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Competition and productivity gains: a sectoral analysis in the OECD countries

- Competition in the markets for goods and services is frequently cited as a contributor to economic growth. That is because greater competition in a given sector is thought to boost activity and jobs by lowering the sale price of goods and raising that sector's productivity, particularly through innovation.

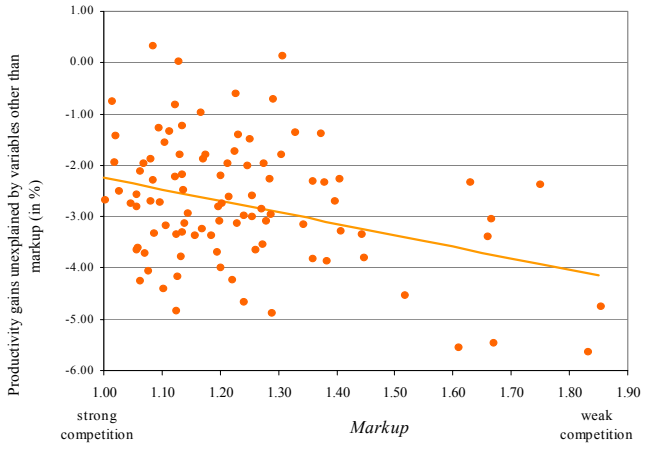
- From a theoretical standpoint, however, the impact of competition on productivity is less certain. Fears of losing market share and of not surviving certainly ought to incite firms to innovate, but it is also possible that firms would be unwilling to bear the costs of innovation unless they could reap sufficiently high rents in return.

- The econometric results obtained from a sample of 11 OECD countries and around twenty sectors indicate the existence of a non-linear relationship between competition and productivity gains: competition, would promotes productivity gains up to a certain point, but would inhibit them beyond that point.

- However, the degree of competition has no material impact on productivity gains when the survey sample contains only the most competitive sectors. Consequently, increased competition would boost productivity in uncompetitive sectors but would have little impact on the most competitive sectors.

- Moreover, the impact of competition on productivity gains differs according to the type of sector. In the manufacturing sectors, which are characterised on average by relatively high levels of competition and sunk costs, an intensification of competition would slow the pace of productivity gains. In services, on the other hand, where there are fewer instances of sunk costs and where competition is relatively weak on average, increased competition would always promote productivity gains (see chart below).

Relationship between markup and hourly productivity gains in the service sector



Source: EU KLEMS database, DGTPE calculations.

NB: This chart shows the relationship between the markup (ratio between sale price and marginal cost, estimated for 1981-1992) and the rate of growth of hourly labour productivity together with the scatter plot for the pairs markup / productivity growth rate unexplained by variables other than the markup (based on the relationships estimated in column (3) of table 3) in services.

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1. Competition is beneficial to productivity, *a priori*, but it can also reduce the incentive to innovate

It is generally agreed that competition boosts productivity thanks to "static gains" acting on the level of productivity and to "dynamic gains" that boost its growth rate.[1] Static gains from competition stem from improved allocation of scarce resources (allocative efficiency), and from improved utilisation of firms' production factors (productive efficiency). Dynamic gains, which emerge in the longer run and have persistent effects, flow from greater incentives to firms to innovate and converge towards-or even shift-the technological frontier.

There is little argument over the existence of static gains. Conversely, there has been a lively debate over many years between supporters of the dynamic efficiency of competition and those who emphasise the importance of monopoly rents as an incentive to firms to innovate: too much competition is claimed to discourage firms from investing research and development (a view dating back to Schumpeter).

Many empirical studies find that competition does have a positive effect on the level and growth of productivity.[2] Other work, however, points to the presence of an inverted U-shaped relationship between competition and innovation. Here, greater competition is found to be beneficial to innovation up to a certain degree of competition, beyond which it is thought to be harmful to it.[3]

2. A sectoral approach to international differences in productivity gains allows us to study the theoretically ambiguous effects of competition on productivity

The aim here is to determine to what extent international differences in productivity gains in a given sector can be accounted for by differences in competitive intensity and to consider the existence of a non-linear relationship between productivity gains and competition.

Productivity gains are measured by the average annual growth rate of hourly labour productivity recorded over the period 1993-2004, which represents a complete economic cycle. The markup, which is the difference between price and marginal cost[4], is used as an indicator of competition: the higher the markup, the weaker competition is in the sector. This margin factor is estimated econometrically using the Roeger method (1995)[5] for 1981-1992 and 1993-2004. Contrary to the indicators of means of competition (e.g. the degree of regulation) used in most econometric or sectoral studies, the markup fairly faithfully reflects the effective competitive intensity of the sectors. Data used are drawn mainly from the EU KLEMS database (see box 1).

2.1 An initial analysis of data does not establish a clear relationship between competition and productivity…

As indicated by charts 1 and 2, productivity gains and levels of competition within a given sector differ sharply from one country to another, especially in services. Hourly labour productivity grows at a faster pace in manufacturing sectors than in services (by a one percentage point difference per year on average). However, these figures conceal wide disparities between sectors (see chart 1).

(1) See for example OECD (2002), "Competition sur les marchés de produits et performance économique" (Product market competition and economic performance), Perspectives économiques, no. 72, December, pp. 189-197; European Commission (2004), "The EU Economy: 2004 Review", *European Economy, no. 6*; and Nicodeme and Sauner-Leroy (2007), "Product market reforms and productivity: a review of the theoretical and empirical literature on the transmission channels", *Journal of Industry, Competition and Trade, no. 7, pp 53-72*.

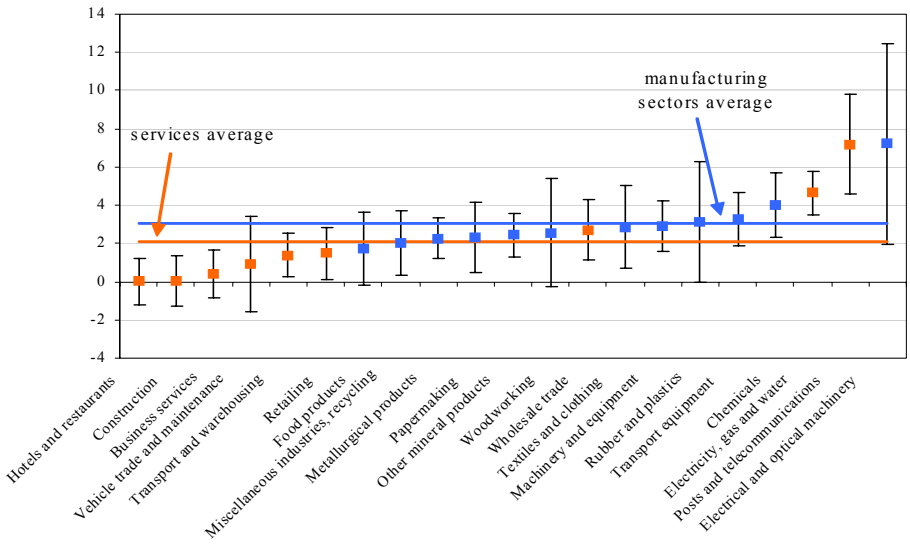
(2) On corporate data: Nickell S. (1996), "Competition and Corporate Performance", *Journal of Political Economy, no. 104, pp 724-746*; Disney R., Haskel J. and Heden Y. (2000), "Restructuring and productivity growth in UK manufacturing", CEPR *Discussion Paper no. 2463*. On macroeconomic data: Gordon, R.J. (2004), "Why Was Europe Left at the Station when America's Productivity Locomotive Departed?", CEPR *Discussion Paper, no. 4416*; Nicoletti G. and Scarpetta S. (2005), "Regulation and Economic Performance: Product Market Reforms and Productivity in the OECD", OECD Economics Department *Working Papers, no. 169*, OECD Economics Department. On sectoral data: ECB (2006), "Competition, Productivity and Prices in the Euro Area Services Sector", *Occasional Paper Series, no. 44, April*.

(3) Scherer F. (1967), "Market Structure and the Employment of Scientists and Engineers", *American Economic Review, no. 57, pp 524-531* and Aghion P., Bloom N., Blundell R., Griffith R. and Howitt P. (2005), "Competition and Innovation: An Inverted-U Relationship", *The Quarterly Journal of Economics, no. 120, pp. 701-728*.

(4) The sectoral markup is defined as the ratio between sale price and marginal cost of production. When the sector is perfectly competitive, the sale price of goods is equal to the marginal cost of production.

(5) "Can Imperfect Competition Explain the Difference between Prima and Dual Productivity Measures? Estimates for US Manufacturing", *Journal of Political Economy, no. 103, pp 316-330*.

Chart 1: Average annual growth rate of hourly labour productivity (1993-2004, in %)



Source: EU KLEMS database, DGTPE calculations

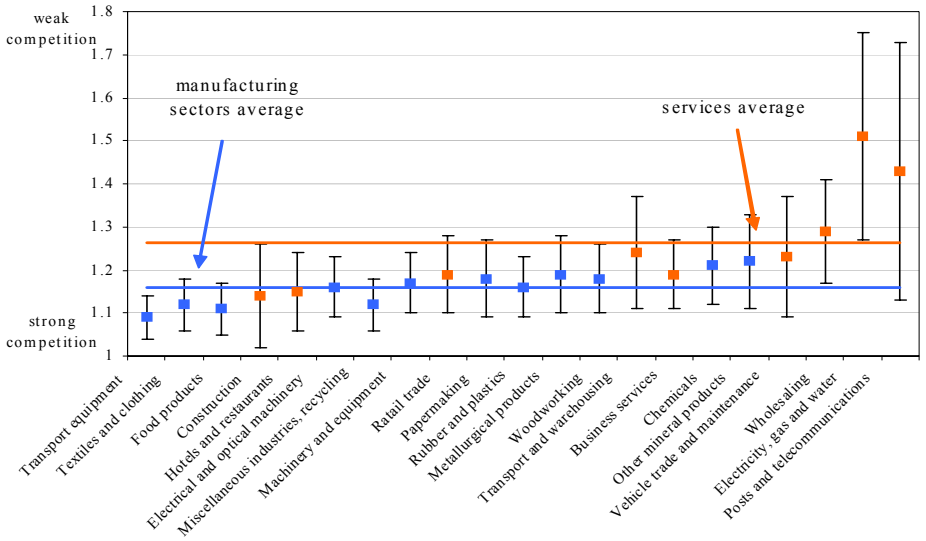
Interpretation: Between 1993 and 2004, hourly labour productivity in wholesale trade rose at an annual average rate of 2.7% for the 11 countries in the sample, with a standard deviation of 1.6.

Moreover, for a given country, there are wider intersectoral divergences in productivity gains within the service sector than within the manufacturing sectors, no doubt reflecting the greater diversity among service activities.

In the manufacturing sectors, productivity gains vary from 1.7% in the food processing sector to 7.2% per year on average in the electrical appliances and optical instruments manufacturing sector. In services, the largest productivity gains are recorded in the posts and telecommunications sector (7.2% per year) but are virtually null, on average, in hotels and restaurants.

Two comments are called for concerning levels of competition (estimated by markups). In the first place, estimated markups in services are generally higher than those estimated in the manufacturing sectors (1.26 on average, versus 1.16 over the period 1993-2004). Markups are relatively concentrated around the average in the manufacturing sectors and more dispersed in services, ranging from 1 to 2.1 (see charts 2 and 3). These observations are qualitatively similar for the estimated markups for the period 1981-1992.

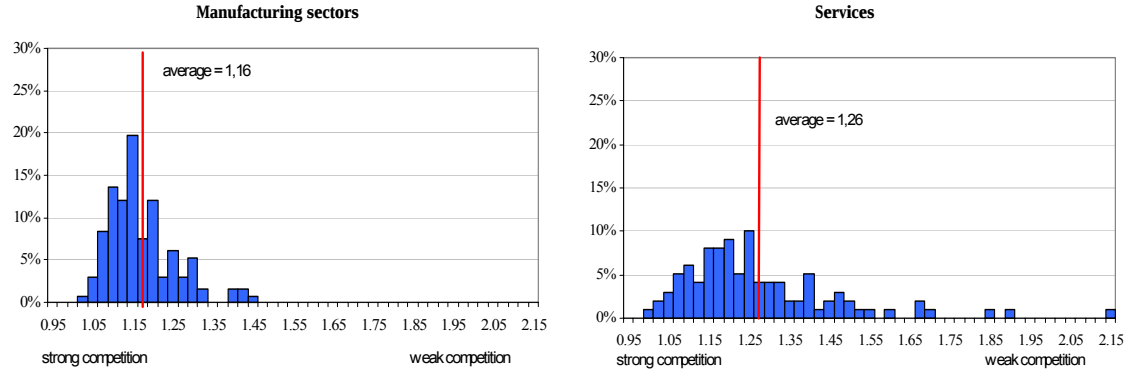
Chart 2: Average markups (1993-2004)



Source: EU KLEMS database, DGTPE calculations

Interpretation: over the period *19*93-2004, the markup in the wholesale trade in the 11 countries in the survey averages 1.29 with a standard deviation of 0.12.

Chart 3: Distribution of markups in manufacturing sectors and services (1993-2004)



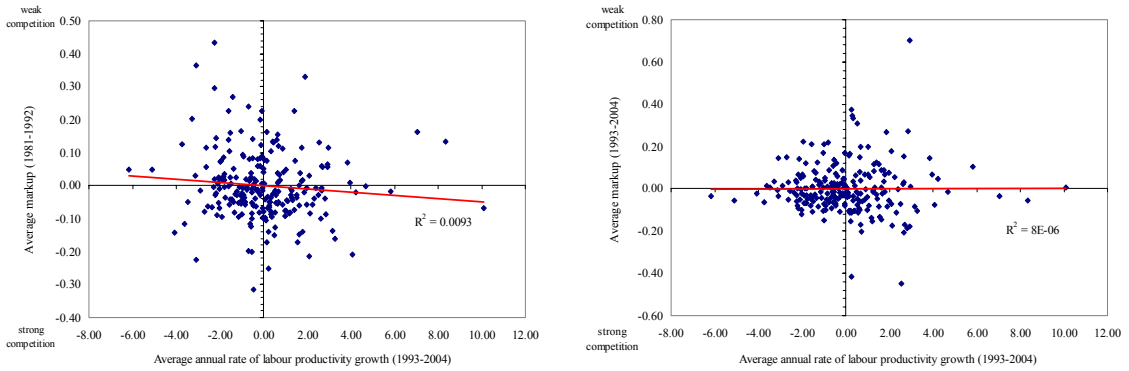
Source : EU KLEMS database, DGTPE calculations

Interpretation: over the period 1993-2004, 20% of manufacturing sectors in the 11 countries surveyed had markups of between 1.13 and 1.15.

Secondly, international differences between markups are wider within services than in the manufacturing sectors, which is consistent with the idea that certain services are more sheltered from international competition than are manufactured goods.

Certain sectors (services especially) appear to combine low productivity gains with low levels of competition. However, no correlation has been observed in the data between productivity gains and the degree of competition (see chart 4). This does not necessarily imply that there is no relationship between productivity and competition. The latter needs to be studied with other determinants of productivity gains in mind, such as specific characteristics of sectors and countries, together with their distance from the technological frontier.

Chart 4: Correlation between estimated markups over the periods 1981-1992 and 1993-2004 and labour productivity gains between 1993 and 2004 (variables centred relative to sector average)



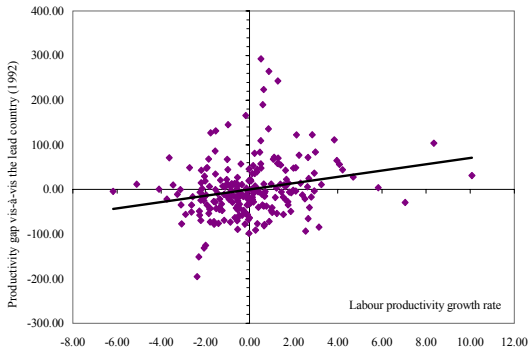
Source : EU KLEMS database, DGTPE calculations

2.2 …probably due to the importance of other determinants of productivity gains, such as the distance from the technological frontier

The distance from the technological frontier represents the difference between technical advances in each sector in each country with the newest and most efficient technologies deployed in the lead countries.

This must positively explain the trend in productivity resulting from a catch-up phenomenon, as suggested in chart 5, which shows the relationship between productivity gaps vis-à-vis the lead country[6] in 1992 and labour productivity gains between 1993 and 2004.

Chart 5: Correlation between productivity gaps vis-à-vis the lead country in 1992 and labour productivity gains between 1993 and 2004 (variables centred relative to sector average)



EU KLEMS database, DGTPE calculations

(6) The productivity gap vis-à-vis the lead country for each sector at the beginning of the period, i.e. 1992, is measured as the ratio between the sector's productivity in the country considered and productivity in the lead country (i.e. the country displaying maximum productivity at purchasing power parity over the year for the sector in question).

Box 1: **Data and selection of sample**

Most of the data are derived from the EU KLEMS database covering 27 countries (EU member countries, Japan and United States) and 71 sectors (NACE nomenclature revision 1) for the period 1970-2004.

Sectors are selected at the most disaggregated level possible, subject to availability of the data required for estimating markups for all of the countries since the beginning of the 1980s. The non-market services, agriculture, property activities and financial services sectors are excluded from the analysis. Services are defined here in the broad sense of the term, and thus include the production and distribution of electricity, gas and water, construction, retailing, business services and personal services. Using this methodology, we have selected 21 sectors (12 manufacturing sectors and 9 service sectors) for 11 countries (Austria, Belgium, Denmark, Finland, France, Italy, Japan, the Netherlands, Spain, the United Kingdom and the United States). These countries, with fairly similar levels of productivity, have been selected in order to limit problems arising with heterogeneous parameters and ensure the results of estimations are capable of being interpreted.

3. Econometric results show that the effects of competition on productivity gains vary according to sector

3.1 According to an initial estimation, competition boosts productivity gains up to a certain level of competition, and reduces them thereafter

As expected, the sector's productivity gap relative to the leader country measured at the beginning of the period positively, and very significantly, explains the average productivity gains observed between 1993 and 2004, regardless of the specifications selected. Thus countries initially furthest from the technological frontier are those whose productivity subsequently grows fastest.

When both are measured over a common period (here 1993-2004), markup and productivity gains are positively linked, probably due to a simultaneity bias or a problem of inverse causality (table 1 column (3)). It is possible, after all, that the sectors enjoying high productivity gains thanks to past innovations simultaneously enjoy comfortable margins, or perhaps substantial productivity gains allow firms to raise their margins. This result bears out the idea that the competition-productivity linkage needs to be viewed with a time lag; it therefore leads us to favour the estimated markup for the period 1981-1992 in explaining the average annual rate of hourly labour productivity growth recorded between 1993 and 2004.

The estimated markup for the period 1981-1992 has no statistically significant impact on productivity gains (table 1 column (1)). However, when the markup is squared (column (2)) to account for non-linear effects, the coefficient is positive and significant while the coefficient of the term squared is significantly negative, suggesting the presence of an inverted-U relationship between markup and productivity gains. In other words, starting from a low level of markup (in other words a highly competitive situation), an increase in margin is slightly favourable to productivity (reflecting the Schumpeterian effect), but beyond a certain level of markup, an increase in the margin inhibits productivity gains ("dynamic gains"), as shown in chart 6.[7]

In a forward-looking approach, the economic impact of competition on productivity gains is considerable. By way of illustration, the markup in a relatively uncompetitive sector in France such as the retail trade sector was 1.28 over the period 1993-2004. Based on the econometric results, reducing the markup in this sector to the level found in Belgium (1.06 for the period 1993-2004) would yield annual hourly labour productivity gains of 0.12 percentage point for the sector in future years.

(7) The results are qualitatively the same when certain sectors that have experienced major changes during the period under study (e.g. business services, posts and telecommunications, and the production and distribution of electricity, gas and water) are excluded, when the estimations are made among European countries only, or when other control variables are included in the regressions, such as investment in information and communications technologies (ICT), degrees of labour and goods market regulation (OECD EPL and PMR indicators), trends in weekly working hours or in the composition of labour. Finally, the sensitivity of the regression to outliers is examined thanks to the Belsley, Kuh and Welsch tests (*Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*, New York, John Wiley, 1980). A more detailed version of this study is due to be published in *Économie et Statistique*.

Box 2: **Model and methodology**

The methodological choices are closely bound up with our choice of indicator of competition, namely the markup. Since the latter is estimated over periods of several years, a panel data approach would be impracticable.The approach adopted here consists in explaining the average annual rate of hourly labour productivity growth for a sector in a country over a given period of time by the sector's markup in the country concerned:

$$\Pi_{i,\,j} = c + X'_{i,j}\,\alpha + \gamma_p \overline{markup_{i,\,j,\,p}} + \kappa d_i + \lambda d_j + \eta_{i,\,j} \quad ,$$

where $\Pi_{i,\,j}$ represents the average annual rate of hourly labour productivity growth for the sector *j* in country *i*, *X'* the vector for the control variables, α the vector for the corresponding estimated coefficients, $\overline{markup_{i,\,j,\,p}}$ the estimated markup of sector *i* in country *j* over the period *p*, d_i and d_j the fixed country and sector effects, and $\eta_{i,j}$ the error term in the regression.

The markups are estimated over periods generally corresponding to complete economic cycles (1981-1992 and 1993-2004) to avoid capturing cyclical effects. The average annual rate of hourly productivity growth between 1993 and 2004 is thus regressed on estimated markups over the periods 1981-1992 and 1993-2004.

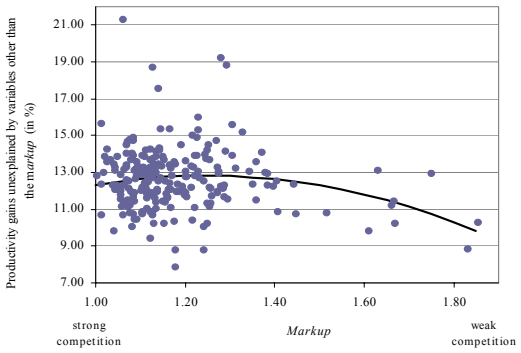
Table 1: Estimates of the impact of the markup on hourly labour productivity gains in all sectors

Explanatory variables	(1)	(2)	(3)	(4)
Productivity gap relative to the lead country in 1992	0.009***	0.009***	0.009***	0.009***
Markup 81-92	−1.33	20.57**		
(*Markup* 81-92)^2		−8.25**		
Markup 93-04			2.64***	14.42**
(*Markup* 93-04)^2				−4.20*
Constant	6.71***	−14.52**	−4.91***	−12.96**
Country fixed effects	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes
R^2 ajusted	0.54	0.55	0.55	0.55
Number of observations	231	231	231	231

Source :EU KLEMS database, DGTPE calculations

Note : ***, **, * indicate a significativity of estimated coefficients at the respective 1%, 5% and 10% thresholds.

Chart 6: Inverted U curve between markup and hourly labour productivity gains



Source: EU KLEMS database, DGTPE calculations

NB: This chart shows the relationship between the markup (estimated for 1981-1992) and the rate of hourly labour productivity growth together with the scatter plot for the pairs markup / rate of productivity growth unexplained by explanatory variables other than markup (based on the estimated relationship in column (2) of table 1).

3.2 A more refined analysis finds that an increase in competition would have a significant (positive) impact on productivity gains only in the relatively uncompetitive sectors

The inverted-U curve (chart 6) suggests that an increase in competition favours productivity gains in uncompetitive sectors but inhibits them in already-competitive sectors. The adverse impact of competition on productivity in already-competitive sectors looks somewhat fragile, however, with the falling portion of the curve (the positive effect of competition on productivity gains) dominating within the sample. This fragility is confirmed by the results presented in table 2 below. They show that in uncompetitive sectors[8], the estimated markup for the period 1981-1992 negatively and significantly explains productivity gains. In highly competitive sectors, on the other hand, the differences in productivity gains do not appear to depend on the degree of competition, thus contradicting the presence of an inverted-U relationship between productivity and competition.

(8) Sectors deemed competitive are those in which the average markup is less than the first quartile (1.12) of the estimated average markup for 1981-1992; those deemed uncompetitive are the sectors for which the markup is greater that the last quartile (1.20) of the markup.

Table 2: Estimates of the impact of the markup on hourly labour productivity gains in the competitive/ uncompetitive sectors

	Low markup	High markup
Explanatory variables	(1)	(2)
Productivity gap relative to lead country in 1992	0.009***	0.008**
Markup 81-92	0.35	−3.50***
Constant	−2.60	10.18***
Country fixed effects	Yes	Yes
Sector fixed effects	Yes	Yes
R2 ajusted	0.59	0.72
Number of observations	55	55

Source: EU KLEMS database, DGTPE calculations

3.3 An increase in competition is found to inhibit productivity gains in the manufacturing sectors but to be beneficial in the service sectors

The existence of the highlighted previously non-linear relationship between competition and productivity might be explained by a sectoral composition effect. Indeed it is likely that competition affects productivity differently in different sectors depending on the latters' intensity in sunk costs, as suggested by the European Commission, for example.[9] In the manufacturing sectors, for example, sufficiently high margins are needed to stimulate innovation, because entry costs to these sectors are generally high. Firms in these sectors would have a greater incentive to innovate and enter the market if they were assured of being able to cover the otherwise sunk costs incurred in research and development subsequently. A lower markup in the manufacturing sectors therefore has a negative impact on the rate of growth of productivity in these sectors. There are fewer sunk costs in services, on the other hand, so that a reduced markup would favour innovation and productivity gains unambiguously. The appropriateness of this hypothesis is studied here by splitting the sample analysed according to whether the sector produces a manufactured good or a service.

In keeping with Schumpeter's view, the estimated markup for the period 1981-1992 is found to have a significantly positive effect on productivity gains in manufacturing sectors (column (1) of table 3). This impact of markup on productivity gains is monotone, the coefficient of the markup squared being not significantly different from zero (column (2)). It is worth noting that the economic impact of the markup here is greater than the one estimated for all sectors (table 1), probably due to the heterogeneous nature of the sectors present in the initial sample.

Where services are concerned (columns (3) and (4)), the estimated markup for the period 1981-1992 significantly and negatively explains the average annual rate of labour productivity growth measured over the period 1993- 2004, which indicates that the impact of competition on productivity gains in these sectors is indeed positive over the long run.[10] As with the manufacturing sectors, the economic impact of the markup on future productivity gains is greater when the sample is split in two according to the type of sector.

Table 3: Estimations of the impact of the markup on hourly labour productivity gains in the manufacturing sectors and in services

	Manufacturing sectors		Services	
Explanatory variables	(1)	(2)	(3)	(4)
Productivity gap relative to lead country in 1992	0.009***	0.009***	0.006***	0.006***
Markup 81-92	6.11*	−0.03	−2.24**	7.77
(*Markup* 81-92)^2		2.62		−3.64
Constant	−6.02	−4.61	1.44	2.00
Country fixed effects	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes
R^2 ajusted	0.42	0.41	0.77	0.77
Number of observations	132	132	99	99

Source: EU KLEMS database, DGTPE calculations

Note : ***, **, * indicate a significativity of estimated coefficients at the respective 1%, 5% and 10% thresholds.

(9) Roeger W., J. Varga and J. in't Veld (2008), "Structural reforms in the EU: A simulation-based analysis using QUEST model with endogenous growth", *Economic Papers 351, December*, European Commission.

(10) The estimated markup for 1993-2004 has a positive effect on productivity gains in the sector (results not reported), but as with the complete sample (manufacturing sectors and services), this effect probably stems from a simultaneity bias.

These results argue in favour of pursuing policies to boost competition in the relatively uncompetitive service sectors - in line with the European Services Directive or the French Economic Modernisation Act. Conversely, according to the econometric results, an increase in competition within the most competitive sectors would have no effect on productivity gains.

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