



Labour Quality and Skill Biased Technological Change in France

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Summary

New interest for the Skill Bias Technological Change hypothesis (SBTC) has been refueled in the wake of ICT capital deepening in the economy. The shift in the share of more educated workers has been explored for France over the 1982-01 period.

It was first shown that differentiating supply and demand changes across different categories of labour mattered on account of important composition effects retraced in the labour quality index. Women and younger educated workers and also, fitting the demographic structure change, the 35-54 age bracket, have increased their hours worked over the 1995-01 period.

The analysis of demand favouring college educated labour across sectors brings also some insight into the debate about the factor/ sector bias of SBTC. Demand for college educated workers has, indeed, mainly increased in sectors already intensive in skilled labour and in ICT investment. This in turn suggests that the sector bias of technological change has driven up the share of college educated labour.

The econometric analysis provides evidence of SBTC over the 1990-01 period. Across education types, ICT capital accumulation and the R&D stock impact favourably the share of college educated labour. Sectorwise, the impact of SBTC is stronger in the non producing sector over the 1990-95 period. In contrast, the ICT producer sector experienced a large SBTC effect over the 1996-01 years.

Key words: Skill biased technological change, skill premium, ICT, shift-share, econometric analysis.

J.E.L.: J2, J3, O3.

I. Background and Motivations

How to explain the increasing share of skilled labour relative to unskilled labour is a question that has regained interest with the deepening of ICT capital in total economy over the 80s in the United States and over the 90s in Europe.

The skill upgrading of labour input, associated with a rise in the relative wages of skilled workers, was paid much attention since the 70s in the changing context of international trade. First, the low-skill contents of imported products were found to compete unskilled labour in the developed countries and cause a skill bias (Wood, 1995; Goux and Maurin, 2000). Further, recent literature has focused more specifically on outsourcing (imported intermediate inputs) as a major explanation of wage inequality. Feenstra and Hanson (2001) for example assess that outsourcing can account for half or more of the observed skill upgrading.

Besides international trade and also institutional-type factors as wage-setting practices and norms that impact the wage gap (Dinardo, Fortin and Lemieux, 1996), the other candidates that have emerged as a potential explanation for the skill-bias are technological and organisational changes.

As technology is complementary to skills, a technological change embodied in capital together with a changing organisational environment will increase the demand for skilled labour. The skill premium, defined as the relative wages ratio, then in turn increases. Numerous studies have given support for the skill biased technological (and / or organisational) change (SBTC) hypothesis linked to ICT in the United States and also in European countries (Autor, Katz and Krueger, 1998; Caroli and van Reenen, 1999; Haskel and Heden, 1999; Greenan et al, 2001 ; Falk, 2001; O'Mahony et al., 2003; Piva et al., 2003). Some have done this by using the plain model of supply of and demand for skilled relative to unskilled labour devised by Katz and Murphy (1992), which fails however to explain the slowdown of the skill premium in the United States over the 90s (Beaudry and Green, 2002).

Further, an opposite view to the labour-augmenting aspect of SBTC is its sector bias. Haskel and Slaughter (2002), for example point out that it is the sector bias of SBTC that determines the change in relative factor prices and not the SBTC's factor bias. They find that in a multi-sector framework, SBTC is concentrated in skill-intensive sectors.

Card and DiNardo (2002) question SBTC on the account of two competing approaches: the ICT capital and high skills complementarity and the skill price rise across all dimensions of skills. The first version fails to explain why in spite of ICT capital deepening acceleration,

the wage gap in the United States was only persistent from 1982 to 1986 and the second version of SBTC cannot explain why the returns to education are concentrated among younger workers or why the gender gap has been closing.

This paper aims at checking if SBTC played a role in France over the period 1982-2001.

Section 2 will stress on descriptive statistics linked to gender, age brackets and skills.

As composition effects in supply and demand across skills may shift out the skill premium and counterbalance the SBTC's effect, it seems necessary to examine supply and demand by gender and age brackets across skills.

Firstly, the labour quality index, measuring the growth rate of efficient hours worked relative to the growth rate of non weighted hours, is a useful indicator as it globalises trends in supply and demand across gender, age brackets and education categories.

Secondly, to give an insight into demand and supply shifts in labour quality changes, some more detailed indicators are displayed. The supply and demand effects are further assessed by using the framework developed by Katz and Murphy (1992), Autor et al. (1998).

Thirdly, a shift-share analysis is carried out. It breaks into two components: the between effect and the within effect. If the former prevails, studies conclude to a skill bias induced by international trade or to a sectoral supply shock (i.e. the defence sector in the United States); if the latter is larger, then the SBTC is seen as the relevant explanation.

In section 3, the econometric analysis provides evidence of SBTC over the 1990-01 period. ICT capital accumulation and the R&D stock impact favourably the share of college educated labour. Sectorwise, SBTC is very positive in the ICT non producing sector over 1990-95, whereas the impact is boosted in the ICT producing sector over the 1996-01 years. Moreover, the trade explanation is not validated, empirically, over the nineties.

II. Descriptive Statistics

2.1. Data and notions

The data for hours and compensation are described at length in Appendix 1. They come mainly from two main databases: the Déclarations Annuelles de Données Sociales (D.A.D.S.) from the INSEE, a sample based on the forms filled in by employers and the Labour Force surveys (LFS) for France from 1982 to 2001.

Ratios by gender, age, education are calculated in the LFS and then applied to the D.A.D.S. The merged database is then controlled for National Accounts totals. Total hours and compensation entail the self-employed workers. Moreover, compensation includes the gross wage and the employers' contributions (provided by INSEE).

The skills considered in this paper are skills by education and not by occupations.

2.2 The labour quality index

ICT can be assumed to impact differently labour categories, as some studies using detailed surveys on ICT use have shown that younger and educated people are more ICT-friendly than other labour categories. The skill bias may then be of different magnitude across education categories. All tables and graphs of this section are included in appendix 2.

The labour quality index is mostly interesting as it synthesises trends in supply and demand across gender, age brackets and education categories and can be viewed as a proxy for the productivity effort of each labour category (table 5). French labour quality is compared to the US in order to stress differences between both countries.

Following the works of Jorgenson (1987), the labour quality is measured by the difference between labour services and the growth rate of hours worked. Labour services are measured by the growth rate of total hours worked by each individual labour category weighted by their compensation share in total labour compensation. Each component is weighted by its marginal product under the neo-classical hypothesis according to which labour is compensated at its marginal productivity¹.

¹ The following equation is then calculated:

$$\Delta \ln L = \sum_l \bar{v}_l \Delta \ln H_l$$

The contribution of education to labour quality in the US decreases in the 90s relative to the 80s, whereas in France, it increases strongly over the whole period. Table 6 exhibits statistics related to the growth rate of hours worked by education type and age bracket. While the upper education categories (down to baccalaureate) see an increase in their hours worked over the whole period, the hours worked by the less educated ones in contrast are undercut. Had the growth rate of hours been calculated across occupations, an increase in hours would have appeared in the second half of the nineties. It is worth being mentioned that the qualification of the unskilled improves as the share of unskilled workers with for instance a baccalaureate increases from 2% in 1982 to 10% in 2001 and the share of unskilled workers with no diploma tumbles down from about 75% in 1982 to 46% in 2001².

By gender, women have raised their labour supply dramatically in the US over the 80s (table 5). In France, no inroad of this magnitude is observed. By age bracket, the contribution of the youngest and the oldest workers goes up in the US in the 90s relative to the 80s. In France, over the 1990-95 period, the sharper decrease in hours relative to labour services calculated on age explains why the age contribution to labour quality remains positive. In the 1995-01 years, increased hours of the youngest and of the 35-54 age bracket hardly balance a sharp decrease in the hours worked by the oldest. This translates into a very negative contribution of age in the second half of the 90s, all the more as non weighted hours increased over this period (table 6).

Interestingly, in spite of a growing integration of the youngest in employment (hours), their share in compensation hardly moves up over the 90s. On the contrary, the 35-54 age bracket compensation share swells up to 59% over 1995-01 (table 7). These evolutions reflect in part what occurs on the labour supply side.

with $\Delta \ln L$ labour services, H , hours worked et v , the weight, with the dash indicating an average. The weight relates to the compensation share of each labour type in total compensation and is calculated with a Törnqvist index, where $P_i L$ is compensation of labour type i belonging to the L category (for example women and men belonging to the gender category):

$$v_i = \frac{P_i L_i}{\sum P_i L_i}$$

$$\bar{v}_{L_t} = 0.5 * [v_{L_t}(t) + v_{L_t}(t-1)].$$

² Chardon Olivier (2001) « Les transformations de l'emploi non qualifié depuis vingt ans » INSEE Première, n°796, juillet.

2.2. Labour supply and demand shifts

Hours and the wage bill

A closer look at supply and demand shifts in the French economy teaches us that over the 90s the population of tertiary educated people aged 25-34 has attained 34% of the total age group, with the share of women outstripping the men's share (OECD: *Education at a glance*). On the demand side, the same statistics but in hours worked indicate that the ratio of tertiary educated people aged 25-34 reaches 38%. The total intensity indicator, dividing the demand into the supply share, amounts to 111% and even 127% for women in 2001, pointing to a higher concentration of education in labour than in population. This intensity was a bit greater in the first half of the 90s.

The stylised facts about the participation and employment rates of women, the youngest and oldest workers in France are well-known. The participation rate of women has increased a lot over the 1982-01 period (OECD: *Employment Outlook*). The share of the youngest (24.3% in 2001) and the oldest (36.5% in 2001) in employment is very weak relative to the United States (57.7% and 58.6% respectively) or to the EU average at least for the young (40.8% and 39.3% respectively). The still high unemployment rate, though declining at the very last end of the period, has left France with an oversupply of young and educated labour. It has been argued that the lack of flexibility in the French labour market involved an adjustment on quantities. This in turn pushes wages down in downturns.

To summarise, demand seems to increase for women, younger and educated workers. If demand exceeds supply, then the hourly wages of these categories should in turn increase. On the contrary, non-educated workers should see their hourly wages decrease as supply of labour for this category is larger than demand. Also, the 35-54 years old supply of labour seems to go up but it has not been translated yet into a lower share of their wages in the wage bill over the recent period.

Hourly compensation

The skill premium, the hourly compensation of college educated labour to non college educated one, should rise in the wake of the massive introduction of a new technology such as ICT entailing an increased demand for educated labour. But across education, the demand for gender or age categories may increase for other reasons than SBTC. For example, firms can hire younger women taking advantage of historically lower wages relative to men unrelated to productivity differences.

Graphs 1 and 2 provide evidence for such shifts within the education criterion. The wage gap between men and women still amounts to more than 20% in France over the last period (graph 1). This suggests that firms fancy different career perspectives for women, as they anticipate bumps in women's careers due to child raising, etc. Further, the wage gap for highly educated women relative to men is larger than for women in the lower education levels. Less flexible hours worked by high educated women would keep them on a lower career track than men, explaining the magnitude of the wage gap between highly educated women and men. By contrast, the less educated women experience about the same career progress as men³.

By age bracket, the age-weighted skill premium rise is steady throughout the period and stiffer in the second part of the 90s (Graph 2). However, composition effects may be linked to economic fluctuations.

Over the first half of the 90s, a period of slack growth, the demand for the youngest and the oldest has dramatically decelerated, weakening even more their share in total employment. This is in line with the disaffection of employers with these categories in sluggish times, when employers gauged wages earned by these categories too high relative to their productivity level. Then, those on search of a job could only find one at the price of a weaker entry wage. These age brackets (below 25 and above 54 years old) are small in total hours worked and compensation and do not impact much the weighted total.

Over the 1995-01 period, the 25-34 years-old bracket and the youngest are the most involved, pointing to a sustained demand effect for these categories of workers. Although the wage premium of the youngest has increased a lot over this period, this has not translated into the improvement of their compensation share as the growth in compensation of the better paid 35-54 years old has enlarged total compensation.

In France, as the education distribution is more splayed out than in the United States, the skill premium of the college educated was computed against workers with no diploma. The skill premium rise is then much stronger for younger educated people than for their elders across all categories of education over the 1995-01 period.

³ An extensive literature exists on the gender gap and on the discrimination in women's wages: see for example Baldwin et al. (2001).

Relative education supply and demand shifts

To synthesise further the education supply and demand for total economy, the model used by Katz and Murphy (1992) and Autor et al. (1998) is used. The following equation derived from a C.E.S. function, is calculated:

$$\Delta \ln D_t = \Delta \ln(W_{ct} / W_{nct}) + (\sigma - 1)\Delta \ln(w_{ct} / w_{nct}).$$

With σ the aggregate elasticity of substitution between college and non college workers, D the demand for college educated relative to non college educated workers, W total compensation, w the hourly compensation, the subscripts t, c, and nc stand for time, college and non college workers.

Both studies retain, as a preferred estimate, an elasticity of substitution of 1.4. Results are displayed in table 8 of appendix. The wage premium amounts to 0.31% on average per year over the 1982-01 period. 40% of this increase being kept due to the elasticity of substitution, this results into a lower skill premium (0.12%). The wage premium rise is steady and reaches 0.26% in the 80s, 0.30% over 1990-95 and 0.38% over 1995-01.

The total demand effect favouring college educated labour is the sum of the change in the relative wage bill and the change in the wage premium⁴ times the elasticity of substitution. The demand curve for college educated labour shifts on account of technological change, relative product price changes, increased outsourcing processes, etc.. Supply, here in this model, is the change in relative hours of the college educated workers.

Demand is greater than the supply effect in France over the whole period. It outstrips the supply effect chiefly over the 80s (4.66%) just as in the U.S. (4.60%).

Demand favouring college educated labour can be split up into sectoral demand schemes. The sectoral breakdown described in table 9: the producer sector, the user sector and other industries, stems from the prediction that college educated workers will be attracted in those sectors that are intensive in ICT investment⁵. The overall relative demand over the 80s is shifted by the other industries' demand change for college educated labour (particularly in the health and government services, the wholesale trade, the plastics and rubber industry and textiles). The shift in global demand favouring college educated labour between 1990 and

⁴ Here, the total wage bill refers to total compensation and the wage premium is the compensation premium.

⁵ The industries in the ICT user sector have been identified by calculating the ICT investment intensity in each industry (share of ICT investment in total investment of the industry compared to the share of ICT investment in investment of total economy).

1995 was towed by the user sector. Since 1995, demand is fully due to the ICT producer sector's contribution. Demand exceeds supply by about 4 points in the producer sector over 1995-01. The ICT boom has generated increased output and employment in this sector. Moreover, the year 2000 bug has played a major role in these trends. Helped by a declining supply change over time, demand in the user sector ranks first over the 90s, at a time of greater ICT diffusion. In the ICT user sector as in other industries, demand has exceeded supply by less than 0.1% over 1995-2001 in spite of growth acceleration.

2.3. Shift-share analysis

Berman, Bound and Griliches (1994) have assessed the impact of the skill bias technological change by using the shift-share method. It allows the share of college educated hours (compensation) to be decomposed into two effects: the 'between' and the 'within' effect. The former relates to inter-industry labour shifts and the latter to intra-industry labour changes for college educated workers. The 'between' effect coincides with international trade changes or with a sectoral shock inducing that college educated labour is attracted to (and unskilled labour decreases in) some specific sectors. The 'within' effect indicates an increase in skilled labour in all sectors as a result of the diffusion of technologies such ICT or the increase in R&D. It could also be interpreted as the occurrence of more outsourcing transactions between firms within a sector (Hanson and Feenstra, 2001).

The initial formula is the following:

$$\Delta S_{DIP} = \underbrace{\sum_i \Delta \frac{H_i}{H} * \bar{S}_{DIP,i}}_{between} + \underbrace{\sum_i \Delta S_{DIP,i} * \frac{\bar{H}_i}{H}}_{within} \quad (1)$$

S_{DIP} = proportion of hours worked (compensation) by college educated workers in total hours (compensation), $S_{DIP,i}$ = proportion of sector hours worked (compensation) by college educated workers in total sector hours (compensation), H = total hours worked, H_i = hours worked in industry i , the long dash overtopping the variables indicates a mean over the whole period and Δ relates to a change between end and initial dates of the period. This breakdown can be performed on hours and also on compensation. In the alternate equation, W stands for compensation.

The above equation is further decomposed into sectors in order to obtain both effects in the ICT producer, ICT user and in the other industries:

$$\begin{aligned}
\Delta S_{DIP} = & \underbrace{\sum_{p=1}^P \Delta \frac{H_p}{H} * (\bar{S}_{DIP,p}) + \sum_{u,u \neq p} \Delta \frac{H_u}{H} * (\bar{S}_{DIP,u}) + \sum_{k,k \neq j \neq p} \Delta \frac{H_k}{H} * (\bar{S}_{DIP,k})}_{\text{between}} \\
& + \underbrace{\sum_{p=1}^P \Delta S_{DIP,p} * \frac{\bar{H}_p}{H} + \sum_{u,u \neq p} \Delta S_{DIP,u} * \frac{\bar{H}_u}{H} + \sum_{k,k \neq j \neq p} \Delta S_{DIP,k} * \frac{\bar{H}_k}{H}}_{\text{within}}
\end{aligned} \tag{2}$$

with p the ICT producer sector, u the ICT user sector, k the other industries.

Both effects for the whole period can be broken down into changes over different periods of time and can sum up on sectoral changes and both of them can also be added (table 10 and 11).

Over 1982-2001, the total ‘between’ effect amounts to 0.34 for hours (0.65 for compensation) whereas the ‘within’ effect indicates a well above change: 13.39 (18.56 for compensation). This ‘within’ effect increases throughout the period. Surprisingly, the ‘between’ effect contribution to the share of college hours, although of a small size, increases too chiefly in the user sector. Computed on compensation, the ‘between’ contribution of the producer sector is the highest, indicating a strong increase in the total compensation of this sector for skilled labour.

The ‘within’ effect ratio to the change in the share of wages earned by the college educated can be allocated to the relative wage bill in order to highlight the ‘within’ component of demand. It thus measures the impact of SBTC on the demand shift towards more educated workers. When the wage premium and the relative wage bill in its ‘within’ component are added, it results into the ‘within’ component of demand (table 9, part A).

The contribution of sectors to the ‘within’ effect depends on the magnitude of the share of each sector in total hours or compensation. Table 12 displays these shares. For example, the ICT producer sector represents only 3.6% and 5.6% in total hours and compensation respectively over the 1995-01 period. When the change in the sector share of skilled hours is weighed by the sector’s share in the ‘within’ effect, the contribution of this sector is bound to be tiny. On the reverse, the contribution of other industries is likely to be large for the same reasons.

Table 13 and 14 then report the absolute change in the share of college educated workers hours and compensation. The ICT producer sector displays the highest change, as it is a very intensive sector in skilled labour. The intensity in college educated workers in the producer sector relative to the total economy has kept, indeed, on increasing to reach 183% in 2001.

The change in the college educated workers share in the user sector is close enough to the other industries' one, mainly over the last period. This could be misleading, as it could be concluded that nothing happened in the user sector. As a matter of fact, demand for skilled labour in this sector occurred chiefly in the eighties. The intensity in college educated workers in the user sector relative to the total economy then increased from 103% to 129% in 1991 and then increased again from 1997 on to stabilise to 122% in 2001. By contrast, in the other industries, this intensity has decreased down to 0.87% in 2001.

ICT expansion over the second half of the 90s has mainly brought about a boom in the producer sector, and hardly in the user sector. This can also be related to the flexibility degree and turnover rate (entry rate) in both sectors. Firms in the user sector have trained those in tenure to use ICT, whereas in the producer sector, the entry rate of firms and employees is very high, enticing a match between ICT capital deepening and the observed higher demand for college educated labour over 1995-01.

To end this first section, it can be concluded that younger and educated workers benefit from the demand shifts in hours worked. It impacts then labour quality as wages of a category are representative of the productivity of this category. The skill premium rise concerns the youngest college educated workers and also to a lesser extent the 25-54 years-old bracket that is the largest represented cohort.

Results of supply and demand shifts favouring the college educated workers show that, sectorwise, demand outstrips supply in the producer sector over the 80s. Furthermore, the 'within' component was chiefly driven up by the producer sector over the 1995-01 period. Obviously, ICT investment deepening has chiefly impacted the change in the share of college educated workers in the producer sector.

However, demand for college educated workers has chiefly taken place into sectors already intensive in college educated labour. This relates to the debate of SBTC in terms of its factor bias versus its sector bias. Probably, both effects play a role in explaining skill upgrading in hours and compensation.

These differentiated trends should shed light on the econometric analysis exploring further the link between the rise in compensation of the skilled ones and SBTC.

III. Demand for college educated workers: the impact of technological change

Two major results can be drawn from the preceding sections. Firstly, the descriptive analysis shows that the labour force composition in France has changed favouring college educated employment. The share of hours worked by tertiary +4 and tertiary +2 educated workers has strongly increased over 10 years⁶, this phenomenon being associated with an increase in their wage bill⁷. Secondly, the shift share analysis shows that the college educated workers share increase has occurred in all sectors.

The goal, in this last section, is to show, empirically, that technical change explains this demand increase for high skilled workers (tertiary +4 and tertiary+2 educated workers).

3.2. Theoretical framework

The objective in this study is to validate the hypothesis of skill biased technological change. Have R&D stock and ICT capital accumulation contributed to the employment of college educated workers? Has the share of their compensation increased?

Given n types of labour ($j = 1, \dots, n$) and m environmental variables ($k = 1, \dots, m$), the total labour cost of industry i can be expressed as:

$$TLC_i = f[w_{ij}, K_i, Y_i, Z_{ik}] \quad (3)$$

where:

w_{ij} : vector of wages of n categories of workers ;

K_i : real capital stock of industry i

Y_i : real value added of industry i

Z_{ik} : vector of m environmental variables.

Or, in translog form (suppressing the i subscript):

⁶ The share of hours worked by tertiary +4 and tertiary +2 (« skilled workers ») increased from 17% to 28% between 1990 and 2001.

⁷ The wage bill share of tertiary +4 and tertiary +2 educated workers increased from 26% to 38% between 1990 and 2001.

$$\begin{aligned} \ln TLC = & \alpha_0 + \sum_{j=1}^n \alpha_j \ln w_j + \alpha_Y \ln Y + \alpha_K \ln K + \frac{1}{2} \sum_{j=1}^n \sum_{k=1}^n \alpha_{jk} \ln w_j \ln w_k + \sum_{j=1}^n \alpha_{jk} \ln w_j \ln K \\ & + \sum_{j=1}^n \alpha_j \ln w_j \ln Y + \frac{1}{2} \alpha_{YY} (\ln Y)^2 + \frac{1}{2} \alpha_{KK} (\ln K)^2 + \phi(w, K, Y, Z) \end{aligned} \quad (4)$$

where:

$$\phi(w, K, Y, Z) = \sum_{k=1}^m \delta_k Z_k + \sum_{k=1}^m \sum_{j=1}^n \lambda_{kj} \ln(w_j) Z_k + \sum_{k=1}^m \zeta_k \ln(Y) Z_k + \sum_{k=1}^m \psi_k \ln(K) Z_k + \frac{1}{2} \sum_{k=1}^m \gamma_k (Z_k)^2$$

It can be shown that cost minimisation by producers requires that the share of each type of labour in total labour costs be equated with the first partial derivative of the cost function, with respect to that type of labour's wage:

$$S_j = \frac{\partial \ln TLC}{\partial \ln w_j} \text{ with } S_j \text{ the share of labour type } j \text{ in total labour cost.}$$

Assuming only two types of labour, college educated and non college educated ($j = h, l$) – receiving wages equal to w_h and w_l respectively – and only one environmental variable – an index of the stock of technology denoted *TECH*, yields the following equation for the share of high skilled labour in the total labour cost of industry i :

$$S_h = \alpha_h + \alpha_{hY} \ln Y + \alpha_{hK} \ln K + \alpha_{hh} \ln w_h + \alpha_{hl} \ln w_l + \lambda_{hh} \text{TECH} \quad (5)$$

Note that the derivation of the above equation assumes that the parameters of the cost function are symmetric, that is: $\alpha_{ij} = \alpha_{ji}$

Assuming homogeneity of degree one in prices implies that :

$$S_h = \alpha_h + \alpha_{hY} \ln Y + \alpha_{hK} \ln K + \alpha_{hh} \ln \left(\frac{w_h}{w_l} \right) + \lambda_{hh} \text{TECH} \quad (6)$$

Assuming that the returns to scale are constant implies that equation (6) can be written as:

$$S_h = \alpha_h + \alpha_{hY} \ln \left(\frac{K}{Y} \right) + \alpha_{hh} \ln \left(\frac{w_h}{w_l} \right) + \lambda_{hh} \text{TECH} \quad (7)$$

In this study, it was chosen to break down the capital stock (K) in ICT capital (*KICT*) and non ICT equipment capital (*KNICT*). The technological variable is represented by the R&D stock (*RD*).

3.2. Econometric results

In order to take into account structural differences between sectors, the model is estimated using the panel methodology with fixed effects.

The model is as follows:

$$S_{i,t} = \alpha_i + \beta_1 \ln \frac{KICT_{i,t}}{Y_{i,t}} + \beta_2 \ln \frac{KNICT_{i,t}}{Y_{i,t}} + \beta_3 \frac{RD_{i,t}}{Y_{i,t}} + \beta_4 \ln \frac{w_{i,t}^h}{w_{i,t}^l} + \varepsilon_{i,t} \quad (8)$$

where:

i : industry, t : time, $S_{i,t}$: share of high skilled workers wage bill.

$KICT$: ICT real capital stock (calculated using the perpetual inventory method)

$KNICT$: non ICT equipment real capital stock.

Y : real value added, RD : R&D stock (calculated with the PIM method).

$\frac{w_{i,t}^h}{w_{i,t}^l}$: ratio of hourly wage of college educated workers to hourly wage of non college educated workers.

Data

ICT and non ICT capital stock are constructed with the Perpetual Inventory Methodology (PIM) using investment series from INSEE. Hours worked and compensation⁸ by category of education (postgraduates, university or higher vocational degree, “A” level, low vocational school degree, mid-secondary school leaving certificate, no certificate or almost none) are extracted from the D.A.D.S. database and the Labour Force Surveys from INSEE (see Appendix 1). The college educated workers have Master and bachelor degrees (above baccalaureate plus 2 years in college). The non college educated workers are the other skill categories.

The value added series are extracted from the National Accounts (INSEE). All these series are available from 1990 to 2001 for 37 industries. The R&D stock is constructed using the RDSMAN indicator extracted from the STAN database, from 1990 to 2000 for the manufacturing industries.

⁸ Wage bill will stand for total compensation and wage for the hourly compensation in the rest of the paper.

Methodology

Equation (8) is estimated by the Generalised Least Squares methodology in panel. Moreover, the relative wage variable is excluded from the regression. Indeed, this variable is used in the dependent variable construction. One commonly encountered solution in the literature is to introduce time dummies instead of the relative wage terms. These dummies represent macroeconomic shocks and missing variables.

The model is estimated from 1990 to 2001 and for two sub-periods: 1990-95 and 1996-2001 in order to test the stability of coefficients.

To begin with, in order to determine if fixed effects have to be introduced in the regression, a Fisher test is implemented. Moreover, an Hausman test is performed (which determines if random effects are preferred to fixed effects) and concludes that the fixed effects model is preferred over the random effects. Introducing fixed effects reflects structural differences between industries.

The estimation results (Table 1), significant at the 1 per cent level, support the SBTC thesis. Technological progress, represented by the R&D stock and ICT capital stock, has a positive effect on the college educated wage bill share.

In contrast, non ICT equipment capital has a negative effect on the college educated wage bill share. This result (significant at the 1 per cent level) indicates that investment in ICT or non ICT equipment will not have the same impact. In the first case, the wage bill share of college educated workers is likely to increase, whereas in the second case, the relative non college educated share is due to increase.

Table 1: College educated wage bill share, 1990-2001

Explanatory variables	
Fixed effects	α_i
ln(RD/Y)	0.02* (0.009)
ln(KICT/Y)	0.06** (0.01)
ln(KNICT/Y)	-0.12** (0.02)
R ²	0.95
F	373
N	256

Heteroskedasticity-consistent standard errors are in parentheses **: significant at the 1% level, * : significant at the 5% level.

KICT : ICT real capital stock; KNICT: non ICT equipment real capital stock; Y: real value added : R&D stock. The regression includes a full set of time dummies.

Source: INSEE, D.A.D.S., Labour Force Survey and National Accounts, STAN; CEPII, authors' calculations.

Introducing fixed effects in the regression illustrates structural differences between industries (organisational change). Nevertheless, fixed effects may reflect error measures, or missing variables. Consequently, interpreting fixed effects is not easy. Estimation results show that the college educated wage bill share is higher *ceteris paribus* in some ICT producer and ICT user industries: office accounting and computing machinery, business activities, education, health and social services, printing and publishing. In the office accounting and computing machinery industry, the share of higher college educated wage bill is the highest.

Moreover, leaning on statistics in the preceding section, it can be suspected that the impact of technological change on the college educated wage bill share should be stronger in the ICT producer sector. Indeed, Haskel and Slaughter (2002) showed that the stronger technical change in industry, the higher the wage bill share for high skilled workers. In order to show that SBTC is stronger in ICT producing industries, a simplified version of the model is estimated introducing a dummy for ICT producer industries⁹:

$$S_{i,t} = \alpha_i + \beta_1 \ln\left(\frac{KICT_{i,t}}{Y}\right)d + \beta_2 \ln\left(\frac{KICT_{i,t}}{Y}\right)(1-d) + \beta_3 \ln\left(\frac{KNICT_{i,t}}{Y}\right) + \beta_4 \ln\left(\frac{w_{i,t}^s}{w_{i,t}^l}\right) + \varepsilon_{i,t}$$

where: $d = 1$ for the ICT producer sector, 0 otherwise;

As in the preceding estimation, the hourly relative wage is proxied by time dummies.

In this regression, performed over the whole sectors (36 sectors), the R&D stock variable is not introduced because it is only defined for the manufacturing sector. If done, data on services in the ICT producer sector are not taken into account (computer services, telecommunications).

Results (table 2) confirm that the ICT capital stock impact on the college educated wage bill share is higher in ICT producer industries than in other industries¹⁰. The skill biased technological change is four times as important in ICT producer industries as in other industries.

In order to analyse if the magnitude of the technology impact on the college educated wage bill share is the same over time, the impact of ICT is estimated from 1990 to 1995 and from 1996 to 2001. The estimation results (table 2, regression (1)) indicate the capital stock impact on the college educated wage bill share is higher over the 1990-95 than in the 1996-2001 period. Nevertheless, the analysis isolating the ICT producer sector from the other ones tones down this result (regression (2)). Over the 1990-95 period, the ICT capital accumulation involves an increase in the college educated wage bill share in the other industries. In the ICT producer sector, the impact is insignificant. On the contrary, over the 1995-2001 period, the ICT stock impact is much stronger in the ICT producer sector than in other industries.

⁹ Industries 30, 32 and 64, 71-74 in the ISIC Rev.3 classification.

¹⁰ The Fisher test rejects the null hypothesis of coefficients equality at the 1 per cent level.

Table 2: college educated wage bill share in the ICT producer sector and in other industries

	1990-2001	1990-95	1996-01
(1) ln(KICT/Y)	0.03** (0.07)	0.16** (0.01)	0.01** (0.002)
ln(KNICT/Y)	-0.05 (0.014)	-0.20** (0.02)	-0.17** (0.001)
R ²	0.94	0.95	0.99
N	432	216	216
(2) ln(KICT/Y)d	0.12** (0.025)	0.03 (0.06)	0.13** (0.02)
ln(KICT/Y)(1-d)	0.03** (0.007)	0.17** (0.01)	0.01** (0.002)
ln(KNICT/Y)	-0.07** (0.0129)	-0.18** (0.02)	-0.17** (0.01)
R ²	0.96	0.95	0.99
N	432	216	216

Heteroskedasticity-consistent standard errors are in parentheses ** : significant at 1% level.

KTIC : ICT real capital stock ; KNICT : non ICT equipment real capital stock ; Y : real value added. Time dummies are introduced in the regressions.

Source: INSEE, D.A.D.S., Labour Force Survey and National Accounts, STAN; CEPII, authors' calculations.

Estimation by education category

The descriptive analysis in the first section shows a large increase in hours worked and in the wage bill share of college educated workers. Over the 1990-01 period, the annual average growth rate of hours worked by tertiary +4 and tertiary +2 educated workers are respectively 4.1% and 4.04% per year (against 2.2% for workers with a baccalaureate and -1.6% for the other non college educated workers). Their wage bill increased, over 1990-01, by 6.8% and 7.2% per year respectively (against 3.8% for workers with a baccalaureate and 1.8% for the other non college educated workers). However, between 1990-95 and 1995-01 a slowdown in the annual average growth rate of the college educated hourly wage is observed whereas the wage bill and the hourly relative wage growth rate of workers with a baccalaureate has strongly increased.

In order to analyse the contribution of technology to changes in the wage bill composition, the wage bill is estimated by education category.

The results by education category (table 3) show a difference between ICT producer and non ICT producer sectors. In the former, the ICT capital stock has a significant and very strong impact on the wage bill share of baccalaureate educated workers. The relationship between the wage bill share and technological change is even higher for this education category than for tertiary +4 workers. On the contrary, in the other industries, the ICT capital stock has a stronger impact on tertiary +2 than on other type of workers.

Table 3: Wage bill shares by education category, 1990-2001

	Tertiary +4	Tertiary +2	Bacc.	Low vocational	mid-secondary	No diploma
ln(KICT/Y)*d	0.02 (0.02)	0.03** (0.01)	0.08** (0.006)	0.005 (0.008)	-0.009 (0.009)	-0.01 (0.01)
ln(KICT/Y)*(1-d)	0.006** (0.0008)	0.03** (0.001)	0.01** (0.001)	-0.002 (0.002)	-0.002** (0.0004)	-0.06** (0.002)
ln(KNICT/Y)	-0.03** (0.006)	-0.03** (0.004)	-0.03** (0.003)	0.03** (0.004)	0.01** (0.002)	0.05** (0.005)
R ²	0.90	0.96	0.94	0.99	0.92	0.97
N	432	432	432	432	432	432

Heteroskedasticity-consistent standard errors are in parentheses **: significant at the 1% level, *: significant at the 5% level. KICT : ICT real capital stock; KNICT: non ICT equipment real capital stock; Y: real value added. The regression includes a full set of time dummies.

Source: INSEE, D.A.D.S., Labour Force Survey and National Accounts, STAN; CEPII, authors' calculations.

A complementary explanation to the increase in skilled wage bill share is the international trade. In order to estimate the trade impact on skilled wage bill share, imports and exports variables are introduced in the regression.

Trade augmented model

Imports and exports as a share of value added are included separately in the specification. Trade variables are extracted from the STAN database (OECD) and are available for the manufacturing industry from 1990 to 2001. Thus, in order to estimate the impact of trade on college educated wage bill share, the analysis is implemented on the manufacturing sector. Then, the R&D stock, also available in these industries, is introduced in this estimation.

Results from this model provide little support for the trade explanation for the college educated wage bill share increase. The import and export coefficients are insignificant in all cases.

Table 4: International trade and college education wage bill share, 1990-2001

Explanatory variables	
Fixed effects	
ln(RD/Y)	0.04** (0.008)
ln(KICT/Y)	0.06** (0.009)
ln(KNICT/Y)	-0.12** (0.02)
ln(IMP/Yv)	0.02 (0.01)
ln(EXP/Yv)	0.01 (0.02)
R ²	0.91
F	93
N	207

Heteroskedasticity-consistent standard errors are in parentheses ** : significant at the 1% level, * : significant at the 5% level.

KTIC : ICT real capital stock ; KNICT: non ICT equipment real capital stock ; Y : real value added, RD : R&D stock, Yv: current value added ; IMP : imports, EXP: exports. The regression includes a full set of time dummies.

Source: INSEE, D.A.D.S., Labour Force Survey and National Accounts, STAN; CEPII, authors' calculations.

CONCLUDING REMARKS

Skill biased technological change has been studied for France, alternatively over the 1982-01 period in the first section and the 1990-01 one in the second section.

It was first shown that differentiating supply and demand changes across different categories of labour mattered on account of important composition effects.

Labour quality then exemplifies these trends across labour categories. Women, younger and better educated workers increase their hours. The labour quality index increases with education but decreases with age and gender over 1995-01. Younger workers, even if better educated than their elders must be trained and acquire experience before their efforts translate into higher productivity growth. Women take over executive positions more often but in lesser proportion than men, allowing for wage differences.

Turning to demand favouring the more educated ones across sectors, the producer sector explains a great deal of demand over the 1995-01 period. This is confirmed by the shift-share analysis. The much greater 'within' component indicates that the demand for high educated workers has occurred in all sectors and when broken down across sectors, the skilled labour share in the producer sector displays the greatest increase. It is then suspected that ICT is a good candidate to explain the demand shift towards more educated labour. However, this demand shift occurs in sectors already intensive in skilled labour, also suggesting a sector bias of SBTC.

The econometric analysis shows in turn that ICT and the R&D stock impact greatly the relative share of college educated labour. Nevertheless, this impact is stronger on the wage bill of workers holding a baccalaureate in the producer sector and on the one of workers holding a Bachelor of Arts equivalent in the other industries over the 1990-01 period.

Sectorwise, the strong impact of technological change over the 1990-01 period must be differentiated over time. In ICT producer industries, the impact is very positive over the 1996-01 period whereas for the other industries it is stronger over the 1990-95 one.

Moreover, the explanation according to which international trade brings about a decrease in the share of unskilled labour does not seem to hold over the nineties. However, allowing for the changing nature of the international trade environment, with growing outsourcing transactions, it would be interesting to add an outsourcing variable to complete the analytical framework.

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Appendix

1. Data

Detailed data on employment, hours worked and labour compensation by type come from two sources: the D.A.D.S. and the labour force surveys. The Déclarations Annuelles de Données Sociales (D.A.D.S.) is a form filled in by employers that cover 15 million people. Till 1992, one wage-earner out of 25 was included in the sample operated by the INSEE. Afterwards, the operation of the database is exhaustive. A break in the series occurs in 1993. Hours worked before 1993 have been deduced from the wages duration provided in the D.A.D.S. Series for years 1981, 1983 and 1990 that are not available in the D.A.D.S. have been interpolated and the years 1999 and 2000 extrapolated forward thanks to the Labour force surveys.

A second source has been used in order to get skills by education: the labour force surveys that cover households. The poll rate of this survey amounts to 1/300. As wages are not available before 1982, the period under review spans 1982-2001 in that database. The database has been wiped out in order to fit in the same field definition as the D.A.D.S.. Ratios are calculated on the distribution of total hours and wages on gender, age and degrees relative to total hours and wages summed on gender and age. These ratios are then applied to the D.A.D.S. database. We mean to keep the highest consistency by maintaining a common distribution by gender and age (the one of the D.A.D.S.).

After integrating degrees in the D.A.D.S., ratios are calculated on gender, age and degrees by year and then applied to the series of hours worked and labour compensation found in the national accounts in order to remain consistent with the growth accounting framework. The series used are total employment times average hours. For the year 2000, hours worked were estimated with the labour force surveys figures. Underlying this extrapolation is that average hours have decreased by a rate of 3% due to the extension of the 35-hour week in France.

In the final database, we have chosen to separate out three categories: gender, age and degrees. Gender regroups 2 (men, women), and age gathers 4 (<25 years old, 25-34, 35-54, >54) characteristics. Age brackets have been cut off that way in order to be comparable with the results obtained by Jorgenson in the framework of the KLEMS project.

By integrating degrees in the D.A.D.S., we include six extra dimensions: postgraduates (A level + 4 years), university or high vocational degree (A level + 2), A level (high school or vocational), low vocational school degree (C.A.P., B.E.P. or equivalent), mid- secondary school leaving certificate (B.E.P.C.), no degree or almost none (C.E.P). The quality of labour when calculated with gender, age and degrees entails 48 ($2*4*6$) categories.

2. Tables and graphs of section I

Table 5: Contributions to labour quality, average annual changes

	Quality	Age	Gender	Education
1982-2001				
United States	0.46	0.24	-0.08	0.33
France	0.87	0.18	-0.02	0.71
1982-1990				
United States	0.49	0.26	-0.12	0.40
France	1.13	0.44	0.00	0.70
1990-1995				
United States	0.55	0.25	-0.01	0.27
France	0.84	0.26	-0.06	0.70
1995-2001				
United States	0.36	0.21	-0.08	0.29
France	0.54	-0.22	-0.02	0.72

Note: the labour quality index equals growth rate of hours times the compensation share of labour category i in total compensation. Quality sums on the different contributions of age, gender, education and interactions not shown here.

$$\dot{Q} = \sum_i H_i * 0.5 * \left[\frac{(wL)_{i,t-1}}{(wL)_{..t-1}} + \frac{(wL)_{i,t}}{(wL)_{..t}} \right] - \dot{H}$$

Source US: Harvard, CEPII, authors' calculations; France: INSEE, D.A.D.S., LFS, CEPII, authors' calculations.

Table 6: Growth rate of hours worked by education type and age bracket

<i>Per year, in %</i>	1982-01	1982-90	1990-95	1995-01
Tertiary+4	4.8	5.7	3.4	4.7
Tertiary+2	4.0	4.0	4.4	3.7
Baccalaureate	2.1	1.9	0.0	4.0
Mid-high school	0.3	1.1	0.3	-0.6
Low vocational	-0.2	0.6	-1.5	-0.1
No diploma	-3.8	-3.2	-4.7	-3.7
<25	-2.9	-7.1	-7.5	7.2
25-34	-0.5	-0.1	-1.1	-0.5
35-54	1.3	2.1	1.1	0.4
>54	-1.7	0.6	-3.5	-3.4

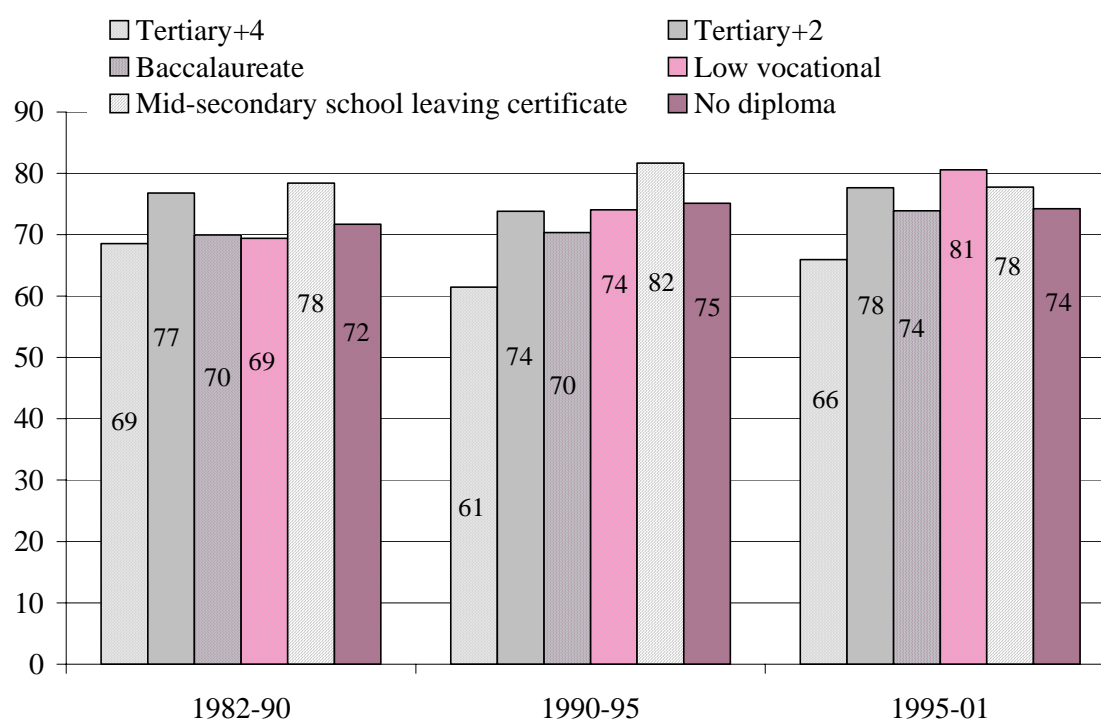
Source: LFS and DADS; National Accounts; CEPII, authors' calculations.

Table 7: Breakdown of total compensation by age bracket and education type, in %

	1982-01	1982-90	1990-95	1995-01
<i>Education</i>				
Tertiary+4	13	10	14	16
Tertiary+2	10	7	11	14
Baccalaureate	13	13	14	14
Mid-high school	29	28	30	29
Low vocational	7	7	7	7
No diploma	27	34	27	20
TOTAL	100	100	100	100
<i>Age bracket</i>				
<25	7	9	6	5
25-34	29	30	29	27
35-54	55	52	56	59
>54	9	9	9	8
TOTAL	100	100	100	100

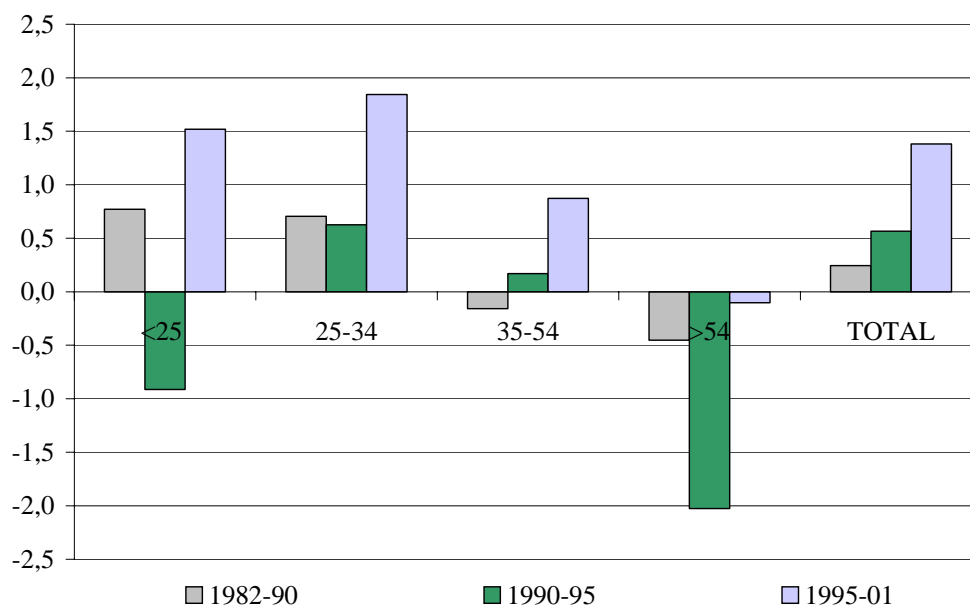
Source: LFS and DADS; National Accounts; CEPII, authors' calculations.

Graph 1: Hourly compensation gap between women & men according to education type,
Hourly compensation of men:100



Source: LFS and National Accounts; CEPII, authors' calculations.

Graph 2: Average annual changes in hourly compensation of college/non college educated, by age bracket, in %



Note: college: tertiary education (>bac+2); non college: high school and below. Total is weighted by the share of hours worked by each age bracket in total hours.

Source: LFS and National Accounts, CEPII, authors' calculations.

Table 8: Relative demand favouring college graduates and supply shifts (college graduates/non college)

- A. Total Economy

	Relative wage bill			Wage premium*0.4 (b)	Supply	Demand (a+b)
	Total (a)	<i>between</i>	<i>within</i>			
1982-01	5.02	0.17	4.85	0.12	4.71	5.14
1982-90	4.55	0.12	4.43	0.11	4.29	4.66
1990-95	5.60	0.05	5.54	0.12	5.30	5.72
1995-01	5.16	0.31	4.85	0.15	4.78	5.31

- B. ICT producer sector

	Relative wage bill	Wage premium*0.4	Supply	Demand
1982-01	8.56	-0.16	8.97	8.40
1982-90	6.72	-0.05	6.84	6.67
1990-95	4.02	-1.65	8.15	2.37
1995-01	15.08	0.96	12.67	16.04

ICT producer = NACE 30, 32, 64, 72 (for a definition of sectors, see table 5).

- C. ICT user sector

	Relative wage bill	Wage premium*0.4	Supply	Demand
1982-01	5.73	-0.13	6.05	5.59
1982-90	6.01	-0.51	7.28	5.51
1990-95	6.13	0.31	5.35	6.44
1995-01	5.01	0.01	4.99	5.02

ICT user = NACE 22, 24, 29, 31, 33,35, 40-41, 65, 66, 67, 71, 73, 74, 90-95 (for a definition of sectors, see table 5).

- D. Other industries:

	Relative wage bill	Wage premium*0.4	Supply	Demand
1982-01	4.19	0.15	3.80	4.34
1982-90	3.57	0.24	2.98	3.81
1990-95	5.46	0.18	5.01	5.63
1995-01	3.95	0.02	3.90	3.97

Note: $\Delta \ln D_t = \underbrace{\Delta \ln \left(\frac{w_h * N_h}{w_u * N_u} \right)}_a + \underbrace{(\sigma - 1) * \Delta \ln (w_h / w_u)}_b$.

w: hourly compensation; N: employment; σ : elasticity of substitution; $\Delta \ln$: growth rate. Supply is the growth rate of hours worked by skilled relative to unskilled labour.

College graduates : tertiary education ; non skilled : baccalaureate, vocational upper secondary education, lower secondary education and below.

Source: LFS and National Accounts; CEPII, authors' calculations.

Table 9: Composition of ICT producer and user sector according to the NACE-Rev.1 classification for France

	ICT producer sector	ICT user sector
<i>France</i>	30, 32, 64	22, 24, 29, 31, 33, 35, 40-41, 65, 66-67, 71-74, 90-95

Note: 30: computers and office machinery; 32: manufacture of radio, TV and communication equipment; 64: Post and Telecommunications;

22: printing and publishing; 24: Chemicals; 29: Manufacture of machinery and equipment; 31: electrical industry; 33: Manufacture of medical, precision and optical instruments, watches and clocks; 35: other transportation means than cars and trucks; 40-41: water, electricity and gas utilities; 65: financial intermediation; 66: insurance and pension funding; 67: Activities auxiliary to financial intermediation; 71-74: business services; 90-95: personal services.

The industries in the ICT user sector have been identified by calculating the ICT investment intensity in each industry (Share of ICT investment in total investment of the industry compared to the share of ICT investment in total investment of total economy).

Table 10: Changes in the share of hours worked by college educated (tertiary education)

% points	1982-01	1982-90	1990-95	1995-01
(1) Between:	0.34	0.06	0.05	0.23
ICT producer sector	0.13	-0.01	-0.01	0.15
ICT user sector	1.09	0.35	0.19	0.55
Other industries	-0.88	-0.27	-0.13	-0.48
(2) Within:	13.39	3.88	4.56	4.95
ICT producer sector	1.17	0.31	0.26	0.60
ICT user sector	4.73	1.81	1.33	1.60
Other industries	7.48	1.76	2.97	2.75
(3) = (1) + (2) Total effect (%)	13.73	3.95	4.61	5.17

$$\Delta S_{DIP} = \underbrace{\sum_{p=1}^p \Delta \frac{H_p}{H} * (\bar{S}_{DIP,p}) + \sum_{u,u \neq p} \Delta \frac{H_u}{H} * (\bar{S}_{DIP,u}) + \sum_{k,k \neq j \neq p} \Delta \frac{H_k}{H} * (\bar{S}_{DIP,k})}_{\text{between}} + \underbrace{\sum_{p=1}^p \Delta S_{DIP,p} * \frac{\bar{H}_p}{H} + \sum_{u,u \neq p} \Delta S_{DIP,u} * \frac{\bar{H}_u}{H} + \sum_{k,k \neq j \neq p} \Delta S_{DIP,k} * \frac{\bar{H}_k}{H}}_{\text{within}}$$

Note: with the notations indicated in the text. The total change in the share of college educated in total hours between 2001 and 1982 is this share in 2001 minus this share in 1982. The average on a variable is the average of its share at the final date and its share at the initial date ($0.5 * (\text{share}_{t-n} + \text{share}_t)$).

Sources: LFS and National Accounts, CEPII, authors' calculations.

Table 11: Change in the share of college educated (tertiary education) compensation

% points	1982-01	1982-90	1990-95	1995-01
(1) Between:	0.65	0.18	0.06	0.42
ICT producer sector	1.02	0.13	0.07	0.82
ICT user sector	1.37	0.73	0.15	0.49
Other industries	-1.74	-0.69	-0.17	-0.89
(2) Within:	18.56	6.31	5.68	6.57
ICT producer sector	1.85	0.48	0.22	1.15
ICT user sector	6.55	2.51	1.94	2.10
Other industries	10.16	3.33	3.51	3.32
(3) = (1) + (2) Total effect (%)	19.21	6.49	5.73	6.99

Note: see table 6.

Sources: LFS and National Accounts, CEPII, authors' calculations.

Table 12: Breakdown of total hours and compensation by sector

	Hours				Compensation			
	producer	user	Other ind.	TOTAL	producer	user	Other ind.	TOTAL
1982-01	3.6	24.6	71.8	100	5.2	27.8	66.9	100
1982-90	3.4	23.3	73.3	100	4.4	27.1	68.6	100
1990-95	3.4	24.6	72.0	100	4.7	28.6	66.7	100
1995-01	3.6	25.9	70.5	100	5.6	29.4	65.1	100

Note: share of sector hours (compensation) in total hours (compensation). For the average, see note of table 6.

Source: LFS and National Accounts, CEPII, authors' calculations.

Table 13: Absolute changes in the college educated hours share by sector

In % points	1982-01	1982-90	1990-95	1995-01
Total economy:	13.7	3.9	4.6	5.2
ICT producer sector	33.7	9.2	7.7	16.8
ICT user sector	19.3	7.8	5.4	6.2
Other industries	10.43	2.4	4.1	3.9

Note: see table 6. Changes in the share of college educated workers in sector total hours. The total economy change is weighted by the share of sectors in the economy.

Sources: LFS and National Accounts, CEPII, authors' calculations.

Table 14: Absolute changes in the college educated compensation share by sector

In % points	1982-01	1982-90	1990-95	1995-01
Total economy:	19.2	6.5	5.7	7.0
ICT producer sector	36.4	11.0	4.7	20.7
ICT user sector	23.2	9.3	6.8	7.2
Other industries	15.2	4.9	5.3	5.1

Note: see table 6. Changes in the share of college educated workers in sector total compensation. The total economy change is weighted by the share of sectors in the economy.

Source: LFS and National Accounts, CEPII, authors' calculations.