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Measuring Intangible Capital Investment: an Application to the "French data"

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MEASURING INTANGIBLE CAPITAL INVESTMENT: AN APPLICATION TO THE "FRENCH DATA"

NON-TECHNICAL SUMMARY

The changing pattern of comparative advantages in the global economy has led advanced economies to increase the share of intangible assets in their production function. Activities intensive in intellectual capital have developed alongside the widespread use of ICT and software in many tiers of business in the 1990s. Innovation, advertisement, consulting and training rank even higher in firms spending. These structural changes set question marks on the nature of these intellectual capital expense items. Are these goods or services to be considered only as intermediates being eaten up in the production process or do they feature long-lasting effects? In the latter case, this spending could be assimilated to investment and should, as such, be included in productivity and growth accounting.

A recent stream of literature addresses this debate by emphasising the importance of properly assessing inputs, especially capital. Corrado, Hulten & Sichel (2005) analyse a source-of-growth accounting model and statistical issues focusing on the full evaluation of intangible capital. According to the authors, the decrease in productivity growth in developed economies comes from the under-estimation of intangible assets. Thus, they delineate a number of intangible expenses that could be accounted for as capital. A first assessment of these intangibles categories has been provided by Hao *et al.* (2008). They evaluate intangibles to amount to €137,195 million in the business sector in France in 2004, or 8.4% of GDP.

This methodological paper aims at shedding light on intangibles in France for the same benchmark year 2004 by proceeding in two steps. First, the conceptual notions are deepened prior to our evaluations. Second, in order to get consistent results with our definitions, we rely on French sources and estimate that intangibles could amount to between 8 and 9% of GDP for the whole economy and between 6% and 7% for the business sector.

ABSTRACT

Following Corrado, Hulten and Sichel (2005) this paper investigates French spending in intangible capital. In this work, we tackle two issues. First, working on national accounting data we sharply investigate the data sources, using detailed supply & use tables taken from the French national accounts. Second, referring to different fields in the economic literature, we deepen the analysis and the measurement methods that have been used recently in the empirical literature. We are then able to assess more accurately the items of interest. We estimate that French intangible GFCF could be valued for the whole economy between 8% and 9% of GDP in 2004 and between 6% and 7% for the business sector.

JEL Classification: E22, B40, C82, O47

Key Words: Intangible capital investment, national accounts, methodology, productivity, growth

LA MESURE DE L'INVESTISSEMENT IMMATÉRIEL : APPLICATION AU CAS FRANÇAIS

RÉSUMÉ NON TECHNIQUE

La modification des avantages comparatifs au niveau international a conduit les économies développées à changer en profondeur leurs schémas de production en « dématérialisant » de plus en plus les produits. Des activités à forte composante en capital intellectuel se sont intensifiées avec le développement des technologies de l'information et de la communication (TIC) au cours des années 1990 et le développement des logiciels a accompagné la généralisation de l'utilisation de l'informatique dans l'organisation des entreprises. L'innovation, la publicité, le conseil ou la formation prennent une place grandissante dans les postes de dépenses des entreprises. Ces changements structurels soulèvent des interrogations portant sur la nature même de ces dépenses en « capital intellectuel ». Ces biens ou services sont-ils uniquement des dépenses courantes incorporées intégralement dans la production, ou ont-ils un caractère durable leur permettant d'être utilisées de manière récurrente ? Dans ce cas, ces dépenses seraient assimilables à l'investissement et devraient, à ce titre, être utilisées dans le calcul de la productivité et de la croissance.

Un courant de littérature récent, initié par Corrado, Hulten et Sichel (2005), s'attache à mesurer précisément l'effet du capital incorporel sur les mesures des performances macroéconomiques, en termes non seulement de production mais également de formation brute de capital. Une première estimation des investissements incorporels en France a été proposée par Hao et Manole (2008) en suivant la méthode proposée par Corrado *et al.* (2005). Hao *et al.* (2008) estiment que les investissements incorporels pourraient s'y élever à 137 195 millions d'Euros dans le secteur marchand en 2004, soit 8,2% du PIB.

Cet article méthodologique vise à apporter un nouvel éclairage sur les investissements incorporels en France pour l'année 2004 en procédant en deux étapes. Premièrement, nous approfondissons les notions nécessaires à la mise en place des évaluations. Deuxièmement, afin d'obtenir des résultats cohérents et plus fiables, nous utilisons les sources françaises nous permettant d'approcher nos définitions. Nous estimons que l'investissement immatériel représente entre 8 et 9% du PIB dans toute l'économie et entre 6 et 7% dans le seul secteur des entreprises.

RÉSUMÉ COURT

Le ralentissement de la productivité qu'ont connu les économies développées au cours des années 1990 ont engendré de nombreux questionnements relatifs à la capacité des modèles de croissance à la Solow à mesurer correctement la croissance et la productivité des facteurs. L'une des raisons de ces défaillances pourrait être la mesure incorrecte ou incomplète des facteurs de production. Corrado, Hulten et Sichel (2005) proposent d'inclure dans la mesure

de la croissance un ensemble d'investissements incorporels actuellement considérés comme des dépenses courantes (consommations intermédiaires). Ces dépenses, de par leurs caractéristiques, leur durée de vie, leur rôle dans le circuit de production, peuvent en effet être assimilées à du capital.

Cet article méthodologique s'inscrit dans la lignée des travaux de Corrado, Hulten et Sichel (CHS) et vise à mesurer ces investissements incorporels pour la France en se basant sur les données de comptabilité nationale à un niveau très détaillé. Cependant, certaines dépenses ne sont pas observables directement dans les comptes nationaux. Pour ces dernières, nous proposons des méthodes d'évaluation alternatives basées sur les coûts de production. Dans le cas de la France, en 2004, ces investissements pourraient se situer dans une fourchette de 8 à 9% du PIB.

Classification JEL : E22, B40, C82, 047

Mots-clés : Investissement immatériel, comptabilité nationale, méthodologie, productivité, croissance

MEASURING INTANGIBLE CAPITAL INVESTMENT: AN APPLICATION TO THE "FRENCH DATA"¹Vincent Delbecque*
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INTRODUCTION

A large debate has emerged since the late 1990s concerning the ability for national accounts and economists to properly evaluate factor productivity and growth in a traditional Solow framework. Indeed, some industries have experienced negative trends in productivity since the mid 1980s, whereas information and computer technology has increasingly been harnessed to production processes, inducing potential gains in productivity.

A recent stream of the literature addresses this debate by emphasising the importance of properly assessing inputs, especially capital. Corrado, Hulten & Sichel (2005) analyse a source-of-growth accounting model and statistical issues focusing on the full evaluation of intangible capital. According to the authors, the decrease in productivity growth in advanced economies in the 1990s comes from the under-estimation of intangible assets. Thus, they delineate a number of intangible expenses that could be accounted for as capital just as fixed capital. This work is not straightforward since some of these expenses are not measured directly. However, this study is not totally from scratch since a number of intangibles have already been included in national accounting standards, such as software or mineral exploration. These concerns over intangibles are also increasingly shared with national and international accounting institutions such as the US BEA, the United Nations, the OECD or EUROSTAT. Corrado *et al.* (2005) find that intangible capital could amount as much as 12% of US GDP and 100% of tangible assets during the 1998-2000 period in the United States.

Corrado *et al.*'s paper (2005) has engendered a number of research at national and international levels using the same framework. Giorgio-Marano, Haskel & Wallis (2009), Fukao, Hamagata, Miyagawa & Tonogi (2007), Rooijen-Horsten, Bergen & Tanriseven (2008) implement the same methodology respectively for the UK, Japan and the Netherlands. Hao *et al.* (2009) lead a comparative analysis of Germany, France, Spain, Italy, the UK and the US for the year 2006.

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Our work has started in the COINVEST project, funded by the European Commission (FP7), the objective of it being to thoroughly assess intangible capital by relying on the Corrado *et al.*'s framework. Our starting point was the only available paper including France in an international comparison of intangible spending, i.e. a mimeo presented by Hao *et al.* at the IARIW conference in 2008, with 2004 as the benchmark year.

Our contribution to the literature is twofold. First, we present a comprehensive work with the view to clarifying the definition and measurement methods of items that have received little attention to date. We rely on specific fields of the economic literature in order to address definition, concepts and measurement issues before implementing the estimation work. Second, we use data from the French national accounts at a very detailed level in order to assess each intangible item for the year 2004 in order to keep comparability with the Hao *et al.*'s paper. Data are taken from the French input-output tables and supply-and-use tables at the "G" level in the French product classification (NES), detailing 116 industries, and at the "H" level, developed into 700 products. Items not directly covered by these two sources are estimated using a labour-cost based approach relying on labour force surveys. Using the methods and the data presented in the following sections, we find that intangible investment could have amounted to between €128 and €157 billion (8% to 9% of GDP) for total economy in 2004.

The paper is organised as follows. Section 2 develops concepts and definitions of each intangible item. Section 3 presents measurement methods and estimations. Section 4 concludes and investigates the work to be carried out in the future.

1. IDENTIFYING ASSETS

Determining which intangibles should be considered as capital is not straightforward. Several characteristics are to be met by these expenses for them to enter the GFCF account. Amongst these characteristics, the main two features are the lifespan of the asset and its ability to increase production and productivity durably over time.

Although some spending items, such as R&D or software, are already or can be easily associated to capital formation, some others are not clearly identified as investment. Research in this field relies on both institutional regulation and academic literature in order to draw up a list of accountable intangible investment. Here, we present a short review of the different items that are already recorded as capital in the French national accounts and those that could enter GFCF in the future.

1.1. Items already recorded in the capital account

International organisations have already established conventions for the recording of intangibles in national accounting. The United Nations through the System of National Accounts (SNA) 1993 and the European Commission through the European System of

Accounts (ESA) 1995 proposed a number of expenses that should no longer be considered as intermediate consumption, but rather as capital.

Although the SNA has no mandatory power on national accounting, its recommendations provide a guideline on how national accounts should be built and to a certain extent on the concepts and methods used to achieve this goal. The SNA93 includes the following items in the capital account:

- Mineral exploration
- Computer software and databases
- Entertainment, literary or artistic originals.

These expenses are considered to be assets due to their lifespan. Indeed, their impact on production is supposed to last durably over time, just as fixed assets do.

The European Commission, through the ESA95, sets rules of national accounting for European member states. As a result, all recommendations in ESA95 should be applied within member states. Being based on SNA, ESA95 includes the same items in the intangible assets accounts.

Mineral exploration is considered as fixed assets as it is undertaken in order to discover new deposits of minerals or fuel that may be exploited commercially (SNA93). The use of new deposits will eventually be used in production for more than one year and can thus be considered as fixed capital. Moreover, once a firm has discovered new deposits, it is allowed to exploit it monopolistically.

Computer software and databases, either purchased or internally produced, are expected to be used for more than one year and can be capitalised. The OECD (2010) deepens the definition of software assets. As an example, the capital account must include software purchased for more than one year but also software with annual licenses acquired through a multi-year contract. Own-account software must exclude software to be sold, copies and embedded software.

The *entertainment, literary or artistic originals* item is closely analysed by the OECD taskforce based on SNA93 and the 2003 EU "Taskforce on GFCF", capital stock and consumption of fixed capital. In order for an original to be included in the capital, it must have two particular characteristics:

- Be covered by copyright;
- Have primary artistic intent.

Besides, the expenses must be intended to be used for more than one year as any fixed asset. Referring to the different sources quoted above, this item should include the following expenses:

- Films (including scripts)
- Television and radio programmes (excluding news, TV games and sport programmes)
- Literary works (including books and audio books)
- Musical works
- Painting, sculpture, antiques, fine art and jewelry (only if they are originals)
- Photographs and images (if valuable and marketable)

Both the UN and the EU Commission provide short recommendations on the measurement methods to be used when recording these expenses in the capital account. The OECD (2010) provides a more accurate guideline for national accountants on both the definition of these intangibles and the methods to be used for recording them. The general method proposed is the following. If the good is acquired on a market, it must be valued at the purchaser's price. If it is produced internally, then it should be valued on a production cost basis.

When measuring production costs, not only employment costs must be included but also non-employment costs, such as equipment purchased and employees training in order to adapt to new tasks associated with intangible production.

Architecture and engineering design. Although this item is not precisely mentioned, neither in the SNA nor in the ESA, it has to be recorded in the GFCF account as a side-cost of buildings investment. Indeed, SNA93 states: "New fixed assets acquired by purchase are valued at purchasers' prices: that is, including not only all transport and installation charges but also all costs incurred in the transfer of ownership in the form of fees paid to surveyors, engineers, architects, lawyers, estate agents, etc.". As a result, spending in architecture and engineering design are recorded as investment in the national accounts.

1.2. Unrecorded items

Beside these items already defined in institutional reference guides and manuals, other expenses that meet the asset criteria have been proposed to be included in the capital account. Nakamura (2001) and Corrado, Hulten and Sichel (2005) investigate spending in intangibles in the US and their effect on economic growth. They include different types of spending in their analysis such as the three items presented above but they also propose a list of other intangibles (R&D, advertising, human capital, financial innovation and organisational capital) that should be accounted for as GFCF given their similarities with fixed assets.

These two papers have spawned a number of empirical investigations in Europe, focusing on the effect of intangibles on growth.

1.2.1. *Research and development*

The most striking case of intangible capital is research and development activity. Measuring R&D in modern economies is a crucial matter for multiple reasons.

Innovation and R&D lead to the creation of new products, often protected by copyrights which confer their holder the right to exploit the patent monopolistically and set prices above equilibrium. Another possible outcome of R&D is gains in productivity if the research activity focuses on physical production processes. Finally, those gains are likely to produce spillovers within or across industries. All these characteristics imply that R&D has drawn a particular attention when it comes to measuring it and its effect on firms and on the whole economy. Although, R&D was not in the list of intangible capital in the previous SNA textbooks, the 2008 version of SNA states that R&D should be recognised as capital formation (art. 10.104).² This new version of SNA does not propose any particular method for valuing R&D except that it should be valued at the sum of costs, including the costs of unsuccessful R&D (art. 10.103). Instead, the manual refers to "*specific guidelines [...], handbooks on methodology and practices that will provide a useful way of working towards solutions that give the appropriate level of confidence in the resulting measures*" (art. 10.104). Amongst these reference guides, the Frascati manual published by the OECD since 1963, offers a very detailed guideline for institutions implementing R&D surveys and computing estimates with the view to building them into a national accounting framework.

Measurement standards are not fully comparable between Europe and the US. One example for these differences is the definition of the coverage of R&D activities. Whereas US accounting only measures scientific R&D, European standards also entails non- scientific R&D including research in humanities and social science.

Whereas R&D has drawn a particular attention from national statistical institutions, other types of innovations have been less scrutinised. Although more difficult to measure, the following items represent large expenses from the private sector.

1.2.2. *Advertising and market research*

Advertising is an important issue given the large amounts spent in communication by firms. Corrado *et al.*, (2005) estimated that annual investment in advertising equalled 2.33% of GDP between 1998 and 2000 in the US, even more than R&D expenses for the same years. This raises two questions. First, can all advertising expenditures be capitalised? Second, how do we properly assess investment in advertising?

² Although it is recommended to record R&D as investment, SNA 2008 will not be applied until the next revision of French national accounts standards.

There are three reasons for firms to advertise. The first one consists in increasing (or at least maintaining) market shares. By doing so, firms increase their output capacity. This can be materialised into temporary promotion for instance. The second one is launching new products. Communicating on new products is not only a way to increase sales, it is also the final part of the whole product development because the product has to be presented to consumers. This type of communication is embedded into TV and newspapers advertising or press relation. The third reason is brand-forming. Not only firms need to maintain market shares and inform customers about new products, but they also need to promote their "brand image". This last objective is maybe the closest to the brand-forming type of investment we focus on. This type of communication can be handled through sponsoring, or patronage. The result of brand-forming is not strictly comparable to the one of capital in the sense that it does not increase productivity. Instead, it will introduce product differentiation between goods and create monopoly power for the advertiser. Advertising has then an effect on the price of the good rather than on the production function of the firm.

We can take as an example the MP3 players market and the position of Apple in this market. There is clearly no technical difference between an Ipod and any other MP3/video player. However, it benefits from a particular status on the market and can charge higher price due to communication-led differentiation.

It is also worth noting that the first two motives for advertising (market share and product launching) are also indirectly brand-forming, though their main objective is closer in time.

The positive effect of advertising is not controversial at the microeconomic level. Indeed a firm engaging in advertising would eventually benefit from positive returns. However, the macroeconomic effect is not clear-cut since the positive effect for a given firm affects negatively other firms in the same industry, *ceteris paribus*. Nevertheless Nakamura (2005) and Nayaradou et Villemeur (2003) agree on a positive effect of advertising at the macro level especially through industry spillovers.

1.2.3. Human capital (training)

Training is a driving force in the maintenance of human capital. Human capital can be serviced by firms or individuals depending on who pays the costs and gets the returns to training.

The issue of what kind of training must be included in investment can be addressed through the debate initiated by Gary Becker in 1964 on general versus specific training as it sheds light on what can be shortlisted as cost-effective investment for the firm during the worker's tenure.

According to Gary Becker (1964), when training is general, the individual must bear the cost of it because in a competitive market, he or she is paid according to his/her marginal productivity and the returns are kept by the individual. In contrast, when training is specific to

the firm, firms have to fund this investment. Training allows the employee's productivity to increase and the returns to training accrue to the firm. The employee does not receive a higher compensation rate in the secondary labour market.

Recent studies (Acemoglu and Pischke, 1998 and 1999; Booth and Zoega, 2000; Lazear, 2003; Garloff and Kuckulenz, 2005) contradict the standard theory as they suggest that firms may have interest in providing general training to their workers and paying for it. Lazear (2003) argues that depending on the thickness of the market, it may not be in the worker's interest to accept a skills-weight that benefits the firm, otherwise, the worker may incur wage losses in the secondary labour market, the thicker the market.

Corrado *et al.* (2005) suggest that training costs must be totally considered as an investment and not intermediates. We argue that general and specific training (when it is offered by the firm on its own training agenda to maintain or enhance the worker's skills) can be considered as an investment. The firm actually sets the level of skills and prioritises its needs for each category of qualifications. In contrast, institutionalised general training as apprenticeship or alternate classes may be questioned as it is much more akin to education and is part of the educational system.

In continuing vocational training schemes provided by the firm, some originate on the firms' initiative, others on the workers' one. As long as the returns accrue to firms, the training scheme must be viewed as an investment. Typically, the training plan belongs to this category (table 1 and appendix 1).

Table 1 - Summary of training types (excluding initial institutionalised training)

	On workers or firms' initiative	Returns accrue to: Firms or workers	Include as Investment
Training plan	FIRMS	FIRMS	YES
Individual leave for training	WORKERS	WORKERS	NO
Individual Right to training	FIRMS	FIRMS	YES
Vocational training periods	FIRMS/WORKERS	FIRMS/WORKERS	YES

1.2.4. Financial innovation

The case of financial innovation is less clear-cut and has hardly been discussed in the economic and financial literature. The first issue concerning innovations in the financial industry is the definition of such innovations. Three types of innovations can be attributed to the financial industry. First is the means of payment, such as coins, credit cards or online payments. These allow for smoother and faster transactions. As a result, introducing means of

transaction increases activity and growth in the whole economy. Second, financial regulations can also be viewed as innovation. Some of these changes in processes are to some extent imposed by regulators and some others devised by firms (internal audits and controls). Third, and this is probably the most important in terms of size and concept, Corrado *et al.* (2005) assimilate the creation of financial products to financial innovation. This raises two questions whose answers should help us measure properly this item.

The first question concerns the definition of new financial products, because only innovations should be accounted for. The second question is about the real positive effects of financial product creation on the economy. Totally new products are rare events (Tufano (2002)). Indeed, most financial products are just derived from older ones. It is then difficult to account for new products only. However, these products can still be considered as innovative in the sense that they will replace previous look-alike products. From a market point of view, financial products are created in order to compensate for market imperfection and to smooth transactions. They should then, as the means of payment, facilitate transactions and resource allocation at a reduced cost. At the macro level, the effect should be positive. In the firm's point of view, creating new products, like innovation in other industries, will give a competitive advantage to the innovator compared to its competitors. However, in the case of the financial industry, firms creating new products may not want to protect them with patents for multiple reasons we will detail in the next section. At the micro level, individual financial innovations may also produce spillovers and increase productivity through the diffusion of new financial products.

Despite the effective positive impact of financial innovations throughout the 1980s and 1990s, the 2007-2009 financial crisis raises questions about the real benefits of financial innovations. Dynan, Elmendorf & Sichel (2005) highlight the role of financial innovation in smoothing consumption, housing loans and fixed investment. Specifically, financial innovation would have had a greater impact than monetary and fiscal policy. A particular attention is devoted to the benefits brought by securitised mortgaged loans. The recent collapse of the mortgage market has forced to reset conclusions on the benefits of such products. Having a closer look at the effect of financial innovations (especially those related to mortgages), Elmendorf (2008) admits that those innovations may increase volatility in the economy. As the access to credit becomes easier, expectations (rational or not) on house prices have a greater effect on both house construction and general spending, increasing the risks and pace of asset price bubbles creation. Another analysis made by Poole (2008) is that, financial innovation does allow for better macro performance, despite some undesirable effects. In his analysis, financial innovation must go pair-wise with regulation in order to develop financial instruments while covering their possible negative effects.

Although the creation of derivatives has helped increase and channel financing at the end of the 20th century, these products may produce an aftershock on the global economy. Thus, these potential investments must be handled very carefully.

1.2.5. Organisational capital

Information is an asset to the firm, for it affects the production possibility set. Prescott & Vissher (1980) call this asset *organisation capital*. Referring to the authors, the firm's knowledge of its employees allows for improvements in three dimensions. First, this knowledge should lead to a better match between employees and occupations. Second, it should improve the match between employees and teams. Third, knowing its employees competencies allows the firm to improve training and human capital embedded employees. Improving the match between employees, occupations and work groups eventually increases productivity within the firm. It allows workers' efficiency to be enhanced and better horizontal and vertical communication.

The communication characteristics of organisation capital is emphasised by Black and Lynch (2005). The capacity for employees to communicate upwards informs management teams about the quality and adequacy of production processes to the firm's objectives. Caroli and Van Reenen (2001) also highlight the role of vertical communication in firms' performance. Based on micro data, they find that an increase in performance goes along with improved vertical communication and lower-level initiative as well as with ICT investment.

2. MEASURING ASSETS

French national accounting follows recommendations from SNA93 and ESA95 and includes software, mineral exploration, copyrights and license costs, and architecture and engineering design in the GFCF account. Thus, we describe below the methodology used by the INSEE to compute the production figures for these items, as long as we will follow these lines to assess the production for own final use of other items. The logics in the order of items presented below, follows the classification implemented by Corrado *et al.* (2005).

A summary table synthesises our results in the appendix (see Table A.1).

2.1. Computer software

Purchased computer software evaluation

Computer software is produced by NACE 72.1 and NACE 72.2. French national accounts use information from the Supply and Use Tables (SUT) in order to determine investment in those industries.

Table 2: Distribution of NACE 72.1 between intermediate consumption (IC) and gross fixed capital formation (GFCF)

Product (NAF)	Label	Distribution	% in NACE 72.1
72.1Z00 + Z20	Research and consulting in Computing set-up	IC	55
72.1Z11	Engineering in computing systems	GFCF	45
72.1Z12	Hardware turnkey contract	Double-count	0
72.1	Hardware and software consulting (total)	45% GFCF, 55% IC	100

INSEE, National Accounts

In the French NAF product classification, a detailed sub-division of NACE 72.1 allows total supply to be split between intermediate consumption and GFCF. The French national accounts include the computer software item in the GFCF account using the following method. First, all intermediate consumptions of NACE 72.1 and 72.2 are measured. Then, following international recommendations, actual intermediate consumption (short lifespan, consumption) and fixed capital formation (longer lifespan, increase in productivity) are distinguished. Table 2 and 3 break down NACE 72.1 and NACE 72.2 into their sub-products and show their respective distribution between IC and GFCF.

Based on EUROSTAT's recommendations and in line with OECD (2010), NAF 72.1Z00 and NAF 72.1Z20 are considered to be intermediate consumption and accounted for 55% of NACE 72.1 in 1999. NAF 72.1Z11 is fully accounted for as GFCF and equalled 45% of NACE 72.1 in 1999. Turnkey contracts are bundled packages made of both hardware and software. They are already recorded in other accounts. Then, NAF 72.1Z12 is a double count and is deduced from NACE 72.1. The distribution percentages between IC and GFCF are extended to all years.

These distributions are based on EUROSTAT evaluation methods and are in line with ESA95 and OECD (2010)'s recommendations. Using this method, INSEE estimated that purchased software that should be accounted for as GFCF from NACE 72.1 and NACE 72.2 amounted to € 4,168 million and €6,794 million respectively in 2004.

Own account software evaluation

The evaluation of own-account software production is based on the employment census: Déclaration Annuelle des Données Sociales (DADS) and the French population census. Two occupation items are retained as computer software producers:

- Engineers and software technical managers (PCS 388a, 388b and 388c)

- Programmers and software technicians (PCS 478a, 478b and 478c).³

Table 3: Distribution of NACE 72.2 between intermediate consumption (IC) and gross fixed capital formation (GFCF)

Product (NAF)	Label	Distribution	% in NACE 72.2
72.2ZA1 + ZB1	License fee for software packages	GFCF	23.0
72.2Z1A	Consulting in software development	IC	8.7
72.2Z1B	Non-standard software programming	GFCF	29.0
72.2Z1C	Provision of programmers within turnkey contracts	60% GFCF, 40% IC	14.2
72.2Z1D	Software maintenance	IC	10.7
72.2Z1Z	Other services in software development	IC	10.4
72.2Z20	Conception & development of software support	IC	4.2
72.2	Software consulting and supply	60.6% GFCF, 39.4% IC	

Source: INSEE, National Accounts

The occupation classification changed in 2003 and estimations based on employment have featured a rugged profile, leading to counter cyclical estimations. After 2003, the assessment of own-account software is based on the employment database, only when it is sufficiently reliable and crosschecked with data from the employers' association, SYNTEC. The growth of software spending by industry provided the SYNTEC association is used to assess the GFCF of the institutional sectors. Then, a fixed key, given by a survey led in the electronic and computer industries in 1992, is applied by the INSEE in order to single out of the total software GFCF (purchased and own account) the own account software production.

³ PCS (Profession et Catégories Socio-professionnelles) is the French occupation classification. Occupations used in measuring the own-account software production correspond to the ISCO 251 and 252 in the 2008 version. However, the two occupation classifications are not directly comparable since ISCO makes a distinction between activities only, whereas PCS also classifies by degree of hierarchy.

Alternative methods are also used by the INSEE in order to check the robustness of the assessment.

Using these methods, INSEE recorded a total of €25,232 million in software GFCF (purchased and own account) in 2004. The largest part of this investment had been made by private firms (€19,466 million), financial firms and public entities accounting for a smaller part (respectively €2,610 and €3,156 million). Table A.1 in the Appendix encapsulates these results.

2.2. Databases

Although databases should be included in the GFCF account just as computer software are,⁴ no particular attention has been paid to this item in the French national accounts. Here, we try to estimate investment in databases with intermediate consumption of NACE 72.4, Database activities (NAF 72.4Z) as a starting point. The information used comes from the SUT of the industry of interest. In 2004, the national accounts recorded a total of €819 million in intermediate consumption of NACE 72.4. Within this total, 41 million were bought for resale, and should then be excluded from our measurement, and €152 million were acquired by public entities. We estimate that 20% of the total purchases were made by firms from the financial industry (€164 million).⁵

We do not distinctly estimate own-account database production as it is already included in the own-account software production item. Indeed, database programmers and managers are part of the PCS 388b and 478b, used to estimate own-account software production. Own-account database production is then recorded in the wrong item. We do not have sufficiently detailed data in computer programming occupations in order to separate software programmers from database programmers.

2.3. Research and development

The research and development account is estimated using French input output tables. The total amount of intermediate consumption of R&D products (NACE 73) was valued €23,140 million in 2004. This amount includes purchases by public administration and by the R&D industry. It is recommended not to record intra-industry consumption in order to avoid double-counting. Just as we exclude intra-industry consumption in the software industry, we exclude R&D consumption made by R&D firms assuming that these purchases can themselves be used to produce R&D. Total intermediate consumption excluding NACE 73 amounted to €20,927 million in 2004 (A-B=C+D in Table 4).

⁴ SNA93 recommends to include large databases in the GFCF account. ESA95, however, does not include this item in the list of intangible assets. As a result, there is no liability for European countries to include such spending in the capital account. The 2008 version of SNA extends the measure to all-sized databases.

⁵ Financial firms accounted for 20.6% of total spending in NACE 72 in 2004. We assume that this share is also valid for the sub-category of "databases".

In order to properly assess spending, we need to include production for own final use of R&D by public administrations which was valued at €7,958 million by INSEE in 2004. This leaves us with a total potential R&D GFCF of €28,885 million in 2004 (rows C+D+E in Table 4).

Table 4: Summary of R&D gross fixed capital formation estimates for total economy in 2004

		Millions of Euros
Total IC of NACE73	A	23,140
Intra-industry cons.	B	2,213
Market Sector	C	19,426
Pub. administration	D	1,501
Production for own final use by public administration	E	7,958
Basic research	F	5,813
Applied research	G	10,694
Experimental development	H	12,377
R&D GFCF 1		28,885
F+G+H= C+D+E		
R&D GFCF 2		22,696
F+G+(1/2*H)		
R&D GFCF 3		20,634
F+G+(1/3*H)		

Note: Market sector is defined as total economy except public administration (NACE 75).

IC: intermediate consumption.

INSEE, Input-output Tables, 2004.

In the Frascati Manual, R&D activities are divided into three types of research: basic research, applied research and experimental development. Both basic and applied research can be fully accounted for as GFCF. Besides, it may be more accurate not to account experimental development as GFCF. Indeed, the frontier between experimental development and pre-production development is somehow blurred. The former should be included in the capital account while the latter should not. It is likely that firms do not make a clear distinction between these two different steps and that figures on experimental development also include pre-production costs. In Table 4, we summarise the calculation made to measure R&D capital including assumption on the share of experimental development that should be accounted for. Under the first assumption, we estimate R&D GFCF as the sum of basic research, applied research and experimental development. Under the second assumption, we include half of experimental development spending. Under the third assumption we include only one third of

experimental development. Using these estimation methods, and under different scenarios, R&D GFCF could range between €20,634 and €28,885 million in 2004 (see Table A.1).

2.4. Copyrights and license costs

International accounting rules already cover the recording of copyrights in the national accounts. Those rules supply a guideline on which expenses should be included in the GFCF account. As recommended in the 1993 SNA (annex 1.68) and directed by the 1995 ESA (annex 7.1 AN.1123), the copyright and license costs have to be recorded as GFCF:

Paragraph 68 of annex 1 in the 1993 SNA states: *"The 1993 SNA includes in output literary or artistic works (i.e., the writing of books, composing music, etc.) which are produced for sale whether they are produced by employees or by self-employed workers. Furthermore, it recognizes that these outputs can contribute to production in subsequent periods and, therefore, treats expenditures on these outputs as gross fixed capital formation resulting in the creation of an intangible fixed asset (AN.1123). Consequently, fees, commissions, royalties, etc. stemming from licensing others to make use of the works are treated as payments for services rendered. Accordingly, copyrights no longer appear as non-financial non-produced intangible assets giving rise to property income, as they did in the 1968 SNA."*

Although SNA and ESA widely define the scope of the GFCF account, neither particular precision on specific spending nor any estimation method is proposed. OECD (2010) adds some precision on the way to measure copyright and license costs GFCF. Table 5 exhibits the activities recorded as GFCF by the INSEE (column B) and the recommendations made by the OECD (whether the national accounts should include or exclude the item from GFCF). The OECD task-force also recommends excluding TV games and sport shows from GFCF due to their short lifetime.

OECD (2010) adds four conditions under which the expense can be considered as investment:

- The item must be covered by copyright
- The work should have a primary artistic intent. This means that the original should be produced with the original itself as the end product, not as an interim part of the production process of another product or asset.
- The item must satisfy the capitalisation criteria, as for any capital item to be included as GFCF. That is the ESA95 requirement that a capital asset must be intended to be used in the process of production repeatedly or continuously for more than one year.
- The item is not covered elsewhere in the national accounts.⁶

⁶ Some particular cases, such as gaming and entertainment software, have to be handled carefully in order not to be recorded twice, both in the software account and the entertainment account.

If the item satisfies the criteria above then it should be included as an entertainment, literary or artistic original asset.

The recorded GFCF is the amount of production for own final use by the NACE activities presented in Table 5. Following this method, INSEE recorded €2538 million in motion picture, radio, literary and sound recording GFCF (0.15% of GDP) in the business sector and €2744 million in the whole economy in 2004.

Table 5: Composition of copyright and license cost items, 2004

NACE Rev.1	Label	OECD recommendations
9211	Motion picture and video production	Include
9212	Motion picture and video distribution	Include
9213	Motion picture projection	Include
9220	Radio and television activity	Partial (exclude games, sports)
9231	Artistic and literary creation and interpretation	Include
9232	Operation of art facilities	Include
9251	Library and archives activities	Include

Source: INSEE, OECD

2.5. Architecture and engineering design (including mineral exploration)

Architecture and engineering design expenses have to be recorded as investment in the national accounts as a side-cost incurred by the purchase of buildings GFCF. Besides, ESA95 states that Mineral exploration and evaluation (included in NACE74.2 or NAF74.2C in the French classification) must be included in GFCF.

The item architecture and engineering design is thus accounted for as GFCF in the French national accounts. The GFCF account is based on SUT of the following products:

- Architecture activity (NACE 74.2) (NAF 74.2A & 74.2B)
- Engineering (NACE 74.2) (NAF 74.2C).⁷

The French product classification is more detailed than the international one. This allows us to accurately assess supply and uses for sub-activities within architecture. The entire NAF 74.2A and NAF 74.2B are included in the GFCF account. Only a share of NAF 74.2C is retained as GFCF. The GFCF part of Engineering excludes sales of equipment and turnkey

⁷ This includes mineral exploration and evaluation.

contracts. All purchases made by the construction industry (NACE 45.1, 45.2, 45.3, 45.4) are excluded from the GFCF account. Indeed, as these expenses are likely to be bundled with other products and resold (the building itself). They are then recorded as IC. NAF 74.2C also includes mineral exploration GFCF.

In 2004, INSEE recorded a total of €15,684 million in architecture GFCF including:

- €12,227 million by non-financial firms
- €2,253 million by households
- €72 million by financial firms
- €1,132 million by public entities.

Own-account design

The GFCF recorded by the INSEE for architecture and engineering design does not take into account the production of design for the own use of other sectors than the design one.

These expenses are not observable in the national accounts. Hence, it is necessary to assess them. A labour cost method is applied. To do so, we rely on the Labour Force Surveys from 1982 to 2006 and retain the figure for 2004.

We shortlisted the following occupations likely to perform design outside the design sector itself, namely:

- Engineers and executives in buildings and civil engineering (382a)
- Architects employed (382b)
- Engineers and executives in electricity or professional electronics (383a)
- Engineers and executives, R&D in mechanics and metal works (384a)
- Engineers and executives, R&D in transformation industries (385a)
- Design and technical assistants in graphic arts, fashion and decoration (465a)
- Designers in and civil engineering (472a)
- Cartographers and surveyors (472b)
- Designers in mechanics and metal works (474a).

As some of these occupations are related to R&D, architecture and design and to computers, it was decided to set aside the respective sectors (NACE 73, 74.2 and 72), all the more these activities have already been recorded as GFCF.

If we mimic INSEE's method to compute the final use production of software (Labour costs of IT scientists - half of IT scientists' time being devoted to other tasks than writing programmes + other costs incurred in their jobs as material costs plus part of the gross surplus amounting to 85% of personnel costs), and replicate it to design, then own-account design makes up €10,041 million in 2004 for the whole economy and €9,920 million for the business sector (see Table A.1 in the appendix).

2.6. Advertising and market research

Purchased advertising and market research

Advertising and market research expenses are accounted for as intermediate consumption in the French national accounts. However they are recorded as distinct items. Thus, we can assess them precisely.

Advertising is recorded under NACE 74.40 (NAF 74.4A and 74.4B) and market research is recorded under NACE 74.13 (NAF 74.1E). When transferring expenses from intermediate consumption to GFCF, one must be very careful with two particular issues. First is avoiding double-counting. Second is being sure that the expense meets the asset criteria. Avoiding double-counting is crucial when measuring GFCF. Indeed, if one double counts the same amount, GFCF being a component of GDP, the later is mechanically over-valued. Referring to the advertising industry, we can take the following case as an illustration. An announcer launches a communication strategy and entrusts a communication consulting agency with the entire project from conception to diffusion. The agency develops the project and buys advertising space in several media on behalf of the announcer. In this case, the agency includes the price of advertising space in the price paid by the announcer. There are then two monetary flows for the same service. These two flows appear as intermediate consumption but only one must be recorded as GFCF. Thus, we remove intra-industry expenses from our estimations, assuming that they are made on behalf of the announcer.

As detailed in Section 2.2, valuing intangible GFCF must only include expenses that meet the asset criteria. In the case of advertising, we only account for expenses that should lead to an increase in the brand value. It is not clear whether short-term communication campaigns, such as promotions, have an impact on the value of the brand. In order not to over-value advertising GFCF, we only account for durable communication. Table 6 presents the type of advertising and their amount and shares in total advertising.

Table 6: French advertising expenses distribution (% of total)

	1995	2000	2004	2005	2006
Media (including):	36.57	37.56	34.83	34.46	34.61
Press	16.02	15.74	14.04	13.91	13.86
TV	11.84	13.06	12.81	12.65	12.94
Radio	3.15	3.04	3.11	3.10	3.08
Display	5.29	5.28	4.53	4.43	4.35
Cinema	0.28	0.43	0.33	0.38	0.39
Internet	0	0.50	0.57	1.19	1.67
Non-media (including):	63.42	62.44	65.17	65.54	65.39
Promotion	15.73	15.56	15.46	15.51	15.61
Direct marketing	30.78	30.88	32.21	31.67	30.69
Directories	3.76	3.01	3.46	3.56	3.66
Marketing events	7.58	7.12	8.10	8.11	8.20
Public relations	5.57	5.38	5.36	5.49	5.56
TOTAL	100	100	100	100	100

Source: IREP, FrancePub

Some other expenses are not assimilated to capital formation. This is the case for classified advertising. Following Rooijen-Horsten *et al.* (2008), we drop classified advertising from the measurement. In France in 2004, 18% of advertising expenses published in the press were classified advertising. Table 7 summarises the evaluation of advertising GFCF in 2004. There are two results depending on the assumption we make concerning the brand-forming capacity of promotion. Estimations range between €15,061 million and €17,899 million for the business sector, depending on whether we include or exclude promotion from advertising GFCF.⁸ When including public administrations these amounts rise to €15,345 million to €18,237 million.

Table 7: Summary of purchased advertising GFCF estimates in 2004 by the business sector

	Components in Mn of €	Result
Total advertising and market research IC		27000
minus intra-industry & public consumption	6834	20166
minus market research IC	1802	18364
minus classified ads	466	17899
minus promotion	2838	15061

Source: INSEE, IREP, FrancePub

⁸ These estimations exclude advertising expenses from the public sector.

Own account advertising, public relation and communication

We have dealt with the purchased part of advertising but, still, a share of firms' communication takes place in-house. The inner advertising produced by the non-advertising firms is close to zero. However, communication plans and strategies are initiated by the announcers themselves and outsourced afterwards. Besides, firms build long-term communication strategies and do handle public relations. As a consequence, it is crucial to account for internal communication production.

As for the own account software production evaluation, we use a labour cost based method in order to estimate the cost of communication performed in-house.

For that purpose, we refer to the quarterly Labour Force survey (LFS) for 2004,⁹ giving information on occupation, industry of employment and wages, amongst others. The figures are displayed in Table 8. Using these data, we can evaluate the number of employees doing communication in firms outside the advertising industry. The occupations retained for this analysis are the following:

- Advertising managers (PCS 375a)
- Public relation and communication managers (PCS 375b)
- Advertising and communication assistants (PCS 464a).¹⁰

LFS also provide monthly net wages per occupation/industry. In order to get total labour costs for the above-mentioned occupation categories, we apply social contribution rates allowing for social security ceilings, the executive status of the employee, and also for social security rebates on low wages. We then peg our estimation on the national accounts figures published by the INSEE for employees and their respective labour costs.¹¹ Relying on these assumptions, own-account communication production during a year could be valued at €3,208 million for the whole economy and at €3,065 million for the business sector. Applying the usual method (half of the time spent on producing own-account advertising and

⁹ Enquête Emploi en Continu.

¹⁰ In 2003, there was a change in the occupation classification. The PCS-ESE 2003 superseded the one from 1982. In 2004, in the transition period, some workers were still registered in the old classification, i.e. with the code numbers 3735, 4629 and 4631. Based on the 2005 survey where both classifications were present, about 22% of the 4629 occupation and 26% of the corresponding wages were assumed to be marketing assistants in the whole economy. They were then added to the 4631 occupation (advertising and PR assistants) to get the total number corresponding to PCS 464a.

¹¹ In order to improve the quality of estimation, two outliers were dropped from 1980 to 2006: 1994 and 2002. So, our 2004 point estimate is not affected by this correction. The latter allows the R^2 coefficient to reach 81% for advertising employees and 92% for their respective labour costs. For the business sector, R^2 coefficients are similarly quite high. This procedure takes into account the composition effects and as such, it outperforms the method consisting in taking an average wage multiplied by the employees.

adding 85% of personal costs dedicated to the purchase of materials, etc.), then the own-account production of advertising amounts to €4,331 million for the whole economy and €4,138 million for the market sector. Adding these estimates to the widely defined purchased advertising (including promotion), total advertising capital could amount to €22,568 million for total economy and to €22,037 million for the market sector.

Still, this is an estimate based on a wide definition of intangible capital that is, including promotion and work done by assistants. No particular manual provides any recommendation on the way to measure advertising capital. Concerning the cost based estimation, one can raise questions concerning the inclusion of assistants in capital creation. There are two different ways this occupation can be considered. Assistants have no creative activity per se, and handle mainly technical work. As such, they do not participate in the building of the brand. However, although they do not create brand value directly, their work implies a cost that must be included in the cost of brand-forming. Indeed, SNC93 recommends that fixed assets produced for own gross fixed capital are valued [...] by their costs of production.

By using the narrow definition of communication occupations, the own-account communication production amounts to €2,163 million for total economy, and to €2,075 million for the business sector. Again, we estimate these people spend half of their time innovating and also we take into account the other costs incurred. Advertising investment (including both purchases and in-house production) using the narrowest definitions could then be valued at €17,508 million for total economy and at €17,136 million for the business sector (see Table A.1 in the appendix).

Table 8: Structure of communication employment, excluding the advertising industry, 2004

PCS code	Whole economy		Business sector	
	Employees No.	Labour costs Mn of €	Employees No.	Labour costs Mn of €
3735+375a+375b (=Investment)	25,319	2,163	23,632	2,075
Part of 4629+4631+464a	22,084	1,045	19,952	990
TOTAL EXPENSES		3,208		3,065

Source: INSEE, CEPII

Market research

We also evaluate market research spending using the detailed supply and use tables. With the same estimation method, we estimate spending in market research by the market sector, excluding intra-industry transactions. In 2004, these expenses amounted to €1,836 million (including €46 million by public entities). The business sector accounted for €1,790 million in market research expenses.

2.7. Financial Innovation

The method used by Corrado *et al.*, (2005) consists in proxying financial innovations by a share of the financial industry intermediate inputs. They assume that these innovations could amount as much as 20% of the industry intermediates. With these calculations, they find that financial innovations equalled 75 billion \$ (0.58% of GDP) between 1998 and 2000 in the US. This method has also been applied to other countries. Hao *et al.*, (2008) make the same calculation for their assessment of French and German intangible capital. This method, however, is not fully satisfactory as claimed by the original authors. Indeed, this proxy lacks foundations and needs to be refined.

Until very recently, the issue of measuring financial innovation had received little attention. However, Hunt (2008) proposed two evaluation methods.

One measure of financial innovation would rely on national R&D surveys. As these surveys usually apply to all industries, including financial services, valuable information could be used from these sources. In the US, the National Science Foundation (NSF thereafter) is in charge of the R&D survey. In 2005, financial industries spent \$ 3 billion in R&D, approximately 0.3% of GDP. However, it seems that R&D surveys, as they are originally designed for manufacturing firms, where R&D activity has its own department (which is not the case in financial firms), do not fit the particular case of financial intermediates. As a result, financial firms do not answer properly to R&D surveys and R&D figures in this industry are largely underestimated. Nevertheless, the gap between NSF results and Corrado *et al.*, (2005) estimations are not totally attributable to the low response rate of firms. The CHS method eventually overestimates real "investment".

In our investigation, we must also account for the large part of financial R&D embedded in computer and software innovation in the financial industry. Hunt (2008) states that 58% of R&D spending of firms in finance, insurance and real estate was devoted to software in 2005.

Because the figures obtained through the NSF survey are not fully satisfactory, Hunt proposes an alternative method to evaluate spending in financial R&D (or spending in R&D by financial firms). According to NSF results, 80% of financial R&D costs consist in wages. Thus, Hunt (2008) suggests that these expenses should be estimated with a labour cost-based analysis. We follow the same methodology applied to the French data. We use the quarterly Labour Force Survey,¹² informative on occupations, industries, and wages amongst others. This method is consistent with SNA93.

The potential research occupations related to innovation as proposed by Hunt (2008) include engineers and computer programmers, all scientists (including social scientists) and research managers. The set also includes actuaries, mathematicians, operations researchers, statisticians, architects, cartographers, and surveyors.

¹² Enquête Emploi en Continu.

We exclude computer programmers, architects and cartographers from the estimation in order not to double count expenses that have already been recorded elsewhere (own account software, own account design...). The research categories proposed by Hunt are broad and might also include people not involved in financial R&D. Indeed, it is not clear why all scientists should be involved in financial R&D (biologists, chemists...).

Thus, we restrict the research categories to economic researchers, engineers in electronics (not included in computer programming) and surveyors. In 2004 they account for 82%, 10% and 8% respectively of the total.

Table 9 displays research occupations as defined above, their numbers, and their total labour costs in the financial industry (NACE 65 to NACE 67).

Table 9: Research occupations in 2004

Code (PCS)	Occupation	Employees	Monthly net wages
372a	Economic, financial & trade research managers	3,407	4,730
387d	Surveyors	317	4,168
383a	Engineers in electronics	441	3,793
	Total	4,135	4,588

Source LFS, authors' calculations

Note: Financial sector = Nace 65 to 67.

If we assume that these employees spend half of their time on innovating and that total non labour costs required for innovating amount to 80% of labour costs,¹³ then we get estimates of €283 million for the financial industry as a whole (see Table A.1).

Again, there is a huge gap between Hao *et al.*'s (2008) €9.666 billion estimates and our cost based measurement. We think however that our method is more consistent than the one based on intermediate consumption since we can identify research occupations within financial firms and derive potential investment directly from input costs in line with SNA recommendations.

2.8. Human capital

In France, continuing training is funded by the State, the regions, the unemployment benefit body, the firms and households. Continuing training funded by the firms includes several

¹³ These are the same assumption than the ones retained for the own account software.

schemes depending on the status of the trainee (see Appendix 1). Training is mainly financed through taxes and can be viewed as a pay-or-train system (see Appendix 2).

Training can be contemplated in two ways with the scope of calculating investment & productivity at the firm / sector level or for the whole economy.

First, if a firm-funding approach is assumed, then a firm invests in its employees, and spends some more money to fund the training system through the tax, up to a ceiling of 1.6% of gross wages (after deduction of its own expenses on training). Some firms, such as the smaller ones, benefit from the tax redistributive system as they can receive more training for their employees than they pay for. Keeping in the tax system¹⁴ could be equivalent to assimilating the tax system to a subsidy for smaller firms.

Second, employees can receive training from their firms but can also be funded by the State and the regions. So, in this second approach including the whole economy, employees are allocated the total sum corresponding to their training. In this setup, investment can be linked to other reasons than productivity (enhancing employment for example).¹⁵

It seems plainer to focus on the firm approach and consider only firms with more than 10 employees and training costs that are tax-deductible. As training is mandatory, firms have to fill tax forms, with their tax deductible expenses (see Appendix 3). The continuing vocational training box of the tax form gives information on the total wage bill of the firm and also includes details on internal and external training expenses, compensation of and special fees for trainees, and funds paid to the tax collecting organisations, in charge of launching training actions for the funding firm and also redistributing the rest to other smaller firms, less subsidies received. It excludes training through job rotation, self-learning and free learning at conferences, lectures and workshops, in contrast with the EUROSTAT 2005 CVTS survey, which was used by Hao, Manole and Van Ark (2008).

All in all, €25,900 million were spent by the State, the regions, firms and households on training in 2005, that is, 1.51% of GDP (see Table 10). Out of this amount, firms dedicated a total of 40% to training including apprenticeship and alternate classes, and about two thirds of this amount to their employees. This spending *stricto sensu* is broken down into internal expenses for 12%, purchase of training for 17%, trainees' compensation for 27% and in payments to the tax-collecting institutions for 41%.

Payments to tax-collecting institutions amounted to €2,353 million when focused on the main core of the business training scheme (i.e. the training plan) and training expenses performed by these institutions for firms related to this specific means of training accounted for €2,203 million. Then, a substantial amount comes back to firms in the form of training actions (94%).

¹⁴ The tax system should be adjusted to remove all expenses not directly driven by investment in training.

¹⁵ See the statistical table in Appendix A showing the wide definition of human capital departing from the point of view of the beneficiary of training versus the narrow definition focusing on the final funder of training.

Hao *et al.* (2008) pointed out that according to the CVTS 2005, indirect costs (the wages paid to the employee during his/her training) including apprenticeship amounted to 0.9% and direct costs to 1.4% of labour costs. All in all, training investment in the business sector would amount to about 1.5% of GDP.

According to our administrative source, indirect costs excluding apprenticeship and alternate classes accounted for 1.26% and direct costs for 1.17% of the wage bill (total gross wages), whereas subsidies amounted to close to nothing in 2005. Including apprenticeship, as firms invest €1,986 million in apprenticeship through the OCTA (tax-collecting institutions for apprenticeship) in 2005, and an extra €1,385 million in alternate classes, the overall firm spending on training is €10,529 million (3.55% of the wage bill and 0.6% of GDP).¹⁶

In our view, investment, as argued *supra*, should be restricted to training spent on employees by either the business or the non business sector (excluding then apprenticeship, alternate classes, the individual leave for training and the share of money devoted by the tax collecting institutions to their own financing). In this regard, investment in training by the business sector only amounts to €6,179 million, i.e. 0.36% of GDP in 2005.

Table 10: National spending for training by final funding

	1999	2000	2001	2002	2003	2004	2005	2006	2007
State	5 198	5 153	5 215	4 812	4 968	4 550	4 425	4 560	4 261
Regions	2 027	1 961	1 971	1 939	2 061	2 715	3 410	3 792	4 246
Other territorial bodies	29	29	29	27	32	45	44	48	53
Other public bodies and unemployment benefits body	1 272	1 139	1 156	1 251	1 347	1 453	1 326	1 185	1 299
Firms	9 049	9 336	9 700	9 691	9 929	10 060	10 529	11 173	11 977
<i>Firms excluding spending on young and apprenticeship and not pure training expenses</i>	5 772	5 869	6 204	5 928	5 888	5 875	6 179	6 322	
Public adm. for their own civil servants	4 400	4 594	4 777	5 050	5 094	5 247	5 196	5 292	5 490
Households	764	808	894	1 043	942	960	970	1 036	1 091
TOTAL	22 739	23 020	23 742	23 813	24 373	25 030	25 900	27 086	28 417

Source: DARES and CEPII's calculations.

2.9. Organisational capital

The organisational capital we want to measure is made up of two distinct items: "purchased" organisation and internally produced organisation. The first component is assimilated to the purchasing of business consulting, which is easily tractable in the national accounts. The second part, however, is much more difficult to assess. We estimate the purchased part of

¹⁶ 2.7% of total labour costs by assuming total labour costs endear gross wages by 0.33. Gross wages are given in the tax statements.

organisation capital with the SUT of NACE 74.14 (NAF 74.1G) "Business and management consulting activities". In 2004, the national accounts recorded a total intermediate consumption of NACE 74.14 of €22,168 million, including €726 million as intra-industry consumption (which is excluded from GFCF), €4,623 million being purchased by public administrations and €16,819 million by firms.

Actually, we estimate that investment in organisational capital could be situated in a 50-100% bracket of these expenses. Then, the lower limit of investment would be set at €10,721 and the upper one at €21,442 for the whole economy.

Own account organisational capital

For the internal production of software, advertising or financial innovation, we have been relying on labour cost based analyses since occupations linked to these productions were easily identifiable. In the case of organisational capital however, it is not clear which part of firms' staff is involved in the production.

As highlighted by Prescott & Visscher (1980), knowledge in employees and staff organisation is handled by human resources departments and managers. Thus, Corrado *et al.* (2005), and Hao *et al.* (2008) proxy organisational capital with a share of managers and top executives compensation. They assume that managers may spend 20% of their time working on improving organisation within the firm.¹⁷

Hao *et al.* (2008), when comparing France and Germany, find that France spent twice as much in organisation capital than Germany did. They use employment data from the Structure of Earning Survey based on data collected by national institutions and bundled by EUROSTAT. Large differences appear between the two countries. Considering ISCO group 1 as the managing staff, they find that Germany counts 486,006 managers whereas France would count as much as 909,806 managers in the same category. This gap leads to incomparable results between both countries. Moreover, it is likely that such problems of comparability also happen for other countries. Exploring employment data at a more detailed level than the 9 ISCO groups could improve quality and comparability of estimations. We thus face two important issues. First, we are still not sure about the accurate way to measure internal production of organisation capital, although we could use CHS method. But, second, we see that we lack comparable data to implement such work at the European level using the most aggregate level of the international occupation nomenclature.

¹⁷ CHS also make estimations with one third of managers' time spent on improving organisation. Indeed, the result is very sensitive to this ad-hoc hypothesis and might seem overvalued given the amounts associated to such estimation methods. However, Edward Prescott in his comments states that these figures may still be underestimating the real potential organisation capital. Based on his work, organisation capital is built by managers but also by lower-level staff once they have been affected to the correct task and that there are no barriers to communication within the firm.

For lack of a better method, we apply the CHS method but restricting the occupations list to managers and then dropping out top executives. The definition of top executives is not clear-cut and as the French occupation classification allows the distinction between managers and executives to be done (in contrast with the ISCO one used by Hao *et al.* (2008)), we take advantage of this.

The occupations considered are managers of firms with more than 10 employees (PCS 231a to 233d). 152,277 managers are surveyed in 2004 in the Labour Force Survey, who are served an average monthly net wage of 4,182 euros. By slicing a 20% share of the wage bill (gross wages), the organizational capital for own account can be assessed at €2,068 million.

CONCLUSION

In this paper we intend to evaluate French intangible investment following Corrado, Hulten & Sichel (2005) propositions. To date, only few intangibles have been recorded as GFCF in the national accounts. Yet, some of these expenses are comparable to capital in two ways. First, they can increase productivity just as tangible capital does. Second, their use is durable in the production process. For these reasons, it seems more accurate to consider these intangibles as capital rather than consumption. Although we follow CHS approach, we try to improve their analysis in two ways. First, we rely on very detailed French national accounting data provided by the INSEE, the French office of national statistics. These data have been authenticated by national accountants and international organisations. Second, we go deeper into the concepts, the definition and the estimation methods of several items relying on the literature of specialised economic fields. By doing so, we refine the definitions of intangible assets and propose more accurate estimation methods and figures.

Some of the items proposed by CHS are already recorded as capital in the French national accounts. This is the case for software, mineral exploration, literary and artistic originals and architecture and engineering design. We take these figures just as they are given by the INSEE. Some other items are not recorded as capital but distinctly recorded as intermediate consumption, such as purchased advertising, R&D or databases. We use supply-and-use tables as well as input-output tables in order to distinguish between the real intermediate consumption part of these items and the part that could be considered as GFCF due to its characteristics. Finally, some items such as, financial innovation, own account advertising or human capital, are not recorded anywhere. For these categories, we rely on alternative sources, like employment data, tax bills or surveys. For each item, we define the asset characteristics and motivate our choices in terms of estimation method. For certain items however, we cannot conclude on a unique definition and estimate. We thus set an estimate range. We find that France could have invested between 128 and 157 billions of euros (8% and 9% of GDP) in intangibles in 2004. If we restrict estimates to the business sector only, they range between 95 and 120 billions of euros (6% and 7% of GDP). Table A.1 in the appendix summarises our results.

Through the large work of investigation that has been implemented not only in terms of data exploration but also in terms of concepts and methods, we have started to deepen the understanding and estimation processes of items such as human capital or financial innovation and implemented methods that had never been handled in Europe previously. We thus hope to provide a significant improvement to CHS benchmark.

This work will eventually pave the way for further studies. First, time series analyses will provide a dynamic view of intangibles in the French economy and be followed by a growth accounting work aiming at measuring the contribution of intangible capital to GDP. Second, the present paper is based on aggregate data. Further work relying on micro data, surveys or interviews will help improving both definitions and measurement of intangibles.

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A. Summary of intangibles evaluation

Table A.1 summarises French intangible accountable GFCF in 2004. When possible, we delineate spending by institutional sector (no-financial market sector, financial firms and households) so that we might at least provide detailed results for both the whole economy and the business sector only. Sometimes, due to data constraints, we are compelled to assimilate the business sector (institutional definition) and the private sector (industry definition).

For items that are subject to conceptual issues, we provide figures depending on the definition span. We have figured out that items such as R&D or advertising could have a wide or narrow

definition. Table A.1 displays these different results. Using either narrow or wide items definitions, intangible GFCF could amount between 8% and 9% of GDP in 2004.

Table A.1: Summarised results for year 2004

	Def.	Total Mn €	% GDP	Sector breakdown	Mn €	% GDP
Software		25,232	1.52%	Non financial firms Financial firms Non market sector	19,466 2,610 3,156	1.17 0.16 0.19
Database		778	0.05%	Market sector Non market sector	626 152	0.04 0.01
R&D	Wide def.	28,885	1.74%	Market sector Non market sector	19,426 9,459	1.17 0.57
	Narrow def.	20,634	1.24%	Market sector Non market sector	12,470 8,164	0.75 0.49
Copyright & licence costs		2,744	0.17%	Market sector Non market sector	2,538 206	0.15 0.01
	Architecture & engineering design		15,684	0.94%	Non financial firms Financial firms Non market sector Households	12,227 72 1,132 2,253
Own account		10,041	0.60%		9,920	0.60
Advertising	Wide def.	22,568	1.36%	Market sector Non market sector	22,037 531	1.33 0.03
	Narrow def.	17,508	1.05%	Market sector Non market sector	17,136 372	1.03 0.02
Market research		1,836	0.11%	Market sector Non market sector	1,790 46	0.11 0.00
	Financial innovation	283	0.02%	Financial industry	283	0.02
Human capital	Wide def.	25,247	1.52%	Business employees Non bus. Employees Unemployed Young (<26 years) Investment	9,976 5,128 3,609 5,920 614	0.60 0.31 0.22 0.36 0.04
	Narrow def.	20,845	1.26%	Market sector Non market sector Rest of the economy	5,875 5,247 9,723	0.35 0.32 0.59
Organisation capital	Wide def.	23,510	1.42%	Market sector Non market sector	18887 4623	1.14 0.28
	Narrow def.	12,789	0.77%	Market sector Non market sector	10,478 2,312	0.63 0.14
Total – All sectors	Narrow def.				128,374	7.73
	Wide def.				156,808	9.45
Total – Business sector	Narrow def.				95,491	5.75
	Wide def.				119,858	7.22

B. Training schemes in France

Several schemes are available in France. Some training actions are planned by the firm, some by the worker with the firm's agreement and some others are at the worker's initiative.

B.1. The training plan

The most popular is the training plan. It gathers the whole training actions defined in the framework of the human resources management of the firm. Can also be included competency interviews for development and accreditation. The working-out of the training plan is under the firm's responsibility, after notice of the employees' representatives. When the training is off working hours, the worker receives an additional wage equivalent to 50% of its net wage.

Some 40% of workers apply for training in this framework and the training duration is about 30 hours.

B.2. The individual training leave

It is the worker's right to take a leave from one's job to follow a training of his or her choice. The leave can't last more than one year for a full-time training or reach more than 1200 hours for a part-time training. The worker's wage and training costs can be paid by the tax-collecting institution (OPACIF) up to 90% for the worker's wage. The employer can't block the leave for training reasons. He can nonetheless delay it for work or lack of personnel reasons. As this leave is independent from the training plan and doesn't match necessarily the objectives of the firm, its keeping may be questioned. At least, one can argue that if the worker stays in the incumbent firm for at least two years after his training, this training has not been used by the employee to get a better job elsewhere but it doesn't mean the returns to this training will be garnered by the firm.

In France, 35,600 employees with permanent contracts and 7,600 employees with fixed-term ones have benefitted from this training leave in 2006. Training sessions are long (880 hours).

B.3. The individual right to training

The worker gets a training credit of 20 hours per year during six years. The initiative to use this right belongs to the worker, but the firm must agree on the training course. This type of training is charged to the employer. It helps promote the worker and give him a higher qualification level or improve his skills. If the training occurs during the working hours, the wage is maintained. If it is off the working hours, the employer pays the training costs and the allowance compensating the worker. This is subtracted from the employer's tax.

4% of workers in firms with more than 10 employees have used their individual right to training.

Furthermore, there exists vocational training periods allowing workers to maintain a certain level of skills. About 400,000 trainees have benefitted from these periods. Public administration bodies are also a big provider of training, with central public administration providing 2.7 million training actions, regional bodies providing 362,700 and the health body some 693,000.

C. The tax-funded training system in France

All firms and self-employed persons must pay taxes to finance continuing and sandwich courses (alternate work/classes). Payments are made to collecting-tax institutions but it is optional for the training plan of firms with more than 10 employees.

More than € 5 billion have been pooled by these institutions. Firms but the smallest ones have a drawing right equivalent to their contribution.

Firms with more than 20 employees and more must assign 1.6% of their gross annual payroll to training (apart from the apprenticeship tax):

- 0.9% to fund the training plan, the individual right for some actions and the alternate professional contract for compensation and costs, along with the training allowance.
- 0.5% to finance the educational cost for the alternate professional contract, the individual right for actions defined as priority ones by the industry, except compensation and tutorship.
- 0.2% to finance the individual leave for workers with permanent contracts and 0.1 % for ones with fixed-term contracts.

Firms with 10 to 19 employees pay a training tax equal to 1.05% and firms with less than 10 employees pay a 0.55% tax on their annual gross payroll.

D. The tax forms

Employees with ten full-time employees at least must fill in a fiscal form, the 24/83 related to employers' contribution to the development of continuing training. The smallest firms fill in another form, the 24/86. Firms which overtake the limit of 10 employees stay in the same fiscal regime for two more years.

In these forms, we get by occupation category (unskilled production workers, skilled production workers, non production workers, intermediate occupations, engineers and executives) and by gender the following information:

- The number of workers in the firm at the end of the year,
- The number of trainees except those who have benefitted from an individual leave for training or alternate work/studies contract,

- The number of training hours related to the above-mentioned trainees,
- The number of workers using an individual right to training,
- The number of hours used related to the individual right to training,
- The number of hours not used in the individual right to training.

Is also mentioned the number of workers who trained through the vocational training period scheme and the number of hours related to it, the number of hours funded with a training allowance, the number of competency interviews fully funded by the employer, the number of accreditation actions also fully funded by the employer.

In another frame, is traced up the gross payroll serviced in the year. The two subsequent frames are related to the financing of the individual leave for training, vocational training contract and periods, and individual right to training, with their tax rates, spending, the contribution already paid to the tax collecting institutions, and the deficit or surplus that comes out of the difference between the tax and payment to the tax collecting institutions.

The F frame concerns the contribution to the development of continuing training. It is related to spending ascribed to training (adaptation, promotion, acquisition, servicing or improving skills and competency interviews, except spending for initial training. Spending by the tax-collecting institutions are not mentioned in this frame.

- The internal training spending is directly carried out by the employer. They point to the amount of total compensation of the personnel engaged in training (trainers and administrative personnel), and other training expenses (spending for renting and servicing the place and furniture ascribed to training, the educational functioning of actions, overheads for which a lump sum of 5% of personnel spending is allowed, spending for the assessment of training needs for the actions that were really carried out, spending for transportation and accommodation).
- The external training spending contracted with an external training centre, agreements on competency interviews or accreditation with an external training firm,
- Compensation for trainees and beneficiaries of competency interviews or accreditation actions,
- Training allowances paid for actions financed out of the working hours,
- Payments made to a tax-collecting training institution (for the individual right to training, the individual training leave and the vocational training periods; for the individual right to training; for the training plan),
- Other financing or spending (spending for investment, etc.).

Training of apprentices is not available in these forms and is submitted to a separate tax process.

In France, firms pay a 0.5% tax for apprenticeship + a 0.18% tax for the development of apprenticeship on the firm's gross wages. This tax covers mainly apprentices trained in special centres for about 52%, but also compulsory training at firms that is part of the teaching in lower and upper professional secondary schools, post-secondary schools, university professional degrees and engineer and marketing studies (*grandes écoles*) for 48%. When firms host a trainee from professional classes, they may get an exemption of part of the tax (4% maximum exemption of the wage payroll for the concerned category). Small firms hosting apprentices may be exempted of the tax. Only firms with a gross annual payroll below six times the annual minimum wage and have at least one apprentice, are exempted from this tax. If firms with more than 250 employees don't take in enough trainees of the professional kind (2% of the number of their employees), they have to pay even more (0.6% + 0.18% for the development of apprenticeship).

In France, the amount of the tax amounted to €1.5 billion for 260,000 apprentices, *stricto sensu*, in 2005.

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