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Assessing the contribution of ICT to sectoral economic growth in Belgium: a growth accounting analysis (1991-2000)

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Introduction

The objective of this paper[1] is to assess the impact of information and communications technology (ICT) on economic performance at the sectoral level in Belgium over the period 1990-2000. The growth accounting approach used in the framework of the neoclassical growth theory for the study of the sources of economic growth will be adopted here in order to quantify the impact of ICT use on output and labour productivity growth. Since annual data on ICT capital stock are not readily available, we use data from a number of sources to construct this indicator at the sector level for Belgium over the period 1990-2000. Our findings should indicate (i) to which extent ICT contributed to output and labour growth at the sectoral level in Belgium in the 1990s and (ii) whether industries making intensive use of ICT performed better then non-intensive ICT ones over the same period.

Some remarks are made below about (i) the sectoral orientation of our study, (ii) the focus being on the use of ICT rather than its production and (iii) the implications of the utilization of the growth accounting approach as far as the implications of the New Economy on growth dynamics are concerned. We believe that these remarks will clarify the aim of our study and justify, therefore, the methods and data used in this paper.

First, it is commonly believed that a country need not produce ICT goods in order to benefit from the positive effects of the new technologies on its growth. These goods can simply be imported from abroad and used by firms in the importing country[2]. So, the limited share in GDP of sectors producing ICT goods should not be an obstacle for the new technologies to exert a positive impact on economic performance, nor for being able to quantify this impact.

This is of course not to deny that the existence of an ICT-producing sector can exert positive effects on economic performance. Besides the positive impact of supplier-user relationships on the efficiency of the innovation and production process of ICT goods and on their subsequent diffusion rate, high rates of TFP growth in ICT-producing industries contribute directly to the growth at the aggregate level. This last point however, concerns less a small open economy like Belgium when it comes to assess the impact of ICT on its economy[3]. Moreover, it is of rather limited interest when it comes to assess the impact of ICT utilization on economic performance.

1. This paper is part of the research program 'Transitie naar de informatiemaatschappij: perspectieven en uitdagingen voor België', financed by the SSTC-DWTC (S2/64/01).
2. OECD (2003) points out that " … *a large part of benefits of ICT production has occured to importing countries and other users, due to terms-of-trade effects and an increased consumer surplus* (p. 26)"
3. As pointed out in OECD (2003), entry costs into the computer industry explain that only a handful countries became producers of computer hardware.

The approach adopted in our paper to quantify the impact of ICT use on economic performance at the sectoral level is similar to those used in other studies[1]: first, we quantify the contribution of ICT capital stock to output and labour productivity growth and compare it with the contribution of other factors of production. Second, we identify sectors that are intensive users of ICT assets and check whether the contribution of ICT to economic performance is more important in those sectors than in sectors that are non-intensive users of ICT[2].

In some studies, the impact of ICT use on growth is assessed on the basis of the contribution of ICT-using sectors to *aggregate* growth[3]. However, the link between the extent to which ICT contributes to growth *within* an industry – which is the aim of our analysis – and the contribution of ICT-intensive industries to aggregate growth seems best to be an approximate one. Indeed, besides ICT use, this contribution depends on many other factors including the evolution of the share of ICT-intensive industries in GDP. Besides, it is extremely difficult to disentangle the role of new technologies from other factors in this contribution to aggregate growth. Therefore, we decided not to use this aforementioned method in our paper[4].

Secondly, the growth accounting approach used in this paper in order to decompose output and labour productivity growth into their components has some limitations. Its successful implementation requires the imposition of assumptions of constant returns to scale and competitive output and input markets. More fundamentally, externalities due to the utilization of a production factor can not be accounted for by this method. This is a major caveat as far as measuring the impact of new technologies on growth is concerned. Indeed, in the framework of the growth accounting approach, contribution of ICT use to growth is explained solely by rapid ICT capital accumulation, itself being the result of profit-maximizing response of producers to rapidly falling quality-adjusted prices of ICT equipment. These falling prices reflect better performance and new characteristics of ICT goods and are the result of rapid technological progress in ICT-producing sectors, and especially in the computer equipment industry. They can be seen as “pecuniary externalities” and integrated easily in the traditional neoclassical framework if hedonic prices for ICT capital goods are available.

This framework, however, provides no special role for ICT capital in the growth process: its contribution to economic growth is simply function of its rate of accumulation like any other input. Consequently, it might explain the strong labour productivity growth observed in industrialized economies in the 1990s but hardly Total Factor Productivity (TFP) growth. We can expect, however, that the resurgence of a new techno-economic paradigm such as the New Economy should influence economic growth in more fundamental ways through such channels as ICT-related production spillovers or network effects. These “non-pecuniary externalities” would exert an impact on growth through their impact on TFP growth. Such non-traditional effects can not be accounted for within the

1. See Van der Wiel (2002) and Cette et al. (2001) for two studies at the sector level.
2. Such an outcome should be observed if ICT use is to contribute positively to economic growth at the sector-level.
3. See Pilat et al. (2002), Van Ark et al. (2002) and OECD (2003).
4. Pilat (2003) admits that mainly problems related to data availability motivates the use of this method: “*A more systematic method would be to examine the link between ICT use and productivity performance by industry. However, estimates of ICT capital by industry are currently only available for some countries*”. An effort is made here to alleviate this problem for Belgium by constructing capital stocks for two different ICT assets over the period 1990-2000.

framework of the growth decomposition method used in paper[1]. Hence, an assumption of non-existence of spillovers or externalities linked to ICT-use is made implicitly each and every time this method is used in order to assess the contribution of ICT to economic growth.

Thirdly, we use industry-level data in our study in order to measure the contribution of ICT capital to economic performance[2]. This down-top approach has a number of advantages when it comes carry out a study aimed at measuring the impact of new technologies on growth[3]. Indeed, since both output/productivity growth and ICT intensity vary to a large extent among industries, a possible link between these variables might be lost if data at the aggregate level are used in the analysis. According to Stiroh (2002), this is one reason why "earlier research on the economic impact of ICT at disaggregated levels typically found a substantial impact, why earlier aggregate studies did not (p. 6)[4]". The loss of heterogeneity when data at higher levels of aggregation are used in the analysis– implying that ICT-intensive industries are combined with less intensive ones – might obscure the productive impact of ICT. These considerations motivated the use of data at the sector-level in our analysis of the impact of ICT on output and productivity growth in Belgium.

The rest of the paper is organized as follows. Section 2 introduces the methodology and data used in our study in order to measure the contribution of ICT to output and labour productivity growth. Section 3 presents growth accounting estimates at the sector level while section 4 compares findings obtained for ICT-intensive industries with those obtained for non-intensive ones. Section 5 concludes the paper.

1. Of course, if they exist, externalities will show up as part of the TFP growth term. Using time series at the sector level for the US economy over the period 1973-1999, Stiroh (2002) finds no evidence of such externalities, contrarily to Mun and Nadiri (2002) who does using data over the period 1984-2000.
2. For other studies which use growth accounting analysis in order to measure the contribution of ICT to growth at the sector level, see Van der Wiel (2002) for the Netherlands, Cette et al. (2001) for France and Kegels et al. (2002) for Belgium. For econometric studies using industry-level data, see Stiroh (2002 & 2002a), and Mun & Nadiri (2002) for the US economy.
3. See Stiroh (2002a).
4. He also reports evidence obtained by other studies showing that the estimated output elasticity of computers is larger when more disaggregated data are employed.

I Methodology and Data

In Section II, *we first introduce the growth accounting* methodology used in existing studies in order to assess the contribution of the "New Economy" to economic growth.[1] Carrying out a growth decomposition exercise with the aim of isolating the contribution of ICT to growth requires data on (a) ICT and non-ICT capital stocks, since the impact of ICT on economic growth is a function of the growth rate of ICT capital stock, and on (b) the respective shares of these two different capital assets in the remuneration paid to all factors of production (to be used to weight their respective growth rates). Since no annual data on these two variables are available, they will have to be estimated from available data. Data sources used to construct these variables will be discussed in a second subsection.

A. Growth accounting methodology

1. Decomposition of output growth

Suppose that the relationship between output and inputs is given by the following production function F:

$$Q = AF(K,L) \tag{1}$$

where Q is output, L is labour input, K is the capital stock which includes ICT as well as non-ICT capital goods - and A measures disembodied technological change. Taking logarithms of both sides and differentiating with respect to time, it can be shown that:[2]

$$\hat{Q} = s_L\hat{L} + s_K\hat{K} + \hat{A} \tag{2}$$

where hatted variables indicate instantaneous or continuous rates of change and where s_L and s_K are labour's and capital's share in total cost, respectively.

In equation (2), the growth rate of output is the sum of the following three components: (i) the rate of change of labour, weighted by its income share (ii) the rate of change of capital stock, weighted by its income share, and (iii) the growth in total factor productivity.

1. See Cette *et al.* (2000) for *France*; Kegels et al. (2002) for *Belgium*, Jorgenson & Stiroh (2000) and Oliner & Sichel (2000) for *USA*; CPB (2000) for the *Netherlands*; Roeger (2001) for the *European Union*; Daveri (2001) and Schreyer (2000a, 2001) for *OECD countries*.
2. An assumption of competitive product and input markets has to be made, as well. For the derivation of this equation, see Berthier & Heckel (2000), p. 14.

However, if we wish to assess the contribution of ICT capital to output growth, we have to distinguish between ICT and non-ICT capital stocks, to be noted by K_{ICT} and K_{OTH}, respectively. Then, equation (2) reads:

$$\hat{Q} = S_L(\hat{L} + S_{ICT}\hat{K}_{ICT} + S_{OTH}\hat{K}_{OTH} + \hat{A}) \quad (3)$$

Van Zandweghe et al. (2001) distinguishes three different types of ICT capital goods: information technology (IT) hardware, communications equipment, and software. Therefore, equation (3) can be written as follows:

$$\hat{Q} = S_L(\hat{L} + S_H\hat{K}_H + S_C\hat{K}_C + S_S\hat{K}_S + S_{OTH} + \hat{K}_{OTH} + \hat{A}) \quad (4)$$

where K_H, K_c and K_S are capital stocks corresponding to each of the three ICT assets introduced previously (i.e. IT hardware, communications equipment, and software). Similarly, S_H, S_C, and S_S represent the share of each ICT capital good in total cost. Since total cost equal total revenue under constant returns to scale, these weights represent also income shares, so that $S_L + S_H + S_C + S_S + S_{OTH} = 1$.

According to equation (4), the growth rate of an input must be weighted by its share in total income or cost in order to measure its contribution to output growth. We examine below methods used for the calculation of these two elements, i.e. capital stocks and their shares in total income.

2. Construction of capital stock series

Once services produced by a capital asset are assumed to be proportional to its stock, it is necessary to construct a variable that measures the productive capacity of capital. The productive capital stock for asset *i* at time *t* will be noted by $K_{i,t}$ and will be calculated according to equation (5):

$$K_{i,t} = \sum_{\tau = 0} h_{i,\tau}F_{i,\tau}\left(\frac{IN_{i,t-1-\tau}}{q_{i,t-1-\tau,0}}\right) \quad (5)$$

Denoting the term between brackets in equation (5) by $I_{i,t-\tau}$, equation (5) shows that the capital stock for asset *i* at time *t* is function of the following variables:

- **Real investment expenditure on asset type *i* at time** τ, $I_{i,t-1-\tau}$, obtained by deflating nominal investment expenditure $IN_{i,t-1-\tau}$ by a price index for *new* capital goods of type *i* at time $t-\tau$, $q_{i,t-1-\tau,0}$;
- **A retirement function** $F_{i,\tau}$ that indicates the share of assets of age τ that are still in service in period *t*. Note that $F_{i,\tau}$ is declining in τ (i.e. $F_{i,\tau} > F_{i,\tau+1}$) and is included between *unity* (when all assets of a particular vintage are all in service) and *zero* (when all assets of a particular vintage have been discarded);
- **An age-efficiency profile** $h_{i,\tau}$ that traces the loss in efficiency as asset *i* ages. Note that $h_{i,\tau} > h_{i,\tau+1}$ and this gap depends on the specific age profile of asset efficiency.

These last two elements can be selected from available retirement functions and age-efficiency profiles used in economic studies.[1] Once this has been done, the calculation of capital stock series for asset *i requires time series data on nominal investment in asset i and on price index for new capital goods of type i.*

3. Calculation of cost shares

In equation (4), the growth rate of each input must be weighted by its cost share in order to evaluate its contribution to the growth of output. As pointed out earlier, under the assumption of constant returns to scale, total cost is equal to total income, and cost and income shares coincide. Therefore, by omitting time subscripts, we have:

$$pQ = \mu_H K_H + \mu_c K_c + \mu_s K_s + \mu_{OTH} K_{OTH} + wL \tag{6}$$

where Q, p and *w* are output volume, price index of output, and wage rate, respectively. The price index of services produced by K_H, K_C, and K_S are denoted by μ_H, μ_C, and μ_S, respectively. The share of each input in total income is:

$$S_L = \frac{WL}{pQ} \tag{7}$$

and

$$S_i = \frac{\mu_i KN_i}{pQ} \tag{8}$$

where i=H, C, S, OTH and KN_i is the *nominal* productive capital stock of asset *i*, calculated by replacing the constant-price investment data in equation (5) by nominal investment data.

Contrary to services produced by the labour input, the price paid for capital services are not observed on the market since, in general, capital goods are owned by producers. Therefore, the price of capital services, to be called "user cost of capital" in the sequel, has to be imputed. In a well functioning capital market, the user cost is defined as follows:[1]

$$\mu_{i,t} = q_{i,t}\left(r + d_{i,t}\frac{-\Delta q^e_{i,t+1}}{q_{i,t}}\right) = q_{i,t}(r + d_{i,t}) - \Delta q^e_{i,t+1} \tag{9}$$

User cost is composed of the opportunity cost of investing money in financial (or other) assets rather than in capital goods (r), the loss in market value of capital good *i* due to ageing (captured by the depreciation rate $d_{i,t}$), and the expected gain or loss due to changes in price of capital asset i, $\frac{\Delta q^e_{i,t+1}}{q_{i,t}}$. The expression in brackets in equation (9) represents "*the gross rate of return that a capital good has to earn in a well-functioning market*[2]".

1. For a review of the state of the art for constructing capital stocks, see Meinen et al. (1998) et OECD (2001).
1. See Bassanini *et al*. (2000), Schreyer (2000b), and Bisciari (2001).
2. Schreyer (2000b), p. 14.

B. Data used for the implementation of growth accounting exercise

1. ICT investment series in current prices

For each ICT asset, i.e. IT equipment and communications equipment[1], the macrocosmic investment series are obtained indirectly, starting from the condition that domestic supply equals domestic use:

$$Q_{it} + M_{it} - X_{it} + W_{it} + (T_{it} - S_{it}) = CJ_{it} + C_{it} + I_{it} + DS_{it} \qquad (10)$$

On the left hand side of this equation, Q_{it}, M_{it} and $X_{i,t}$ respectively stand for domestic production, imports and exports of the asset, and the difference between total supply and exports ($Q_{it} + M_{it} - X_{it}$) denotes domestic supply. The remaining terms are margins W_{it} and $(T_{it} - S_{it})$ net taxes, accounting for the fact that total supply is measured at basic prices whereas use is measured at acquisition prices. Domestic use is described on the right hand side: CJ_{it} denotes intermediate consumption, C_{it} is final consumption, I_{it} is investment and DS_{it} gives the change in stocks.

Unlike data on investment, detailed data on the import and export of goods are readily available for the period 1978-2000. Detailed production data are available for the period 1994-2000 from the National Bank of Belgium and the growth rate of imports of each asset is used for the retropolation of production for each ICT asset[2]. Thus, time series of domestic supply at basic prices are obtained for each ICT asset covering the period 1978-2000[3].

Investment in IT and communications equipment is at present only available for the year 1995 from the detailed input-output investment table. Therefore, estimates of investment in IT and communications equipment for the period 1978-2000 are calculated by adjusting domestic supply by the amount of investment per euro of domestic supply in 1995:

$$I_{it} = \frac{I_{i,95}}{Q_{i,95} + M_{i,95} - X_{i,95}}(Q_{it} + M_{it} - X_{it}) \qquad t = 1978 - 2000 \qquad (11)$$

The only year for which data on ICT investment are available on a sectoral basis is 1995. Productive capital stock series at the sector level and over the period 1990-2000 have been calculated as follows: using data from the 1995 input-output table of the Belgian economy, the share of each sector in total ICT investment was calculated for 1995 and multiplied with the ICT investment expenditures calculated at the macro level in Section 2. These calculations provide us with nominal investment series in IT and communications equipment from 1978 to 2000.

1. Since data on software investment are available only from 1995 to 2000, productive capital stock series for this asset are not constructed in this paper.
2. For IT equipment, the ratio of domestic production over imports equals 0.24 on average for 1994-2000. For communications equipment this ratio is larger, namely 0.81. The ratios of both assets declined, however, over the given period.
3. See Pamukçu and Van Zandweghe (2002).

2. ICT investment series in constant prices

The hedonic method is a statistical tool for developing standardised per unit prices for goods - such as ICT assets - whose quality and characteristics change rapidly over time. According to this method, heterogeneous goods can be redefined as aggregations of their characteristics, so that changed models or new models of a good can be represented as a new combination of characteristics. In practice, this approach analyses the relationship between price and quality by regressing prices on explanatory variables that represent important product characteristics.

Since no hedonic price indices are available for ICT assets in Belgium, a solution consists of using the so-called "harmonised deflator" for each ICT capital good in order to obtain quality-adjusted price indices. At least two different methods are available and both take the U.S. hedonic indices as a benchmark[1].

We will retain here the assumption that the change of the relative price of an ICT asset should be the same across countries. The relative price is expressed as the price level of the ICT good divided by the price level of non-ICT goods. Let the rate of change of the price index of good *i* in country *j* be expressed as $\dot{q}_i^j$ and let N denote non-ICT goods. Then the rate of change of the harmonised price index of Belgium is given by:

$$\dot{q}_{ICT}^{B} = \dot{q}_{N}^{B} + \dot{q}_{ICT}^{US} - \dot{q}_{N}^{us} \tag{12}$$

3. ICT and non-ICT capital stock series

The productive capital stock of asset type i in period t is:

$$K_{i,t} = \sum_{\tau=0}^{T} h_{i,\tau} F_{i,\tau}\left(\frac{I_{i,t-1-\tau}}{q_{i,t-1-\tau}}\right) \tag{13}$$

where $\frac{I_{i,t-1}}{q_{i,t-1}}$ is constant-quality volume investment in asset i in year t-1, which becomes part of the capital stock at the beginning of year t. Furthermore, T is the maximum service life, $h_{i,\tau}$ is an age-efficiency profile, and $F_{i,\tau}$ is a retirement function that gives the proportion of assets of age τ still in service at time t. For the construction of capital stocks over the period 1970-2000, INR (2002, p. 20) uses a bell-shaped retirement function. However, to save observations we make the simplifying assumption that the assets' mortality is characterised by simultaneous exit (i.e. deterministic mortality):

$$\tilde{F}_{i,\tau} = \begin{cases} 1 & i = 1 \ldots L \\ 0 & \text{otherwise} \end{cases} \tag{14}$$

1. See Pamukçu and Van Zandweghe (2002) for a discussion.

where L denotes the average service life, assumed equal to 5 years for IT equipment and 11 years for communications equipment. If $F_{i,\tau} = \tilde{F}_{i,\tau}$, the capital stock becomes:

$$K_{i,t} = \sum_{\tau=0}^{L} h_{i,\tau}\left(\frac{I_{i,t-1-\tau}}{q_{i,t-1-\tau}}\right) \tag{15}$$

Regarding the choice of the *age-efficiency profil*e, two common profiles are the hyperbolic and the geometric age-efficiency profile. Although the geometric pattern is appealing because it simplifies the calculations, the hyperbolic profile is often regarded as more realistic. Assets with a hyperbolic age-efficiency profile lose relatively more of their productive value towards the end of their service life, whereas assets with a geometric deterioration lose relatively more productive value in the beginning of their service life. In the calculations presented here, a hyperbolic age-efficiency profile is used, specified by:

$$h_{it} = \frac{T - t}{T - \beta t} \tag{16}$$

Here β is set to 0.8 and the maximum service life T = 1.5L, as in Colecchia and Schreyer (2001). INC (2002: 19) assumes that T = 2L for its calculation of the stock of non-ICT assets, but judging from the low resulting depreciation rates this seems too long for ICT equipment.

The *user cost* of each ICT capital asset is needed to obtain the share of the asset in total income. It is given by:

$$\mu_{i,t} = (r + \delta_{i,t} + \dot{q}_{i,t})q_{i,t} \tag{17}$$

and depends on the internal rate of return r, the asset's depreciation rate $\delta_{i,t}$ and the percent change in market value of the asset $\dot{q}_{i,t}$. The latter is obtained as a 3-year moving average of the harmonised price indices.

The rate of *depreciation* is calculated as follows. Once the functional form of the age-efficiency profile has been decided on, the age-price profile can directly be derived from it, using the result that the value of an asset depends on the expected stream of revenue provided over its service life. The age-price profile is used to calculate the net capital stock, in the same way as the age-efficiency profile is applied to calculate the productive stock. Since the change in the net stock consists of investment minus depreciation, the amount of depreciation is readily derived, and the depreciation rate is calculated as the ratio of the level of depreciation and the net stock. More details can be found in OECD (2001a). As suggested there, the real discount rate needed for the calculation of the age-price profile has been set to 0.04. The nominal or internal *rate of return* can be calculated as the ex-post rate that exhausts all non-labour income in the production account. That requires solving the following equation for r_t:

$$P_tQ_t - w_tL_t = \sum_i \mu_{i,t}K_{i,t} = r_t\sum_i q_{i,t}K_{i,t} + \sum_i (d_{i,t} - \dot{q}_{i,t})q_{i,t}K_{i,t} \tag{18}$$

II Contribution of ICT to sectoral economic growth in Belgium: discussion of findings at the seven sector level

Figures and graphics reported in the following pages show the contribution of labour,[1] non-ICT and ICT capital, as well as of Total Factor Productivity (TFP), to value added (VA) and labour productivity growth.[2] These contributions are measured in percentage points at the sector and aggregate level[3]. They are reported for the period 1991-2000, as well as separately for the first and second half of the 1990s.

We observe a general pick-up in economic growth at the sector as well as at the aggregate level during the period 1996-2000, of which a considerable part is due to the positive contribution of labour and TFP growth. The contribution of ICT capital to VA growth over both sub-periods is positive and rises from the first to the second half of the 1990s.

1. labour is measured by the number of employees since data on hours worked are not available at the sector level. This is the reason why our estimates differ slightly from those obtained in Kegels et al. (2002). After the growth accounting exercise was implemented, the Institute for National Accounts has published new data on employment, including data on hours worked. Using these data might have changed the results, especially at the sector level.
2. By definition, "labour" is not taken into account while examining the determinants of labour productivity growth.
3. In Table 1, findings of the growth accounting analysis are reported at the seven sector level. Detailed results for thirty one sectors are reported in Tables 8 and 9 of the appendix.

TABLE 1 - Decomposition of value added growth at the 7 sector level *(%)*

Sector	1991-00	1991-95	1996-00	Sector	1991-00	1991-95	1996-00
Agriculture				**Industry**			
Labour	-0.19	-0.13	-0.15	Labour	-0.96	-1.65	-0.32
ICT capital	0.22	0.17	0.26	ICT capital	0.55	0.45	0.61
Non-ICT capital	-2.28	-1.84	-2.72	Non-ICT capital	0.92	1.15	0.67
TFP growth	5.10	5.88	5.57	TFP growth	1.63	0.63	2.43
	2.85	**4.07**	**2.97**		**2.13**	**0.59**	**3.39**
Construction				**Transport, Communication and Trade**			
Labour	0.53	0.84	0.62	Labour	-0.01	-0.33	0.36
ICT capital	0.30	0.25	0.32	ICT capital	1.30	1.13	1.39
Non-ICT capital	1.28	1.35	1.21	Non-ICT capital	0.71	0.96	0.45
TFP growth	-0.74	-1.89	1.12	TFP growth	-1.43	-1.68	-0.10
	1.37	**0.55**	**3.27**		**0.57**	**0.07**	**2.10**
Finance, Insurance and Real Estate				**Public administration and education**			
Labour	0.80	0.76	0.78	Labour	0.38	-0.56	1.30
ICT capital	0.55	0.46	0.58	ICT capital	0.08	0.07	0.09
Non-ICT capital	1.54	1.56	1.53	Non-ICT capital	-0.02	-0.01	-0.03
TFP growth	0.93	0.95	1.10	TFP growth	0.91	1.84	-0.06
	3.82	**3.72**	**3.99**		**1.35**	**1.33**	**1.30**
Services n.e.c.				**Economy**			
Labour	2.79	1.68	3.79	Labour	0.29	-0.13	0.72
ICT capital	0.15	0.07	0.23	ICT capital	0.54	0.45	0.60
Non-ICT capital	-0.26	-0.79	0.23	Non-ICT capital	0.67	0.76	0.57
TFP growth	-2.17	-2.72	0.56	TFP growth	0.51	0.23	1.15.
	0.52	**-1.77**	**4.82**		**2.01**	**1.31**	**3.04**

At the aggregate level, the contribution of ICT capital to VA growth over the period 1991-2000 (2.01%) is equal to 0.54 point, which makes it the second most important factor explaining growth after non-ICT capital (0.67 point). However, the contribution of ICT capital rises from 0.45 to 0.60 point from the first to the second half of the decade, while the contribution of non-ICT capital diminishes from 0.76 to 0.57 point over this same period.

TABLE 2 - Decomposition of labour productivity growth at the 7 sector level *(%)*

Sector	1991-00	1991-95	1996-00	Sector	1991-00	1991-95	1996-00
Agriculture				**Industry**			
ICT capital	0.24	0.18	0.28	ICT capital	0.60	0.54	0.63
Non-ICT capital	-0.71	-0.65	-1.57	Non-ICT capital	1.51	2.10	0.88
TFP growth	5.10	5.88	5.57	TFP growth	1.63	0.63	2.43
	4.64	**5.42**	**4.29**		**3.73**	**3.28**	**3.94**
Construction				**Transport, Communication and Trade**			
ICT capital	0.28	0.22	0.31	ICT capital	1.30	1.18	1.34
Non-ICT capital	0.89	0.76	0.73	Non-ICT capital	0.71	1.15	0.24
TFP growth	-0.74	-1.89	1.12	TFP growth	-1.43	-1.68	-0.10
	0.43	**-0.91**	**2.16**		**0.59**	**0.64**	**1.49**
Finance, Insurance and Real Estate				**Public administration and education**			
ICT capital	0.47	0.38	0.52	ICT capital	0.08	0.07	0.09
Non-ICT capital	-0.13	-0.01	-0.13	Non-ICT capital	-0.08	0.07	-0.22
TFP growth	0.93	0.95	1.10	TFP growth	0.91	1.84	-0.06
	1.28	**1.31**	**1.49**		**0.92**	**1.98**	**-0.19**
Services n.e.c.				**Economy**			
ICT capital	0.14	0.06	0.22	ICT capital	0.53	0.46	0.56
Non-ICT capital	0.32	-0.43	0.99	Non-ICT capital	0.48	0.85	0.07
TFP growth	-2.17	-2.72	0.56	TFP growth	0.51	0.23	1.15
	-1.70	**-3.09**	**1.77**		**1.51**	**1.54**	**1.79**

A. Agriculture, forestry and fishing

TFP is the major driver of growth in this sector, both for the growth of VA and labour productivity. The contribution of non-ICT capital to VA and labour productivity growth is negative and this negative impact rises – in absolute values – from the first to the second sub-period. In contrast, the contribution of ICT capital to both performance indicators is positive and rises slightly from the first to the second half of the 1990s.

B. Industry (manufacturing, electricity, water and gas supply)

Over the period 1991-2000, the contribution of TFP to both performance indicators exceeds that of the capital, with a strong increase from the first to the second period. The contribution of non-ICT capital exceeds that of the ICT capital over the period 1991-2000, but this is the result of a weaker contribution of non-ICT capital during the first period compared with the second. During the period 1996-2000, contributions of these two capital items are comparable, with the contribution of ICT capital increasing slightly from the first to the second period.

C. Construction

The contribution of TFP to VA growth during the 1990s is negative, resulting from a positive contribution during 1991-1995 and a negative one during 1996-2000. The contribution of non-ICT capital is higher than that of ICT capital during both sub-periods and it diminishes slightly from 1991-1995 to 1996-2000 while the contribution of ICT increases slightly over this same period.

D. Trade, transport and communication

The contribution of ICT capital to VA growth (1.30 points) exceeds that of the non-ICT capital (0.71 point) over the entire period 1991-2000. Also, the contribution of ICT capital to both performance indicators rises from the first to the second sub-period while that of ICT capital diminishes. The significant positive impact of ICT capital offsets the negative contribution of TFP growth during the first sub-period. This sector has experienced the strongest contribution of ICT capital to VA as well as to labour productivity growth. The important contribution of ICT capital is due to the extensive use of ICT goods in the trade and communication sectors (see tables 8 and 9 in the appendix). Note that the negative contribution of TFP to both VA and labour productivity growth observed during the 1991-1995 period diminishes strongly during the period 1996-2000.

E. Financial intermediation, real estate, renting and business activities

The contribution of each factor to VA growth is positive over both periods, with ICT capital's contribution being less important than those of other factors although this contribution rises slightly from the period 1991-1995 (0.46 point) to 1996-2000 (0.58 point). The contribution of ICT capital to labour productivity growth is positive over both periods while that of non-ICT capital is negative.
The contribution of ICT capital to growth of VA and labour productivity is probably stronger in the sole finance sector since we believe that firms therein have extensively invested in ICT goods, like in other European countries. We cannot, however, calculate this impact since we do not have data for this sector alone.

F. Public administration and education

The contributions of non-ICT and ICT capital to VA growth over both periods are weak. The positive contribution of labour over the period 1991-2000 (0.38 point) results from a negative one during the period 1991-1995 (-0.56 point) and a positive one during 1996-2000 (1.30 points). A for the TFP growth, a significant positive contribution to VA growth during the first period vanishes during the second period. The contribution of TFP growth (1.84 points) explains almost all the labour productivity growth during the period 1991-1995, with this contribution being equal to -0.19 percentage point during 1996-2000.

G. Services n.e.c.

Over the period 1991-2000, the contribution of ICT to VA and labour productivity growth in the remaining service industries ranks second after the contribution of labour. However, the contribution of ICT capital to the economic performance of the health sector and personal services is strong, which points out the extensive use of ICT goods in these sectors.

III Contribution of ICT to sectoral economic growth in Belgium: ICT-intensive *versus* non-intensive industries

A. Identification of ICT-intensive sectors

Criteria used in empirical work in order to classify sectors according to their ICT intensity are presented in Table 3 In this paper, four indicators, based on ICT capital stock and calculated with available data, have been used for the identification of ICT-intensive sectors in Belgium economy for the year 1995. Detailed results are presented in Table 10 in the appendix.

TABLE 3 - Survey of criteria used for identifying ICT-intensive sectors

	Stiroh (2002)	Van Ark (2001)	Van der Wiel (2001)	Vijselaar & Albers (2002)
1. Share of ICT capital in total capital*	x		x	x
2. Share of ICT capital in value-added* (in constant prices)			x	
3. ICT capital divided by hours worked* (in constant prices)			x	
4. ICT investment divided by value added* (in constant prices)		x		x
5. ICT capital divided by the economy-wide capital stock**	*			

* Both variables are calculated at the sector level.

** Sector specific ICT capital divided by capital stock at the macro level.

Based on the figures reported in Table 10 of the appendix, we calculated three indicators that measure ICT intensity for 31 industries of the Belgian economy for 1995 and divided each sector-specific value by the corresponding economy-wide value. The results are reported in Table 4 below.

TABLE 4 - Criteria for identifying ICT intensive sectors in Belgium (1995)*

	Capital-labour ratio	Capital-output ratio	Share of ICT capital**
A	0.45	0.19	0.21
B	0.84	1.02	0.98
CB	0.38	0.33	0.81
DA	0.64	0.72	0.98
DB	0.37	0.74	1.00
DC	0.22	0.40	0.79
DD	0.41	0.62	0.56
DE	1.32	1.40	2.00
DF	4.83	2.03	2.11
DG	0.99	0.66	1.37
DH	0.65	0.66	0.63
DI	0.48	0.50	0.66
DJ	0.43	0.49	0.75
DK	0.41	0.53	0.89
DL	1.66	1.76	2.77
DM	0.32	0.39	0.73
DN	0.34	0.59	0.57
EE	4.53	1.55	0.93
FF	0.19	0.23	0.70
GG	1.11	1.09	2.69
HH	0.92	1.20	1.58
II	4.23	4.96	6.42
JJ	1.24	0.86	1.45
KK	2.22	0.67	0.32
LL	0.17	0.28	0.16
MM	0.02	0.03	0.04
NN	0.37	0.61	1.81
OO	1.34	1.80	3.15
Economy	**1.00**	**1.00**	**1.00**

* For each sector, the value of each indicator is divided by its economy-wide value.

** CT capital at the sector level divided by total capital at the sector level.

A value superior to unity for a sector means that this indicator takes a value that is superior to the value for the whole economy. On the basis of Table 4, we classified a sector as an ICT-intensive one if at least *two* of the three indicators presented in Table 4 take a value that is superior to unity.[1] Consequently, based on these indicators; the following eight industries have been classified as ICT-intensive sectors[2]:

- Manufacture of paper products, publishing, printing and reproduction of recorded media (DE)
- Manufacture of coke, refined petroleum products and nuclear fuel (DF)
- Manufacture of electronic and electronic component (DL)
- Wholesale and repair trade (G)
- Hotels and restaurants (H)
- Transport, storage and communications (I)
- Financial intermediation (J)
- Health and social work (N)
- Other community, social and personal service activities (O)

These industries have then been aggregated into four sectors: "ICT-intensive services", "other services", "ICT-intensive manufacturing" and "other manufacturing".

B. Results

1. Value added growth

One clear trend comes out from the growth accounting analysis when we distinguish between sectors that use intensively ICT and those that do not.

Compared to its impact on non-intensive ICT users, the impact of ICT on value added growth, which is measured by the contribution of ICT capital to output growth in the framework of growth accounting analysis, is larger for ICT-intensive sector as a whole, as well as for manufacturing and services industries that are intensive users of ICT (see Table 5). The contribution of ICT to the growth performance of ICT-intensive industries is at least three-times larger than its contribution to the growth of non-intensive users. This observation holds for the whole period 1991-2000, as well as for both periods 1991- 1995 and 1996-2000.

Independently of the level of sectoral aggregation and of the period analyzed, a striking characteristic of the contribution of the ICT to value added growth capital is that it is always positive and its size increases from 1991-1995 to 1996-2000. This indicates that utilization of ICT contributes positively to the increase of the growth rate observed in the Belgian economy in the second half of the 1990s. Once again, this observation holds for sectors that are both intensive and non-intensive users

1. The rationale behind this rule is that we did not want any extreme value for only one year, i.e. 1995, to bias our results.
2. Note that the *electricity-gaz-water* industry (E) has not been classified as an ICT-intensive sector although it satisfied to the aforementioned criteria. The reason is that it has also been classified as a non-ICT intensive sectors by Van der Wiel (2002) and that calculations made on the basis of sector-level US data show that the first two indicators are inferior to the corresponding economy-wide value in 1995 for this sector: see BEA (2002).

of ICT. The magnitude of the contribution of the ICT-capital is lower, however, than the contribution of TFP growth[1].

Another striking finding is that the impact of ICT capital on growth is more important in ICT-intensive than in non-intensive users, not only in absolute terms, but also in relative terms, i.e. in proportion of the rate of growth of each sector. For example, ICT explain 74% of the growth rate in ICT-intensive sector as a whole (13% in the remaining sectors), 66% in the ICT-intensive manufacturing sector (18% in non-ICT intensive manufacturing) and 75% in ICT-intensive services sector (16% in non-ICT intensive services). This points out once again to the important positive contribution of ICT to economic growth in sectors that use them intensively. This observation holds also for the period 1991-1996 and, to a lesser extent, for the second half of the 1990s when the contribution of to TFP growth to value added growth increases strongly.

We also observe that the annual average growth rate in sectors that are not intensive users of ICT is more important than in ICT-intensive sectors. This may indicate that ICT use is but one of the determinants – however important it may be - of economic growth in Belgium. The growth performance differential between these sectors diminishes, however, from the first to the second half of the 1990s. After labour and TFP growth, ICT-capital ranks is the third factor that contributes most to the pick-up of growth in Belgium during the period 1996-2000. Similar development seems to have taken place in the Netherlands over the same period[2].

2. Labour productivity growth

As is the case with contribution of ICT to output growth, we observe that the contribution of ICT-capital to the growth of labour productivity is more important in ICT-intensive industries than in non-intensive ones. This finding is valid for the whole ICT-intensive sector as well as for the whole services and manufacturing industries that use intensively ICT equipment. It concerns the whole period 1991-2000, as well as both periods. Once again, the impact of ICT on productivity growth in ICT-intensive industries is at least three-times larger than the one observed in non-intensive users.

These findings also hold in relative terms, i.e. whenever the impact of ICT is measured in proportion of the productivity growth. For ICT-intensive industries, the contribution of ICT-capital to productivity growth rate of 0.57% during 1991-2000 is 1.03 percentage points, which is reduced to some extent by the negative contribution of 0.58 points due to TFP growth. This trend is representative of what is going on during both sub-periods: the rate of productivity growth in ICT-intensive sector is 0.99% during 1991-1995 and ICT-capital explains 0.92 point thereof. During the period 1996-2000, ICT-capital contributes by 1.07 points to a labour productivity growth rate of 0.76%, the negative effect being due now to non-ICT capital. For sectors that are non-intensive users of ICT, the contribution of ICT capital to productivity growth is much lower (see Table 6).

1. Note that TFP growth might simply be due to end of recession rather than genuine productivity growth.
2. See Van der Wiel (2002), p. 33.

As observed for value added growth, the contribution of ICT-capital to productivity growth is always positive and increases from the first to the second half of the 1990s. This observation holds for industries that are intensive-users of ICT as well as those that are not.

Once again, annual average growth rate (AAGR) of labour productivity is higher in sectors that are non-intensive ICT users than those that are intensive ICT users. This result is explained mostly by the growth performance of ICT-intensive services sector: AAGR of this sector over the period 1991-2000 equals 0.31% whereas that of the non-intensive services equals 1.53%. As for the growth performance of manufacturing industries, such a difference is not observed between ICT-intensive and non-intensive manufacturing industries.

TABLE 5 - Decomposition of value added growth (ICT-intensive sectors vs non-intensive sectors) *(%)*

Sector	1991-00	1991-95	1996-00	Sector	1991-00	1991-95	1996-00
ICT-intensive sectors				**Other**			
Labour	0.55	0.01	1.09	Labour	0.03	-0.55	0.63
ICT capital	1.09	0.92	1.19	ICT capital	0.32	0.26	0.35
Non-ICT capital	0.42	0.69	0.13	Non-ICT capital	0.84	0.90	0.78
TFP growth	-0.58	-0.62	0.19	TFP growth	1.24	1.24	1.33
	1.48	**1.00**	**2.60**		**2.43**	**1.84**	**3.09**
ICT-intensive manufacturing				**Other manufacturing**			
Labour	-0.84	-1.69	0.04	Labour	-0.67	-1.28	-0.02
ICT capital	1.28	1.03	1.42	ICT capital	0.38	0.32	0.43
Non-ICT capital	0.77	1.13	0.31	Non-ICT capital	0.89	1.09	0.69
TFP growth	0.73	-0.74	2.28	TFP growth	1.46	0.79	2.16
	1.94	**-0.26**	**4.05**		**2.06**	**0.92**	**3.25**
ICT-intensive services				**Other services**			
Labour	0.67	0.16	1.18	Labour	0.59	0.06	1.12
ICT capital	1.08	0.91	1.17	ICT capital	0.31	0.25	0.33
Non-ICT capital	0.36	0.61	0.10	Non-ICT capital	0.85	0.86	0.83
TFP growth	-0.68	-0.54	-0.01	TFP growth	0.97	1.40	0.69
	1.43	**1.14**	**2.44**		**2.72**	**2.58**	**2.97**
Economy							
Labour	0.29	-0.13	0.72				
ICT capital	0.54	0.45	0.60				
Non-ICT capital	0.67	0.76	0.57				
TFP growth	0.51	0.23	1.15				
	2.01	**1.31**	**3.04**				

TABLE 6 - Decomposition of labour productivity growth (ICT-intensive sectors vs other sectors) *(%)*

Sector	1991-00	1991-95	1996-00	Sector	1991-00	1991-95	1996-00
ICT-Intensive sectors				**Other**			
ICT capital	1.03	0.92	1.07	ICT capital	0.32	0.28	0.33
Non-ICT capital	0.12	0.69	-0.50	Non-ICT capital	0.81	1.38	0.23
TFP growth	-0.58	-0.62	0.19	TFP growth	1.24	1.24	1.33
	0.57	**0.99**	**0.76**		**2.37**	**2.90**	**1.89**
ICT-intensive manufacturing sectors				**Other manufacturing**			
ICT capital	1.36	1.23	1.42	ICT capital	0.41	0.37	0.43
Non-ICT capital	1.14	1.78	0.29	Non-ICT capital	1.40	2.04	0.70
TFP growth	0.73	-0.74	2.28	TFP growth	1.46	0.79	2.16
	3.23	**2.27**	**3.99**		**3.27**	**3.21**	**3.28**
ICT-intensive services				**Other services**			
ICT capital	1.00	0.89	1.04	ICT capital	0.29	0.25	0.30
Non-ICT capital	-0.01	0.53	-0.59	Non-ICT capital	0.27	0.80	-0.26
TFP growth	-0.68	-0.54	-0.01	TFP growth	0.97	1.40	0.69
	0.31	**0.88**	**0.45**		**1.53**	**2.45**	**0.73**
Economy							
ICT capital	0.53	0.46	0.56				
Non-ICT capital	0.48	0.85	0.07				
TFP growth	0.51	0.23	1.15				
	1.51	**1.54**	**1.79**				

IV Conclusion

In this paper, our objective has been to assess the contribution of information and communications technology (ICT) to economic performance at the sector level in Belgium over the period 1991-2000. Both output and labour productivity growth have been used as performance indicators. Computer hardware and communications equipment are the two ICT assets that have been integrated into the analysis.

In section 1, we introduced and discussed some questions concerning the modelling of the impact of ICT on economic performance at the sectoral level in a small open economy like Belgium. We pointed out that ICT utilization rather than ICT production matters whenever the aim is to measure the impact of ICT on growth. We also mentioned that the neoclassical framework used in our paper in order to measure the impact of ICT capital on growth has some limitations: for example, it can not take into account externalities related to the utilization of ICT. Finally, reasons that led us to carry out the growth decomposition analysis at the sector rather than aggregate level have been exposed.

In section 2, we introduced the growth accounting methodology used in this paper in order to decompose sectoral output and labour productivity growth into its components, as well as the data used for the implementation of the growth decomposition analysis, especially data used for the construction of ICT capital stock series at the sector level for the period 1990-2000. The assumptions made for the construction of ICT capital stock series at the sector has also been carefully explained.

In section 3, results of the decomposition analysis have been presented and discussed at the seven-sector level (findings at a more disaggregated sectoral level, i.e. for 31 sectors, have also been made available). Our findings point out to the important contribution of ICT capital to output and labour productivity growth within sectors. Although this contribution is seldom the most important one – except for transport and communications industry – the contribution of ICT capital to growth is always positive and increases from 1991-1995 to 1996-2000. In general, it is superior to the contribution of non-ICT capital stock. We also observe that the tertiary sector makes more extensive use of ICT goods than manufacturing industries. We also observe that the service industries such as trade and communications, finance and personal services are important users of ICT goods.

In section 4, we first introduced a number of indicators that measure the intensity of ICT use in an industry. Combining these indicators with sectoral data for Belgium for the year 1995, we identified industries that use intensively ICT capital goods as well as those that do not. If ICT use is to exert a positive impact on economic performance, we expect its contribution to be stronger in ICT-intensive industries than in non-intensive ones. This expectation holds indeed for the ICT-intensive sector as a whole as well as for ICT-intensive manufacturing and services sector.

To this date, few studies tried to quantify the contribution of ICT capital to economic growth at the sector level. Using a new database for the Belgian economy, we used the growth accounting approach in order to measure the impact exerted by ICT on economic growth at the sectoral level. Our study shows that ICT exerts indeed a positive and important impact on economic performance through sectors. When sectoral data over a longer time span will be available, econometric techniques can be used in order to obtain estimates of the contribution of ICTto growth.

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VI Appendix

TABLE 7 - NACE 31 sectors

A	Agriculture and forestry
B	Fishing
CB	Mining
DA	Manufacture of food products and beverages
DB	Manufacture of textiles and wearing
DC	Leather products
DD	Manufacture of wood and products of wood and cork
DE	Manufacture of paper products, publishing, printing and reproduction of recorded media
DF	Manufacture of coke, refined petroleum products and nuclear fuel
DG	Manufacture of chemicals and chemical products
DH	Manufacture of rubber and plastic products
DI	Manufacture of other non-metallic mineral products
DJ	Manufacture of basic metals and fabricated metal products
DK	Manufacture of machinery and equipment
DL	Manufacture of electronic and electronic component
DM	Manufacture of motor vehicles and other transport equipment
DN	Miscellaneous manufacturing
EE	Electricy, gas and water supply
FF	Construction
GG	Wholesale and repair trade; repair of motor vehicles, motorcycles and personal and household goods
HH	Hotels and restaurants
II	Transport, storage and communications
JJ	Financial intermediation
KK	Real estate, renting and business activities
LL	Public administration and defence; compulsory social security
MM	Education
NN	Health and social work
OO	Other community, social and personal service activities

TABLE 8 - Decomposition of value added growth at the 31 sector level *(%)*

Sector	1991-00	1991-95	1996-00	Sector	1991-00	1991-95	1996-00
A				**B**			
Labour	0.31	0.27	0.28	Labour	-2.15	-3.42	-1.15
ICT capital	0.22	0.17	0.26	ICT capital	0.17	0.14	0.19
Non-ICT capital	-2.35	-1.85	-2.83	Non-ICT capital	0.41	-1.07	2.12
TFP growth	4.67	5.47	5.27	TFP growth	4.60	8.74	1.48
	2.85	4.06	2.98		3.03	4.39	2.65
CB				**DA**			
Labour	-0.45	-0.51	-0.31	Labour	-0.38	-0.89	0.01
ICT capital	0.43	0.37	0.45	ICT capital	0.40	0.34	0.44
Non-ICT capital	2.11	2.77	1.42	Non-ICT capital	1.63	2.27	0.97
TFP growth	-2.88	-2.98	-1.29	TFP growth	-1.32	-0.50	-2.83
	-0.79	-0.35	0.26		0.33	1.21	-1.41
DB				**DC**			
Labour	-3.71	-4.67	-2.32	Labour	-3.14	-0.71	-5.19
ICT capital	0.42	0.33	0.50	ICT capital	0.28	0.21	0.35
Non-ICT capital	0.55	0.57	0.51	Non-ICT capital	0.58	0.56	0.60
TFP growth	5.13	2.85	4.13	TFP growth	-5.42	-10.70	-1.19
	2.40	-0.92	2.83		-7.70	-10.64	-5.43
DD				**DE**			
Labour	-1.01	-0.43	-1.23	Labour	-0.51	-1.01	-0.08
ICT capital	0.34	0.26	0.40	ICT capital	1.11	0.92	1.21
Non-ICT capital	0.17	-0.02	0.37	Non-ICT capital	1.64	2.19	0.98
TFP growth	2.69	-0.33	6.01	TFP growth	-0.73	0.95	-0.27
	2.18	-0.52	5.56		1.50	3.05	1.83
DF				**DG**			
Labour	-1.67	-1.50	-1.45	Labour	-0.27	-0.75	0.11
ICT capital	1.61	1.27	1.86	ICT capital	0.69	0.61	0.67
Non-ICT capital	-0.48	0.32	-1.48	Non-ICT capital	3.43	2.94	3.96
TFP growth	-9.34	-7.94	-16.52	TFP growth	0.97	1.15	0.39
	-9.88	-7.86	-17.59		4.82	3.95	5.14
DH				**DI**			
Labour	-0.31	-1.70	1.01	Labour	-0.54	-0.84	-0.50
ICT capital	0.32	0.26	0.35	ICT capital	0.31	0.26	0.34
Non-ICT capital	0.88	1.26	0.49	Non-ICT capital	0.95	1.52	0.41
TFP growth	2.71	3.61	3.94	TFP growth	0.80	3.59	0.00
	3.60	3.43	5.80		1.51	4.53	0.25
DJ				**DK**			
Labour	-1.31	-2.49	-0.34	Labour	-1.23	-2.44	-0.31
ICT capital	0.36	0.28	0.40	ICT capital	0.41	0.31	0.49
Non-ICT capital	0.45	0.49	0.42	Non-ICT capital	0.04	0.25	-0.24
TFP growth	1.60	0.64	4.60	TFP growth	1.04	-2.08	4.03
	1.10	-1.08	5.08		0.26	-3.96	3.97

Sector	1991-00	1991-95	1996-00	Sector	1991-00	1991-95	1996-00
DL				**DM**			
Labour	-1.08	-2.45	0.41	Labour	-0.39	-1.59	0.91
ICT capital	1.32	1.05	1.50	ICT capital	0.20	0.17	0.22
Non-ICT capital	0.28	0.48	0.02	Non-ICT capital	1.32	1.29	1.34
TFP growth	3.92	0.04	7.59	TFP growth	1.26	0.28	1.78
	4.44	-0.89	9.52		2.38	0.14	4.26
DN				**E**			
Labour	-2.19	-2.65	-1.57	Labour	-0.35	-0.29	-0.40
ICT capital	0.31	0.23	0.38	ICT capital	0.61	0.51	0.68
Non-ICT capital	-0.16	-0.02	-0.33	Non-ICT capital	0.29	1.19	-0.59
TFP growth	1.87	-0.10	3.78	TFP growth	2.59	-0.05	3.30
	-0.17	-2.53	2.25		3.14	1.36	2.99
F				**G**			
Labour	-0.09	-0.58	0.70	Labour	0.39	-0.33	1.19
ICT capital	0.30	0.24	0.32	ICT capital	1.17	0.97	1.27
Non-ICT capital	1.30	1.36	1.22	Non-ICT capital	0.96	1.52	0.37
TFP growth	-0.14	-0.49	1.02	TFP growth	-2.95	-2.79	-1.91
	1.37	0.55	3.27		-0.43	-0.63	0.91
H				**I**			
Labour	1.77	2.84	0.54	Labour	0.27	-0.46	0.90
ICT capital	0.74	0.62	0.80	ICT capital	1.43	1.26	1.53
Non-ICT capital	1.09	2.24	-0.13	Non-ICT capital	0.44	0.32	0.55
TFP growth	-2.89	-4.20	-0.71	TFP growth	0.06	-0.10	1.33
	0.71	1.49	0.50		2.20	1.02	4.32
J				**K**			
Labour	-0.32	-0.55	-0.05	Labour	0.78	0.40	1.23
ICT capital	0.80	0.62	0.94	ICT capital	0.50	0.42	0.52
Non-ICT capital	-0.56	-0.46	-0.68	Non-ICT capital	2.04	2.11	1.97
TFP growth	4.15	4.63	3.25	TFP growth	0.42	0.62	0.43
	4.07	4.25	3.46		3.74	3.56	4.16
L				**M**			
Labour	0.58	-0.74	1.66	Labour	0.44	0.42	0.68
ICT capital	0.14	0.11	0.16	ICT capital	0.01	0.01	0.02
Non-ICT capital	0.06	0.08	0.04	Non-ICT capital	-0.14	-0.16	-0.13
TFP growth	1.01	2.29	0.01	TFP growth	0.50	0.58	0.04
	1.79	1.75	1.87		0.81	0.85	0.61
N				**O**			
Labour	1.54	0.99	2.18	Labour	0.93	0.50	1.32
ICT capital	0.55	0.47	0.58	ICT capital	1.17	1.00	1.24
Non-ICT capital	0.30	0.91	-0.30	Non-ICT capital	0.34	0.91	-0.24
TFP growth	-1.21	-1.30	-0.73	TFP growth	0.36	0.84	1.86
	1.18	1.08	1.73		2.80	3.25	4.18

TABLE 9 - Decomposition of labour productivity growth at the 31 sector level *(%)*

Sector	1991-2000	1991-1995	1996-2000	Sector	1991-2000	1991-1995	1996-2000
A				**B**			
ICT capital	0.18	0.13	0.24	ICT capital	0.23	0.21	0.24
Non-ICT capital	-5.19	-4.83	-5.05	Non-ICT capital	2.13	1.30	3.19
TFP growth	4.67	5.47	5.27	TFP growth	4.60	8.74	1.48
	-0.34	0.77	0.45		6.96	10.25	4.91
CB				**DA**			
ICT capital	0.46	0.40	0.46	ICT capital	0.42	0.38	0.44
Non-ICT capital	2.65	3.38	1.81	Non-ICT capital	1.90	2.91	0.96
TFP growth	-2.88	-2.98	-1.29	TFP growth	-1.32	-0.50	-2.83
	0.22	0.79	0.98		1.00	2.79	-1.43
DB				**DC**			
ICT capital	0.56	0.49	0.59	ICT capital	0.35	0.22	0.46
Non-ICT capital	2.17	2.35	1.67	Non-ICT capital	1.75	0.82	2.59
TFP growth	5.13	2.85	4.13	TFP growth	-5.42	-10.70	-1.19
	7.86	5.69	6.39		-3.32	-9.65	1.87
DD				**DE**			
ICT capital	0.36	0.27	0.43	ICT capital	1.16	1.02	1.21
Non-ICT capital	0.60	0.15	0.95	Non-ICT capital	1.89	2.64	1.02
TFP growth	2.69	-0.33	6.01	TFP growth	-0.73	0.95	-0.27
	3.65	0.09	7.39		2.31	4.60	1.97
DF				**DG**			
ICT capital	1.97	1.57	2.18	ICT capital	0.71	0.67	0.67
Non-ICT capital	1.55	1.74	0.79	Non-ICT capital	3.65	3.48	3.87
TFP growth	-9.34	-7.94	-16.52	TFP growth	0.97	1.15	0.39
	-5.82	-4.63	-13.55		5.32	5.31	4.93
DH				**DI**			
ICT capital	0.33	0.32	0.32	ICT capital	0.32	0.28	0.35
Non-ICT capital	1.07	2.25	-0.13	Non-ICT capital	1.28	2.06	0.70
TFP growth	2.71	3.61	3.94	TFP growth	0.80	3.59	-0.004
	4.11	6.17	4.13		2.40	5.93	1.05
DJ				**DK**			
ICT capital	0.39	0.36	0.41	ICT capital	0.45	0.39	0.50
Non-ICT capital	0.97	1.47	0.56	Non-ICT capital	0.50	0.99	-0.10
TFP growth	1.60	0.64	4.60	TFP growth	1.04	-2.08	4.03
	2.96	2.47	5.57		1.98	-0.70	4.42
DL				**DM**			
ICT capital	1.42	1.30	1.46	ICT capital	0.21	0.19	0.21
Non-ICT capital	0.58	1.10	-0.11	Non-ICT capital	1.45	1.84	1.03
TFP growth	3.92	0.04	7.59	TFP growth	1.26	0.28	1.78
	5.92	2.44	8.94		2.91	2.31	3.02

Sector	1991-2000	1991-1995	1996-2000	Sector	1991-2000	1991-1995	1996-2000
DN				**E**			
ICT capital	0.36	0.30	0.42	ICT capital	0.65	0.54	0.72
Non-ICT capital	0.77	0.93	0.45	Non-ICT capital	0.89	1.71	0.06
TFP growth	1.87	-0.10	3.78	TFP growth	2.59	-0.05	3.30
	3.00	1.12	4.65		4.13	2.21	4.08
F				**G**			
ICT capital	0.30	0.26	0.31	ICT capital	1.13	1.02	1.15
Non-ICT capital	1.36	1.77	0.69	Non-ICT capital	0.69	1.75	-0.50
TFP growth	-0.14	-0.49	1.02	TFP growth	-2.95	-2.79	-1.91
	1.53	1.55	2.01		-1.14	-0.03	-1.27
H				**I**			
ICT capital	0.58	0.36	0.76	ICT capital	1.39	1.33	1.39
Non-ICT capital	-0.40	-0.03	-0.61	Non-ICT capital	0.33	0.50	0.21
TFP growth	-2.89	-4.20	-0.71	TFP growth	0.06	-0.10	1.33
	-2.70	-3.87	-0.56		1.78	1.73	2.93
J				**K**			
ICT capital	0.83	0.66	0.94	ICT capital	0.41	0.36	0.41
Non-ICT capital	-0.36	-0.17	-0.65	Non-ICT capital	-0.55	0.67	-1.81
TFP growth	4.15	4.63	3.25	TFP growth	0.42	0.62	0.43
	4.61	5.12	3.54		0.28	1.65	-0.97
L				**M**			
ICT capital	0.13	0.12	0.14	ICT capital	0.01	0.01	0.01
Non-ICT capital	-0.05	0.23	-0.27	Non-ICT capital	-0.19	-0.20	-0.19
TFP growth	1.01	2.29	0.01	TFP growth	0.50	0.58	0.04
	1.10	2.63	-0.11		0.33	0.39	-0.13
N				**O**			
ICT capital	0.48	0.42	0.49	ICT capital	1.05	0.93	1.09
Non-ICT capital	-0.35	0.48	-1.18	Non-ICT capital	-0.25	0.60	-1.08
TFP growth	-1.21	-1.30	-0.73	TFP growth	0.36	0.84	1.86
	-1.08	-0.39	-1.42		1.16	2.37	1.87

TABLE 10 - Criteria for identifying ICT intensive sectors in Belgium (1995)

	Capital-labour ratio	Capital-output ratio	Share of ICT capital (1)	Share of ICT capital (2)
A	3177	2.0	0.008	0.003
B	5840	11.0	0.036	0.000
CB	2655	3.6	0.029	0.001
DA	4471	7.8	0.035	0.019
DB	2620	7.9	0.036	0.008
DC	1541	4.3	0.029	0.000
DD	2899	6.7	0.020	0.002
DE	9236	15.1	0.073	0.022
DF	33759	21.9	0.077	0.008
DG	6926	7.1	0.050	0.024
DH	4563	7.1	0.023	0.005
DI	3340	5.4	0.024	0.006
DJ	3029	5.2	0.027	0.015
DK	2886	5.7	0.032	0.006
DL	11580	19.0	0.100	0.029
DM	2205	4.3	0.027	0.008
DN	2398	6.4	0.021	0.004
EE	31664	16.7	0.034	0.043
FF	1320	2.5	0.025	0.012
GG	7747	11.8	0.098	0.130
HH	6411	13.0	0.057	0.019
II	29572	53.6	0.233	0.345
JJ	8677	9.3	0.052	0.053
KK	15487	7.3	0.012	0.132
LL	1197	3.1	0.006	0.023
MM	124	0.3	0.001	0.002
NN	2572	6.6	0.066	0.037
OO	9342	19.4	0.114	0.045
Economy	6989	10.8	0.04	1.00

(1) Sector specific ICT capital divided by the sector specific total capital.

(2) Sector specific ICT capital divided by total capital at the macro level.