how factors combine to generate competitiveness and innovation. A country might perform badly in terms of one indicator but very well in terms of another, with particular conditions in the country making it best practice for that country, although the best practice for another country might be a different combination of indicators, due to different conditions. The reflection on the nature of intangibles and their measure sheds new light on this issue, as shown in the following sections.

3. Economic theory behind measures

Before attempting to provide a discussion of the properties and policy implications of intangibles, it might be useful to review what economics has to say about them. Economics considers intangibles in four main aspects: human capital, innovation, organisation and knowledge. We discuss these in turn.

3.1. Organisation and the survey measurement method

The organisational capital appears as an important intangible asset for firms, as shown in authoritative publications such as the report of the HLEG (2000), which stresses that "the capacity to combine external and internal sources of knowledge to exploit commercial opportunities has become a distinctive competency", i.e. the capacity to organise activities and knowledge flows along the production process. Lev (2000), Vickery - Wurzburg (1998) show that organisational practices help reduce production costs and raise productivity. Lev particularly stresses the link between human capital and organisational capital (two intangible assets), through the example of Xerox: "Specific organisational designs, such as Xerox's Eureka system, which is aimed at sharing information among the company's 20,000 maintenance personnel, enhance the value of the human resource-related intangibles by increasing productivity" (p 13).

The consideration of organisation as a factor for differential performance across firms has recently experienced renewed interests among economists, due to the evidence of organisational changes diffusing in firms of most countries. In particular, the development of new databases on firms' organisation, based on surveys to managers and sometimes employees, has provided new insights on the importance of the new organisational practices, their determinants and effects.

The surveys ask how the firm is organised, including questions on the number of hierarchical levels, the average number of subordinates per head, the extent of team work, job rotation, incentive systems, etc. Often it is asked how is the organisation now and how it has changed in the last few years, in order to get an idea of the changes arising in the organisation. Such surveys provide qualitative data with a number of problems of measurement error (answers might be exaggerated and therefore produce biases in the statistical and econometric computations) or selectivity biases. Data are often not representative of the whole industry in the whole country, surveys being confined to particular sectors (mechanical industry in the German ISI study, see Coriat, 1999) or particular regions (for instance, Leoni et al., 2002, in a Northern region of Italy). However, some nationally-representative databases have been compiled in a number of countries, including (not exhaustively) the US, UK and France. Despite such limitations, the survey method is diffusing, partly because no other better method exists, and partly because some econometric methods are being developed to mitigate such problems (for instance, Athey - Stern, 1998).

In the US, the National Employer Survey (NES) has been conducted in different years in the decade 1990 (1994 and 1996). It is based on questionnaires sent to American firms in all sectors,

asking questions about some aspects of the production system, such as the adoption of just-in-time, work organisation (the use of quality circles, job rotation, team work, etc.), about remuneration systems (profit-sharing or other forms of remuneration), and so on. Various authors have analysed such data, and have found that a relatively small but significant part (about a third) of US firms have adopted such practices, that adoption depends primarily on the sector and firm dimension, and that adoption has a positive impact on productivity (Black and Lynch, 1997, 2000, Cappelli and Neumark, 1999, as well as Osterman, 1994, and Ichniowski et al. 1997, 1999, on other sets of US data).

In the UK, the survey is the Workplace Industrial Relations Survey (WIRS), based on questionnaires sent to employers, and conducted in different years: 1980, 1984, 1990 and 1998. In 1998, the respondents of the 1990 survey were traced back and interviewed again, generating a first panel dataset, and employees were also interviewed, so that the survey became WERS (Workplace Employee Relations Survey; see Millward et al., 1999, Cully et al., 1999, for a review). The focus of these surveys is workplace organisation and industrial relations; however, a number of questions allows to draw insight on the link between technology, organisation and performance, as shown by the work of Michie and Sheenan (1999) on the impact of organisational change on product and process innovation.

In France, different surveys have been conducted (see Greenan and Mairesse, 1999, for a review). One survey is REPONSE (work relations and firm negotiations) which was first conducted in 1993 (Coutrot 1996, Coutrot and Malan, 1996). The survey TOTTO was conducted in 1987 and 1993 and aims at identifying the relationships between work conditions and worker and workplace characteristics, on the basis of questionnaires sent to workers only. A number of surveys concentrate on technological and organisational changes rather than solely on work practices. One example is the SESSI survey conducted by the Ministry of Industry in 1993 on organisational changes (Greenan, 1996a) and another is the COI (Organisational Changes and Computerisation) which Greenan and Mairesse (1999) analyse.

Overall, studies find a broad direction of changes in organisations, characterised by higher communication (both horizontal and vertical), flatter hierarchy, higher interactions with the environment (suppliers, competitors,…) at the level of firm structure; concerning work organisation, higher decentralisation, higher task integration and lower specialisation; internal labour markets have more complex remuneration systems (profit sharing, pay for skill, etc.), higher selection (screening) and more training, and industrial relations improve, in that trust tends to be established between the management and workers. Most studies (Arthur, 1992, 1994; Black and Lynch, 1997, 2000; Ichniowski, 1997, 1999; Greenan and Mairesse, 1999) on the various datasets find that the organisational practices (such as teamwork, job rotation, low number of hierarchical level, pay for performance, and so on) form clusters and must be implemented together to produce positive productivity effects. The latter analyses of productivity generally assume that organisational changes add to usual productive factors (labour and capital) in the production function. However, no theoretical rationale for such production functions are given. The only theoretical reference mentioned in some studies is the so-called supermodularity literature (Milgrom and Roberts, 1990, 1995), which idea is that it is the complementarity between practices which makes their joint adoption profitable, complementarity being defined as a case in which the adoption of one practice raises the marginal profit of adoption of other practices. The problem is that such a theory justifies ex-post why some practices may be adopted together, but does not predict ex-ante what practices will form a cluster, i.e. what practices combine to form an organisational model that may have positive productivity effects. The analyses of the effects of organisational changes on performance generally concentrate on productivity effects (except for Ichniowski et al. 1997, 1999, who analyse the effects on product quality and on profitability) and effects on wages (with mixed results, see Leoni-Cristini-Labory, 2000, for a review). This and the fact that organisational practices are typical non-marketed intangible assets, result in a lack of consideration of the costs of organisational

changes. Besides, the studies generally have data on performance for the next few years after organisational changes, so that long term effects on performance are not captured. Kato - Morishima (2001) on Japanese data finds that employee involvement schemes and employee share option programmes take seven years to have positive effects on performance.

Overall therefore, there is evidence of widespread organisational change. Being based on opinion surveys and given the lack of theoretical background on organisational practices, data are not comparable across countries: questions differ and even management concepts differ across countries. However, broadly about a quarter of larger firms have shifted to the new structures. Adoption depends on the size of the firm (larger firms do more OC), the intensity of competition (OC is more widespread among firms competing in international markets), and the sector.

3.2. Human capital

In the new organisation, the nature of work changes and a higher skilled workforce is required (Caroli – Van Reenen, 1999, Caroli – Greenan – Guellec, 2001, Thesmar – Toenig, 2000). This means low-skilled workers are either trained to gain new skills or are fired and replaced by higher skilled workers. However, even after the adjustment is done, it seems that firms continue training programmes, job rotation and other features that mean that the nature of work could be changing. Work was rather repetitive and monotonous, work is now enriching, requiring constant evolution and adaptation. Hence human capital appears to be more important now than under fordism. Rajan and Zingales (2000) argue that human capital is the key to competitiveness in the new economy.

The human capital theory emphasises the notion that individuals are investors: they invest in education in order to achieve higher incomes in the years to come. Human capital is an asset similar to physical or financial assets. Becker (1975) and Schultz (1969) in their seminal work have stressed that human resources are a major production factor and contribute to a large extent to productivity increases. Another advantage is that investment in human capital provides positive externalities (benefits not reflected in private incomes) in that it fosters the efficient acquisition and transmission of knowledge. Thus Romer (1989) shows that the initial level of literacy does help predict the rate of investment and indirectly the rate of growth of a country.

The theory is well developed in terms of contractual issues and incentives of employees to exert effort (Lazear, 2000 and the review of the economics of personnel), under problems of information asymmetry. The heterogeneity of employees in terms of ability is considered in theoretical models, but the problem is empirical: the ability or competence of workers and the knowledge they master is difficult to measure and, as shown in the previous section, mainly proxied by educational levels in empirical research. This excludes innate abilities not learnt at school and training and skill development during the working life. If human capital is a key to innovation and to the development of intangible assets, such issues would need to be addressed in more details. For instance, in the “new” economy, whether and what competence/knowledge should be emphasised in the educational system, what type of training should be given to low-skilled workers, what relationships between some institutions (e.g. universities and firms) should be favoured, and so on.

3.3. Innovation

In many industries the rate of product renewal and of product differentiation has increased in recent years, making innovation a key to competitiveness. According to Lev (2000), “innovations are created primarily by investments in intangibles. The new products, services, and processes that are generated by the innovation process (e.g. new drugs, etc.) are the outcomes of investment in R&D, acquired technology, employee training, customer acquisition costs, etc. When such investments are commercially successful and are protected by patents or first-mover advantage, they are transformed into intangible assets creating corporate value and growth.”

Traditionally, innovation studies have mainly focused on R&D activities and on process innovation, with the expenditure on R&D assumed to determine the rate of innovation, and on the determination of optimal patents (see Ulph, 1995, Malerba, 2000, chapter 14, for a review; Gilbert – Shapiro, 1990). More recent studies have stressed that knowledge is complex in nature, being both codified and tacit, so that innovation is also complex and difficult to imitate and generate. Both imitation and generation require interactions between individuals that communicate, share experience and ideas. Very broadly (see Bianchi et al., 2002b, for a review), such considerations have led to the stress of networks as key determinants of innovation: networks within and between firms and, at the level of the economy, between knowledge generators (e.g. universities) and knowledge users (firms, which apply basic scientific knowledge to develop new products). The problem is that the way such networks function is not well understood, nor what kind of network is most appropriate for innovation: is there a type of network conducive to innovation that works in all countries, whatever the conditions, or should the network be defined according to the particular conditions existing in the country?

3.4. knowledge

Most of the few and recent studies that discuss the definition, measure and impact of intangible assets conclude that the growth in importance of intangible assets reflects the fact that knowledge has become a key factor in the economy (Vickery, 2000; HLEG, 2000). In fact, we think that the common denominator in the discussions of intangible assets and their various generators and forms may be knowledge. Innovation is a creation of new ideas, hence of knowledge. Human capital is a stock of knowledge and ability to create new knowledge. The advantage of organisations may stem primarily from their ability to co-ordinate knowledge exchange and creation.

Knowledge has not been very much discussed in mainstream economics. The focus has been on information, because in order to be treated as a good, knowledge must be put in a form that allows it to circulate and be exchanged. The main transformation considered by economists is the transformation of knowledge into information, i.e. the codification of knowledge. Information is knowledge reduced to messages that can be transmitted to decision agents. The view that the distinction between information and knowledge is not meaningful dates back to the approach of Arrow (1962), who considers knowledge as equivalent to information and as a public good.

Evolutionary economists (Nelson – Winter, 1982, Dosi - Marengo, 1994) have a different view of knowledge (see Gambardella – Pammolli, 2000, for a review). They highlight the importance of the learning processes by which knowledge is created and underline its contextual features. An important point is that knowledge is not necessarily easily transferred. Even scientific knowledge is not systematically tranferred, and is replicated with high costs: different scientists in a different laboratory may not produce the same result.

Knowledge is not a scarce resource: it can be expanded infinitely. In practice, the knowledge set is limited by the capacity of human mind. Hence knowledge generates increasing returns to scale: knowledge is cumulative. As stressed by Grossman and Helpman (1994), “knowledge is cumulative, with each idea building on the last, whereas machines deteriorate and must be replaced”.

Knowledge may be non excludable: codified knowledge is non excludable and can be appropriated if not protected by legal rights. Tacit knowledge is imperfectly appropriable: product reengineering may allow a company to discover the tacit knowledge embedded in the new product of a rival firm; hiring an employee from the rival firm may also allow to acquire both codified and tacit knowledge (intangibles) of the rival. Hence there can be spillovers. This partial excludability (fuzzy property rights) property of intangibles is important. According to Lev (2000, p 55), “exploiting the potential of a machine to the fullest is a manageable engineering task. Making full use of the tacit knowledge residing in the brains of employees is considerably more challenging. Only when such knowledge is coded (in manuals or artificial intelligence programmes) and systematically shared with other employees is the value of knowledge fully exploited to the benefit of the company”.

Knowledge is difficult to grasp also because it can take various forms: it can be embedded in products, protected by legal rights or can take the form of organisational assets. This create problems for its evaluation. It is difficult to say how much knowledge is embedded in a product, and it is difficult to say how much knowledge contributes to the performance of a firm.

Another characteristic of knowledge it that it is intimately linked to networks: knowledge builds and diffuses in networks of relationships between individuals and organisations. In order to collect new information and knowledge it is important to set up networks with many nodes in order to have access to different sources of knowledge, but not too many nodes otherwise the problem of overload may occur, implying delays in knowledge processing and therefore decision-making. (Radner, 1992, 1993; Bolton and Dewatripont, 1994; Caillaud et al., 1995; Marschak and Reichelstein, 1998; Garicano, 2000).

3.5. Analysis and policy recommendations from Economics and intangible assets

The evidence that intangible assets increasingly contribute to firm performance raise two major questions. First, how to account for intangibles, when they are so difficult to measure. As shown in Abernethy et al. (2002), the evidence from firms' experience is that measurement is mainly based on surveys; that there is a need to change accounting regulation so that some measure of intangibles be included; and that what investors and stock market analysts assess when valuing a firm (and what firms try to signal) probably include intangible assets (human capital, products in the pipeline, etc.).

Second, how to include them in the economic analysis, in order to derive policy implications. Economic analysis has traditionally been based on the "paradigm" of the production function, at both micro and macro level: at micro level, firms combine inputs (capital, labour) to produce output, and the production function shows how these inputs are combined to determine a firm's productivity; at macro level, a country combines various inputs (mainly: aggregate capital stock, aggregate labour force) to produce GDP, and the production function is used at macro level just linking aggregate measures instead of measures at firm level. Such aggregate production function turned into dynamic terms (taking variations) gives the equation for the country's growth rate; dividing by the population or the workforce, one obtains an equation for the productivity of the whole country. Recent development in the theory have attempted to include important factors such as human capital (proxied by the number of engineers and scientists or level of education: e.g. Lucas,1988) or technological progress (with the inclusion of a simple function of the growth rate of the total stock of knowledge, as a function of the number of researchers in the country: Aghion-Howitt, 1992). Such developments in the theory are part of the endogenous growth theory.[8]

Apart from a number of very restrictive assumptions on which these theories are based, what is of interest to us here is the attempt to include a number of intangible assets into analyses of the determinants of a country's growth: human capital, innovation, learning by doing, and so on. A first issue in including intangible assets into economic analysis is here raised: how to include previously neglected factors of production, such as the quality (and not only the quantity) of labour, innovative capacity, and so on. Given that intangible assets are difficult to measure, some proxies are generally found to allow the inclusion of the intangible assets in a simple and measurable way, such as the stock of knowledge of the economy considered as a function of the number of researchers in the economy.

However, a simple reflection on the nature of intangibles shows that this approach is insufficient: what matters is not only including intangible assets in the production function, but also, and more importantly, understanding how they create value, productivity, innovations. A simple example might illustrate the point. Consider for instance innovation. At firm level, the rate of innovation depends not only on how much is spent in R&D, but also on how much engineers and scientists are employed (tangible), the availability and quality of the laboratories (tangibles), what is the quality of such

[8] See for instance Guellec-Ralle (1996) for a review.

researchers (intangible), and how they are organised and motivated within the firm (intangible): whether they work in isolation or in teams, whether they have good rewards and good incentive schemes, and so on. Therefore, innovation, like other intangible assets, results from particular combinations of both tangible and intangible assets, and considering only one determinant (e.g. R&D expenditure) in the assessment of the innovative capacity of a firm might be misleading. At country level, this is even more so.

Another example is that of organisational changes. The empirical evidence on organisational changes discussed in section 2.1. shows that the productivity effects of such changes are estimated by adding dummies of organisational practices directly in the production function. This means that organisational practices account for the differential productivity not accounted by physical capital or the quantity of labour. One result common to a number of studies is that the most significant determinants of productivity are not organisational practices and other factors alone, but their interactions: variables defined as products of organisational practices and other variable (skills, presence of a union) turn out to be significant, meaning that what matters might not be individual assets but their particular interactions.

The next section reviews major existing policies towards intangibles and evaluates them in light of the above reflection.

4. Policies towards intangibles

The awareness of governments and policy-makers of intangible assets is not new; policies to develop such assets have been defined for decades. Such an awareness is also true at the European level of policy-making; just to mention a few, the 1994 communication on "*An Industrial competitiveness policy for the European Union*", argues for across-the-board measures, given that the new dynamic of competitive advantage disrupts past patterns of sectoral and industrial organisation. The 1994 communication takes on board the concept of intangible. The "Action priorities" specifically mention "*Intangible investment*". Among intangible assets, the major focus however has tended to be put on RTD policies. For instance, already the three treaties establishing the European Communities - the European Coal and Steel Community (ECSC) treaty of 1951, and the Treaties of Rome 1957 establishing the European Economic Community (ECC) and the European Atomic Energy Authority (Euratom) - allowed for the financing of Research & Development only in the fields of coal and steel, nuclear research and agriculture. The ***Cooperation in Science and Technology*** programme (1971) survived into the 1990s to become a useful framework for the penetration and implementation of European projects involving applied scientific research, even if it remained strictly intergovernmental. The ***ESPRIT*** programme, produced in September 1980, attempted to develop a European strategic programme based on collaboration between the major European companies, small and medium-sized firms as well as universities and research institutes. The ESPRIT programme for 1994-1998 promoted user-suppliers collaborations by supporting joint research projects oriented to develop usability of technologies, best practices, training, dissemination and technology transfer actions. Furthermore, since 1984, the Community had decided to make decisive improvements to its role in promoting research, innovation and the optimal exploitation of human resources, through the formulation of a Multi-annual Framework Programme. Nonetheless, the ***White Paper on "Growth, Competitiveness and Employment***" in December 1993, had a powerful impact, particularly for technology policy. Its central argument was that innovation was a key to kick-starting Europe out of the recession. After the 1994 communication, "***Agenda 2000***" (1997) confirmed the new approach characterised by the awareness of intangibles. It has been followed by "***The Fifth Framework Programme of Research, Development and Demonstration***" (European Commission, 1999), created to establish in Europe an environment favourable to innovation. That means encouraging technology transfer, ensuring venture capital is available, helping to protect intellectual property and developing human resources.

Beyond such awareness at both national and European level, what have been the contents and effects of policies towards intangibles? The next section address this issue.

4.1. Existing policies: separate consideration of the various intangible assets

Macro policies aimed at developing intangible assets have so far comprised different directions of actions, in accordance with the main broad categories of intangible assets: innovation, human capital, knowledge intensive sectors, growth and competitiveness.

The OECD (2001) stresses that policies for intangible should consists of two major actions: first, favour investments in intangibles by providing fiscal incentives, subsidies or public investment programmes; second, increase the rate of return on intangible investments by increasing the benefits of investment, e.g. by providing intellectual property rights (IPR) regimes in particular.

However, a number of questions have to be addressed before adopting the above actions: should the investment be public or private? How are intangible assets produced at both the micro and the macro levels, what are the barriers to the development of intangibles? If these issues are not taken into account, IPR regimes might end up favouring some actors of the economy at the expense of others (for instance, large firms versus small firms).

Therefore, we review in what follows existing policies in light of such consideration, and then start addressing such issues.

Innovation policy

Policy towards innovation have been an important policy concern in the US, the EU and Japan for a long time. The main policies have addressed different aspects of the fundamental trade-off of innovation: providing incentives to innovate (problem of appropriation of the returns to innovation by the inventor) and encouraging technological knowledge diffusion (which is also beneficial to the economy but contradicts the first aspect). R&D subsidies, patents, public research and programmes of R&D collaboration among firms and "knowledge institutions", such as universities, research labs, and so on have been the main instruments of innovation policy (Geroski, 1995; Metcalfe, 1995; Malerba, 2000).

The OECD (2001) argues that fiscal incentives are increasingly used as stimulators of private R&D spending. OECD countries use a large range of R&D tax measures, such as tax allowances or tax credits, to all firms or especially some types of firms (like smaller firms). Hall - Van Reenen (1999) estimate that fiscal incentives yield increases in business R&D investments. However, subsidising R&D does not mean that effective innovation will take place; this depends on the capacity of the firm, of its engineers and scientists, to generate new ideas and turn them into new products. Besides this, fiscal incentives might generate abuses, in the form of over reporting of R&D expenditures in order to get higher tax releases and so on.

Hence the most important policy to favour innovation and not only R&D spending might be another one. From this point of view, the 1990s have witnessed a shift of focus from one side of the trade-off (incentives to innovate), with main policies of subsidies, public research, encouragement of collaboration at pre-competitive phases of research, to the other side: focus on knowledge diffusion across the economy, because it allows other sectors to benefit from spillovers and because it allows more knowledge exchange and collective learning, hence further innovation. The policies, especially in the EU, are now focused on providing an environment favourable to innovation, by different measures, such as ensuring the existence of venture capital, encouraging R&D collaboration, encouraging the links between universities and business, and so on (Bianchi et al., 2002b). The problem is that policy turns out to be a list of actions to take without showing how such actions combine to produce the desired effects (Bianchi et al., 2002b). Empirical research on the effects of particular policies on the rate of innovation are relatively scarce (Bianchi et al., 2002b). In the EU, it appears that policies have had mixed results: the positive effects have been to ensure a good

technological base, as well as to favour networking across the EU, while the negative "effects" (or rather lack of results) are the continued gap in innovative performance between the EU and especially the US, and the lack of transformation of innovation into commercial success (Bianchi et al., 2002b; HLEG, 2000): the European paradox. There is evidence that firms are increasingly performing R&D in networks with other institutions (other horizontally or vertically related firms, universities, innovative SMEs, etc.). Hence in terms of indicators, the R&D intensity of networks should be included in the measures of R&D intensity.

Human capital

Investment in human capital is both public and private. The public part is the most important, and mainly consists in education at school and before the working life. Concerning education policy, a current debate is about the "skill gap", i.e. whether the labour force in certain countries lacks the new (and higher) skills required by the firms in knowledge sectors and in other sectors, where work practices have changed towards more worker responsibility (as shown in the section discussing organisational changes). The UK has been particularly concerned with such a gap (Caroli - Van Reenen, 2000; see also in general analysis of skill-biased technical changes, Greenan, 1996b; Machin - Van Reenen, 1998; Dunne - Haltiwanger - Troske, 1996). The major policies adopted in this respect are the diffusion of computer technology in schools, so that students learn computing and internet skills, as well as training programmes for the less skilled and for the unemployed to upgrade their skills.

The change in work practices outlined in section 3.1. may mean a fundamental shift in the skills required by firms. If the nature of work is changing from the repetition of monotonous tasks to multi-tasking, higher responsibility and adaptation to frequent changes in job position and in the production process, as well as working in teams rather than on individual work station, it means that both relational (ability to communicate) and analytical (ability to confront changes and analyse problems) skills may be increasing in importance relative to purely technical skills.[9] In turn, this may mean a need to substantially revise school and other training programmes.

A second aspect of human capital policies regards training during the working life. Most OECD countries have defined policies to encourage such training, especially for the unemployed, who may lack certain skills to be attractive to employers.

The discussion of the measurement of human capital in the second section pointed to surveys measuring the participation of employees to training programmes during their working life. It was shown that countries like Italy, Greece and Portugal have lower participation, while the UK, France, and Scandinavian countries display higher participation. Some detailed studies on training such as that by Black-Lynch (1995) show that training is less likely for workers in smaller firms and with lower levels of education. Other studies show that employees with part time or short term contracts are less likely to receive training (OECD, 2001, p 18).

Governments have therefore defined policy to encourage firms' investment in training. According to Gasskov (2001),[10] the main policies in this respect are as follows:

- compulsory financing: legal requirements for firms to fund a certain percentage or level of employee training (Denmark, France, Ireland, Korea and Mexico);
- training grants: grants and subsidised loans to enterprises for training, often targeted to the unemployed, certain population groups, types of training or small firms (Australia, Belgium, Denmark, France, Korea, New Zealand);
- training leave: a certain amount of paid training leave is granted to employees who meet certain conditions (France, Belgium, Denmark, Germany, Korea, Spain, Sweden);

[9] This distinction between technical, relational and analytical skills is done by Koike (1994, 1997) in his analysis of work in the Japanese firms.

[10] Reported in OECD (2001), p 19.

- fiscal incentives: tax credits and exemptions for enterprises which offer training (France, Germany, Korea);
- labour agreements: employers and unions define training development funds under the relevant clauses of collective labour agreements (Belgium, Denmark and The Netherlands).

Some of these training schemes are particularly directed at certain types of employees, especially those with higher risks of becoming unemployed (training grants). However, it is not clear overall which types of employees receive more training than others, and what type of training they receive: training in safety and security is common and required by law, while training in the use of new machines or in doing new jobs really means skill upgrading. Firms are more likely to train their core workforce, that is, the workforce employed with long term contracts, since they will be more likely to get the return to their investment in training: if the employee leaves the firm after a while, the employer will not get the return from his investment.

It is also probably difficult to check what type of training or what types of employees have been trained thanks to the government subsidy. This is especially true regarding fiscal incentives, i.e. tax credits or exemptions for firms which offer training, unless the government bears some costs of monitoring the types of training performed by the firms.

Unfortunately, we not aware of studies that may have estimated the impact of such training policies on the stock of human capital.

An important issue often left aside in discussion of policies that favour human capital development is that of the compatibility between flexibility in the labour market and training during the working life. Flexibility in the labour market means higher proportions of the workforce employed with short term or part time contracts, but the employees with such contracts are also those which are less likely to receive training during their work time. There is evidence in all countries of an increase in flexibility, since the number of part time, short term or temp contracts is increasing in all OECD countries (Samek Lodovici - Semenza, 2001; Samek Lodovici, 2000). If those employees with flexible contracts are also those receiving less training, should not this be a subject of concern regarding human capital?

A number of distinctions have to be made in order to answer this question. First, one should distinguish external and internal flexibility; external flexibility refers to the ease in firing and hiring employees according to the needs of the firm, and this is the kind of flexibility which increases with the use of flexible labour contracts. Internal flexibility refers to the flexibility in moving employees from one job to another or in adapting to changes in work methods or contents. The latter type of flexibility has increased since roughly the 1980s and is related to the changes in the organisation of production that have been made by firms in order to produce varied and often renewed products, rather than standardised products as in the mass production system. The evidence provided in previous sections about the changes in work practices and organisational changes is a sign of the diffusion of such internal flexibility, since for instance employees are given more autonomy and responsibility to confront changes and adapt or rotate job to gain more experience and be able to replace a colleague that may be absent, so that no disruption to the production process ever occurs.

If the major factor for firms' competitiveness is internal flexibility, then the policy of increasing the flexibility of labour market might not be appropriate, since it favours the diffusion of flexible contracts at the expense of long term contracts, thereby favouring the reduction of the core workforce and the possibility to increase internal flexibility. Employees with flexible contracts are not trained, since they leave the firm after a short period or are not involved full time. The increase in labour market flexibility might just end up segmenting the labour market into a group of employees with long term contracts, who are trained, rotate jobs and learn new skills during their working life, and a group of "flexible employees", with short term contracts, lower skills and the impossibility of

learning new skills during their working life (hence a possible vicious circle of precarious job situation (Rubery-Fagan-Maier, 1997; Samek Lodovici, 2000; Yeandle, 1999).

Internal flexibility has positive effects on human capital, since it requires investments in human capital: employees must be trained to accept and adapt to frequent changes and to rotate jobs, while external flexibility has rather negative effects on human capital, flexible workers being less likely to receive training. The latter is especially true for employees with lower skills.

A solution might be for governments to design programmes allowing employees with flexible labour contracts to have access to training, so that they may have a chance to get better jobs.

Of course, such issues require deeper thinking, which we will pursue in the course of this research project.

Knowledge-intensive sectors

Policies that favour the development of knowledge-intensive sectors have been a growing concern for governments in industrialised countries from 1990 onwards. Given that these sectors were experiencing rapid growth rates and were used by many other sectors of the economy, it was felt that the country should develop own capabilities in such sectors.

This policy reflects a continuous focus of policy-making on particular sectors of the economy, in particular the "leading" sectors, despite increasing pressures to adopt "transversal" policies, i.e. policies concerned with particular aspects that affect different sectors at the same time.

Competitiveness and Growth

Policies towards growth and competitiveness generally constitute broad policy orientations and actions to favour the country's economic growth and the competitiveness of its industry. The shift of orientation towards creating a favourable environment outlined for the case of RTD policy (Bianchi et al., 2002b) has been generalised to policies towards competitiveness, in the whole OECD area. This is the focus of the competitiveness policy of the EU (for instance, European Commission, 2000), but also of the OECD: thus the Committee of Industrial Policy of the OECD is now called the Committee on Business Environment. Industrial policy is therefore now about building an environment favourable to the development of the private sector through competition policy, measures to favour firm creation and entrepreneurship, innovation, etc.

Thus for instance the policy actions recommended by the European Commission following a benchmarking exercise is as follows (European Commission, 2000c):

1. the potential for the knowledge-based services must be fully realised;
2. investment in ICT must increase and must be more thoroughly exploited;
3. the administrative, regulatory and fiscal environment of firms must be simplified and improved;
4. entrepreneurship must be encouraged.

As far as the European Commission is concerned, the actions to take are:

- improve the business environment, by reducing the regulatory burden, facilitate the diffusion of new technologies and procedures, favour the development of services;
- improve implementation of the best procedure: encourage Member States to adopt other country's best practice, monitor the results of these actions, improve benchmarking.

However, no thorough analysis is given on the correlation between the proposed actions and competitiveness. For instance, the need to reduce the regulatory burden has been raised originally by surveys of firms that asked what are the positive and negative aspects for business in different countries (such as the IMD Survey, see Labory-Malgarini, 2000, for a review of the effectiveness of European regulation). In some countries the regulatory burden put on firm is very low, and at the same time the number of firm creations is relatively high (e.g. the US). Should we conclude that other countries should reduce their regulatory burden? There are two points here. First, reducing the regulatory burden does not mean eliminating regulation but improving the effectiveness of regulation where needed (Labory-Malgarini, 2000). Second, the differential in firm creations might have other

more fundamental determinants, such as the lack of entrepreneurs, an industry structure based on large firms and industry dynamics based on variations in the dimension of the large firm. This is a hypothetical case, but it serves to point to the need to consider all the factors that determine a phenomenon and analyse how the different factors combine to produce the phenomenon in order to understand the phenomenon. This has also consequences on the adoption of best practices: a best practice in a country might not be an adequate practice for another country, if the conditions (resources, strengths and weaknesses of the economy) of the other country are very different.

Competition policy

Competition policy is based on the "old economy", i.e. the economy in which tangible assets where predominant. Buigues et al. (2000) stress that with the rise of intangibles new forms of restrictions to competition are emerging, and that tighter actions are needed to ensure a fair degree of competition on the market. In particular, identifying restrictions on competition deriving form a dominant position, collusion or a merger means looking at not only tangible assets such as excess capacity, costs of capital, and so on, but also intangible assets such as intellectual property, the holding of strategic knowledge, patents, cross-licensing technologies and brands, and so on. Our analysis of the nature and effects of intangible assets will provide new insights into this issue.

4.2. Preliminary reflection on the nature of intangible assets and policy conclusions

The (rapid) evaluation of existing policies towards intangibles provided in the last section has shown three major points. First, despite the increasing importance of intangible assets, government support programmes have continued to be targeted on tangible investments (OECD, 1997; Buigues et al., 2000). The approach towards individual sectors is being progressively abandoned towards more transversal policies, given that the distinction between goods and services is becoming less and less clear: firms in all sectors are using more and more services to bundle with the goods there are producing (cars, domestic appliances, etc.). Second, although different industries rely to a different extent on intangible assets, one should not assume from the start that certain industries are more knowledge or intangible - intensive than others, before having good indicators. Thus in terms of knowledge, high tech sectors undoubtedly use more sophisticated knowledge than more traditional sectors, but should we conclude that high tech sectors are more knowledge intensive? The knowledge created in the fashion sector is certainly very dense, because new collections reflect cultural, societal and psychological trends, as well as the particular talent of the designer.

Third, beyond the problems in measuring particular intangible assets, there appears to be a lack of a global view that considers not only individual assets but also their interactions. One symptomatic case in our opinion is benchmarking, which tends to provide indicators of the different assets but no picture of the combinations of the different assets in the different countries, in order to assess not only which assets are more or less developed in a country, but also which assets combine to produce a certain level of performance, in terms of GDP and GDP growth and employment. One illustration of our point might be taken from developing countries. Thus a well known case in development is the comparison between Ghana and South Korea. In 1960, income per capita was about the same in the two countries. Nowadays, income per capita in South Korea is equivalent to seven times the level of per capita income in Ghana. A number of studies have analysed the figures and their determinants, and found that part of the difference is explained by the accumulation of physical and human capital. However, a significant ($ 4,000) gap remains unexplained. Many analysts agree that knowledge might be the factor behind the unexplained difference (World Bank, 1999). We would argue that the difference must lie in the different sets of intangible and tangible assets in the two countries: importing knowledge to Ghana will not generate further growth unless other tangible and intangible assets (human capital in particular) are adopted or adapted.

Another but related example is that of the knowledge effects of trade. Free trade and policies to encourage trade flows have been advocated as leading to learning and knowledge flows beneficial for countries, especially for developing countries receiving knowledge from developed countries. Economic work showing the knowledge effects of trade are both theoretical and empirical. The empirical evidence of the effect of knowledge accumulation and trade on a country's growth is very limited, mainly because of the problem related to the measure of knowledge, which we have outlined in the first section of this chapter. However, some attempts include Coe - Helpman (1995), who assess knowledge diffusion among OECD countries, and Coe-Helpman-Hoffmaister (1997) who extend the 1995 work to the case of developing countries. These works however use aggregate data to measure the impact of knowledge diffusion through trade flows, while a number of effects occur at a more micro level: technological improvement and learning by doing are mainly firm (or sector) specific. From a theoretical point of view, the empirical work just mentioned is rooted in the endogenous growth theory, which outlines two main routes through which trade may generate knowledge effects. First, trade may change the pattern of specialisation of a country (Lucas, 1993; Stockey, 1991; Young, 1991). Second, trade in goods and factors of production may open up new potential sources of technological inputs (Grossman-Helpman, 1991, Rivera Batiz - Romer, 1991). All the models generate the prediction that trade is important for the international diffusion of knowledge.

The problem with these models, apart from their restrictive assumptions of no cost of knowledge diffusion or common stock of knowledge across countries, is that they ignore important conditions for knowledge transfers. In the models, purchasing some inputs is enough to get access to the knowledge embodied in such inputs. However, two engineers educated in different countries and education systems and working and living in a different environment might not have the same ability to understand the knowledge embodied in the product and might not simply be interested in the same aspects of the knowledge embodied in the product. Hence the actual knowledge transfer and effect on growth will not be the same. For instance, a computer exported to an African country and to an Asian country will not generate the same use and, as far as acquiring the computer technology is concerned, the experience of engineers of both countries are likely to differ and not lead to the same results. Besides this, if the African engineer has been educated in a developed country, he might be more prepared to quickly understand and find uses for the imported technology.

This shows that transferring knowledge through products in itself is not enough to generate growth. What is needed is appropriate levels of other intangible assets, such as human capital, innovative capacity, organisational capacity. Trade will have different effects according to the set of intangibles available in a country.

The same is true of the knowledge diffusion effects of foreign direct investments (FDI): these depend on the absorptive capacity of local firms, the type of relationships that develop between the multinational and local firms, etc., that is, on the set of intangibles locally available.

Need for a new policy framework

In terms of a framework for defining appropriate policies, the most important aspect to underline might be the complementarities between tangibles and intangibles. Section 2 discussed the theoretical background of existing policies, as defined in economics. The production function paradigm was presented, and it was argued that the rise in intangibles raises two issues for the paradigm. First, how to include the intangible factors of production, when they are often not priced or difficult to evaluate. Second, account for the complementarities between assets, i.e. how they combine to produce value and productivity. Why is it that at firm level, a particular type of organisation, particular level of qualification and experience of the work force, hence particular type of human capital, together with particular levels of tangible (physical and labour in quantitative terms) capital yield more productivity or more value than the same combination of assets except for a different organisation and different quality (but same quantity) of labour?

A particular intangible asset is knowledge. We have shown in previous section its complexity (both tacit and explicit) and its relations with other assets: knowledge is primarily embodied in individuals and used by individuals, and the capacity to learn, create and use knowledge depends on the human capital (abilities) of each individuals; only explicit (codified) knowledge can be embodied in manuals and other (non brain) forms. Knowledge is also intimately related to innovation because innovation means knowledge creation. The organisation means structuring the knowledge flows in a firm and determining interactions between individuals, hence individual and collective learning. Therefore, knowledge might be considered as the common denominator of other intangible assets (and maybe also tangible assets). An important implication of this consideration is that the "knowledge-based" economy is just the emerged part of an iceberg: looking at the growth of knowledge intensive goods and services one concludes that knowledge has become the key factor for the economy, while in fact it might be just the expression of a more fundamental move, that of the rise of intangible assets in general, the common denominator of which is knowledge.

One way of looking at it might be by defining intangible assets as knowledge and capabilities, as an interaction of various forms of personal and collective knowledge which are embodied in an economic process as a part of the value generation capacity: tacit and explicit knowledge, know-how, know-why, know-who and know-what; capabilities are technical (ability to manufacture the product, to learn about technologies); analytical (to confront problems and to resolve them, to adapt to changes); relational (to exchange knowledge and take part in collective learning). The intellectual capital is just that: knowledge and capabilities.

If intangibles are defined in this way, a key to understand the complementarities between factors seems to be the network of relationships: between the firms' members; between the firm and the external environment (competitors; suppliers; distributors; institutions; and so on).

Besides, the type of knowledge has to be distinguished. Thus knowledge linked to production has been explored by several researchers inquiring into the relation between R&D and production, but nowadays we have to take the emerging nature of the new economy into consideration: in the past, in the period of automobile as a paradigm of modern production, research was a very limited part of production, because the very core of value generation model was the economies of scale generated by the production plant. The dimension of the plant was the real barrier to entry in the sector. In the software production like in the biotech sector the real barrier to entry is given by the research activity, because in the research stage we define the prototype that is the real result of the process of value generation; the replication cost is tending to zero, and the plant which reproduces the prototype cannot be defined as a barrier. Intangibles become not the complement to the core of value generation as in the past, **but the core of value generation** and this core is the result of a variety of interactions and knowledge exchange, which become a well-defined product only when those knowledge inputs become complementary in a stable combination, which can be guaranteed by a transferable property right.

The knowledge linked to the market has to be explored more deeply. In the past, economic theory stated "consumer sovereignty", based on the capacity of the individuals to evaluate ex ante the value of a specific product in a space given by price and quantity. By differentiating products, and embodying in those products knowledge, skills, services the capacity of the consumers to evaluate ex ante the best price-quantity combination in the choice among various comparable products is quite reduced, because the consumer is not able to manage all the variables connected to quality, and sellers can influence consumer choice though a variety of channels. For his choice, the consumer has to consider elements **like trust and reputation**, which are a cumulative result of previous actions and a matter of company investments. This is increasingly true for products and services embodying intangibles; we could say that the higher the intangible content of the product, the higher the role of trust- reputation in the market. We could say that embodying intangibles changes the nature of the product, transforming consumer goods in merit goods, that is to say a product that the consumers can evaluate only after consumption, and therefore buy on the trust-

reputation of the provider, because the price is not a perfect signal of the quality and value of the product.

The combination of the knowledge about production and the knowledge about the market generates **information asymmetries**, which are changing the production-market scenario. A double need is emerging, of guaranteeing property rights for the producer, to protect research and organisational capacities without constraining the diffusion of science, and of protecting the consumer when acquiring those merit goods which can impact on his own life, like health, education, security, safety.

A new paradigm as explaining the complementarities

The evidence provided in the previous sections is that among economic activities, research and development, training of personnel and the use of ICT are becoming predominant relative to investments in physical capital; firms are requiring higher quality rather than higher quantity of the workforce. These might just be signs that the average education of the population is increasing, that the ICT sector is booming and that the amount of research and development activities are increasing because some sectors, such as pharmaceuticals, energy, transport, are attempting to innovate and gain competitive positions.

Complementary to these aspects, changes are also arising in the organisation of production. Firms are concentrating on core activities, outsourcing some activities, decentralising authority within their hierarchies, which are becoming flatter. To a certain extent the nature of work at lower levels of the hierarchy is changing, in that workers are increasingly involved in teams, hence need to develop relational competencies, as well as being involved in problem solving, hence more analytical competencies are required of them. In our view, these changes are the fundamental changes that need to be taken into account, in particular since they might have fundamental policy implications.

One interpretation of such changes is that of a change in paradigm resulting from a major technological change, the “third industrial revolution”: the development of computers and information and communication technologies. Such technological change has had two major implications. First, it has eased globalisation, that is competition in different markets in the world (or world-wide for a number of industries) and competition against more rivals. Second, it has allowed new strategies to be implemented (or old strategies to be better implemented), in particular non price strategies: increasing vertical and horizontal product differentiation, that is, higher quality and more variety respectively. ICT indeed allow higher amount of information to be collected and processed, and therefore more knowledge creation, more innovation. Another strategy is frequent product renewal, also eased by the ability to collect and process large amounts of information on markets, consumers’ tastes, and so on.

The "extent of the market" has increased not only in terms of geographical market, but also in terms of relative power,[11] since the number of competitors has increased. Another consequence of the development of the above-mentioned technologies has been the development of new productive tools, such as CAD/CAM, robots, and so on, that have made possible a number of changes in the division of labour, i.e. the organisation of production, such as the flexible production system.

Hence the way firms produce and create value has changed, with a fundamental shift of value creation from the manufacturing phase of the production process to the research phase. Economies of scale or scope at the manufacturing phase are no longer so important; what matters is learning, knowledge creation, and organising activities (organisational structure within the firm, relationships between the various employees of the firm, relations with other firms, etc.). Controlling physical capital becomes less important, while controlling the learning and knowledge creation phases are key. Control in the former case arose mainly through ownership: physical capital is well defined and priced and therefore straightforward to acquire. Control in the latter case is less easy: control via

[11] We take the extent of the market as defined by Smith (1776).

ownership is difficult, because knowledge is largely tacit and therefore difficult to codify in manuals that one can claim to own; knowledge creation arises through the communication of various individuals, each with their intellectual and relational abilities that determine the extent of knowledge they will be able to create. One cannot own human capital, nor knowledge embodied in human capital. Hence property rights might not be the form of control to look for.

5. Conclusions

Intangible investments and assets are complex, uncertain, costly, and not fully valued now because they take value in the future (at least partly). Their consideration in economics has been so far rather partial and reductive. However, their increasing importance with the diffusion of information and communication technologies and globalisation make it high time to try and improve their treatment in economics. We think that they represent essential assets, that did not need to be considered in economics in the past, when the organisation of firms was stable, workers were little skilled and had wages attached to jobs, products were standardised; in such a case, the physical capital and the physical part of labour were (almost) enough to account for productivity and performance. At present intangible assets, which cannot always be valued because a price cannot always be attached to them, have become key factors for competitiveness and the productivity and performance of firms and economies cannot be assessed by physical and financial capital alone.

Intangible assets are created by combining a number of complementary activities: R&D, education, motivation, organisation, relations; it is difficult to predict ex ante what is the optimal combination that produces innovation, entrepreneurship and growth. Such properties might imply that the appropriate policy is that which create linkages, between economic actors, institutions and so on; the conditions for linkages to develop have to be determined and put in place. The conditions for the right linkages and therefore intangible assets to develop might be the existence of proper incentives (equal bargaining power and complementary activities which provide the conditions for co-ordination of activities and exchange of knowledge, e.g. through the definition of intellectual property rights), and sanctions (to avoid opportunistic behaviour; competition policy). Policy makers should create the conditions for linkages to develop rather than setting up the linkages, because the complexity of intangibles make it difficult to predict which linkages are necessary and it might be better to let economic actors try and select linkages. Complementarities should be taken into account in formulating policy. They mean interactions between different policies, but also side-effects of particular policies on other sectors or other complementary activities; for instance intellectual property rights limit access to some knowledge by not only directly involved actors but also all actors whose activities are complementary. Besides, when assets are complex to define and highly uncertain, other forms of control than ownership might be more efficient. Thus for the case of innovation, surveys have shown that firms often use other means to protect their innovation than asking for a patent: secrecy, lead time advantage or complementary manufacturing and marketing capabilities (Cohen-Nelson-Nash, 2000). The discussion in this paper shows that the organisation of production expand beyond firms' legal boundaries, so that what matters is the control of some assets by making them dependent, but not necessarily owning them; in other words, there are other barriers to entry than intellectual property rights, and the capability to build, maintain and develop networks might be an important one. In other words, when linkages are important what matters is not the ownership of assets but the control of assets. For instance, human capital cannot be owned, but can be controlled by making it dependent in a relationship; the firm cannot own its human resources but make them dependent by making it profitable for them to relate to the firm and its activities. Another example is that innovative activities: firms do no longer seek to own all laboratories that make R&D, but establish relations with outside laboratories where control results from making such laboratories

dependent. Such dependency results from the development of complementary activities: the firm derives advantage from access to the innovation capacity of the lab, while the lab gains from access to the firm's marketing and distribution capacity.

In other words, there is now a new paradigm of the firm and of production, that of the firm carrying out activities in a network of relationships with other firms and institutions (for instance, universities) and the new property right policy has to be defined taking this new paradigm into consideration. This is what the policy analysis will focus upon in the next steps of the project.

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