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**WORKING PAPER 9-09**

## **Alternative assessment of Belgian competitiveness**

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**Abstract** – This paper investigates graphically and econometrically the relationship between the relative positions, in terms of value added and relative prices, of Belgian manufacturing and market services in the European Union over 1970-2005. Relative prices are then decomposed into relative unit costs of factors of production. The analysis goes further by replacing relative unit labour cost with relative hourly wages and relative productivity. Finally, relative productivity is replaced with relative capital deepening, relative labour composition effect and relative total factor productivity. All data are coming from the EUKLEMS database, March 2008 release.

**Jel Classification** – D24, F14, F20, P42

**Keywords** – Relative position, relative prices, relative unit costs, TFP

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## Executive Summary

The constant deterioration of the Belgian current account surplus during the last few years has again focused attention on the determinants of competitiveness. In order to provide a complementary light to the traditional approach which is based on the analysis of relative export performances, an alternative approach is developed in this Working Paper. This approach is based on the evolution of the share of Belgian industries in the total value added of the European Union (EU15). Indeed, the aim is not to gain export market shares if the content of exports in local value added decreases because exporters make greater calls on foreign suppliers. The reason for maintaining the competitive position of an economy, especially of a small economy, is, indeed, rooted in the need to keep value added creation inside the country's borders in order to guarantee economic growth.

The aim of this paper is to investigate the determinants of the evolution of Belgian value added in the European Union at industry level in order to take into account industry specificities such as the degree of competition, the presence of foreign multinationals or the technological mutation. All data used in the analysis are coming from the EUKLEMS database, March 2008 release.

The first determinant analysed is relative value added deflators. The intuitive assumption, based on economic theory, is that decreasing prices below European ones allows industries to increase the share of European value added created in Belgium. This assumed relation is more likely to be validated whenever trade and competition barriers are low, allowing free product movements, and whenever industries produce homogeneous products, promoting price competition.

The econometric results indicate that over 1970-2005, relative prices movements were a significant determinant of the Belgian share of European value added for manufacturing and market services. This negative relationship was, however, more pronounced for manufacturing industries than for market services, which conforms to the assumption that competition is more pronounced for manufacturing than for market services.

The second series of determinants is linked to the main components of value added price evolution: the unit costs of factors of production, labour and capital. The short term effect as well as the long term effect of relative unit labour cost is econometrically significant for manufacturing and for market services. The elasticity is higher for manufacturing than for market services.

The third series of determinants is obtained by the decomposition of the relative unit labour cost into relative hourly wages and relative productivity. Relative productivity is clearly the main determinant for manufacturing, with an elasticity equal to double the elasticity of relative hourly wages.

The last series of determinants is based on the identification of the three factors influencing productivity growth: capital deepening, labour composition effect and total factor productivity (TFP). However, given data availability, this decomposition can only be implemented for the EU10 over 1981-2005, at a lesser desegregated industry level. The results underline the importance of relative TFP as a determinant of the relative European position of manufacturing and market services. Relative capital deepening is also an important determinant of the relative position of manufacturing in the EU10.

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## 1. Introduction

Over the last few years, the Belgian current account surplus has continuously deteriorated, turning into a deficit in 2008. This evolution is in line with the worsening of competitiveness, measured by means of the real effective exchange rate based on unit labour costs. However, this worsening alone is insufficient for explaining the deterioration of export market shares. Especially from 1995 onwards, competitiveness seems to lose in importance as an explanatory variable as shown in the recent working paper published by the Federal Planning Bureau<sup>1</sup>.

In order to shed a complementary light to that given by this approach, it appears useful to analyse the evolution of the share of Belgian industries in total value added of the European Union (EU15). Indeed, the aim is not to gain export market shares if the content of exports in local value added decreases because exporters make greater calls on foreign suppliers. The analysis based on value added takes this aspect into account.

This paper consists of an extension of the Working Paper 05-09<sup>2</sup> which is devoted to the same analysis but limited to the most recent period, 2000-2005, and is only based on descriptive statistics. In the present Working Paper, the aim is to confirm these preliminary results both by extending the period to 1970-2005 and by econometrically testing the visual relationships.

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<sup>1</sup> Marktaandeelen, concurrentievermogen en de lopende rekening, WP 06-09, Bart De Ketelbutter, Federal Planning Bureau.

<sup>2</sup> La position relative de l'économie belge en Europe, WP 05-09, Bernadette Biatour et Chantal Kegels, Federal Planning Bureau.

## 2. Descriptive analysis

The aim of this part is to offer a first glance at the main evolutions of the relative position of Belgian manufacturing and market services over 1970-2005, using five-year annual average growth rates of the share of Belgian industries in European value added in volume.

A relationship is graphically established between this average growth rate and the evolution of relative value added deflators. The expected relation based on economic theory is that if Belgian value added deflator increases faster than the European one, value added growth rate is expected to be lower than that of Europe. This assumed relation is more likely to be validated when the EU becomes a single market, leading to significant decreases in trade and competition barriers, and for industries producing homogeneous products.

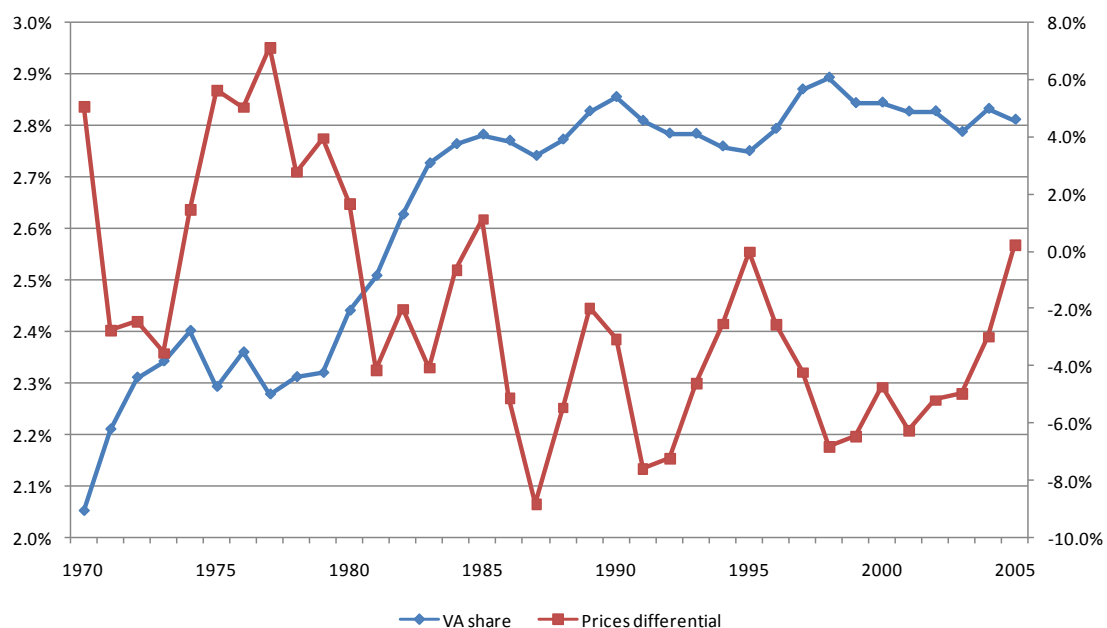
### 2.1. Manufacturing industries

Over 1970-2005, the share of Belgian manufacturing in the EU15 manufacturing value added increased from 2.05% to 2.81%<sup>3</sup>. However, as illustrated by Graph 1, the peak was reached in 1998 at 2.89% and since then, the share has been on a slightly declining trend. The evolution of relative prices has been more erratic: they declined between 1977 and 1987, period corresponding to a fast increase in relative value added; they increased until 1995 before decreasing again until 1998. Since then, relative prices have increased with Belgian prices increasing faster than the European ones.

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<sup>3</sup> This variation could seem limited but represents an important increase in Belgian value added: over 1970 and 2005, the Belgian manufacturing value added increase reached 151% against 83% for the EU15. Moreover, 1% of the EU15 manufacturing value added at constant prices in 2005 represented 35.6% of the Belgian manufacturing value added.

**Graph 1 – Share of Belgian manufacturing in the EU15 manufacturing value added in volume (left scale) and prices differential, logarithm of Belgian value added deflator index on the EU15 value added deflator index, 1995=100 (right scale)**

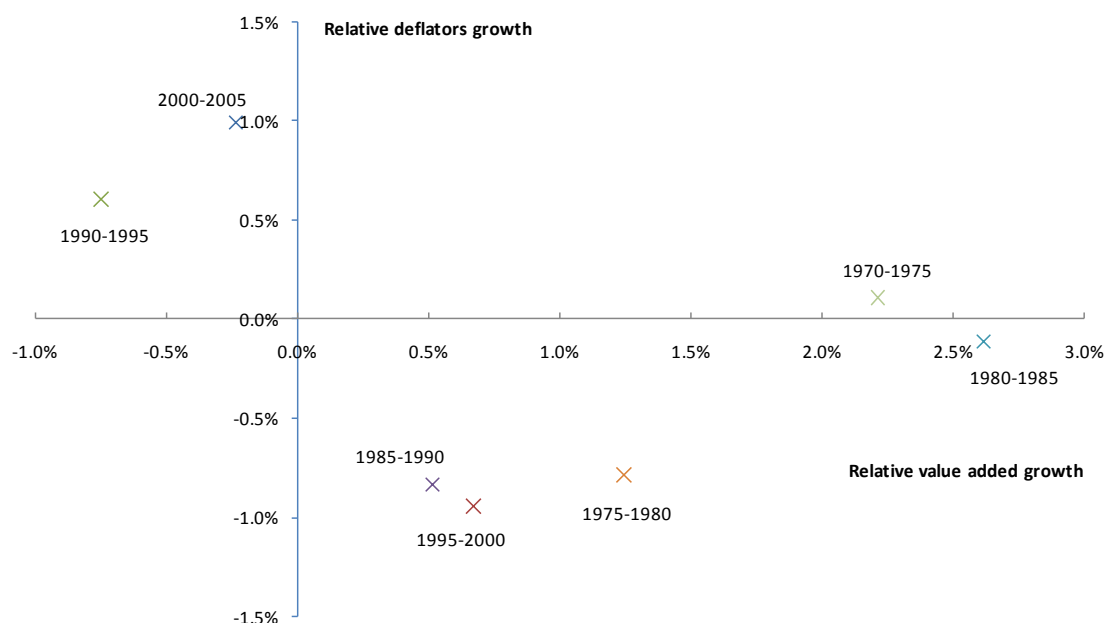


Source: EUKLEMS, March 2008 release.

The negative relation between relative value added and relative deflators is also visible in terms of average annual growth rates for all sub-periods of 5 years as illustrated by Graph 2, except for 1970-1975, period which corresponds to the early stage of the EU expansion<sup>4</sup>.

<sup>4</sup> In 1973, the Community expanded to 9 Member States.

**Graph 2 – Evolution of relative value added and prices of Belgian manufacturing in the EU15, 5-year period average annual growth rate, %**



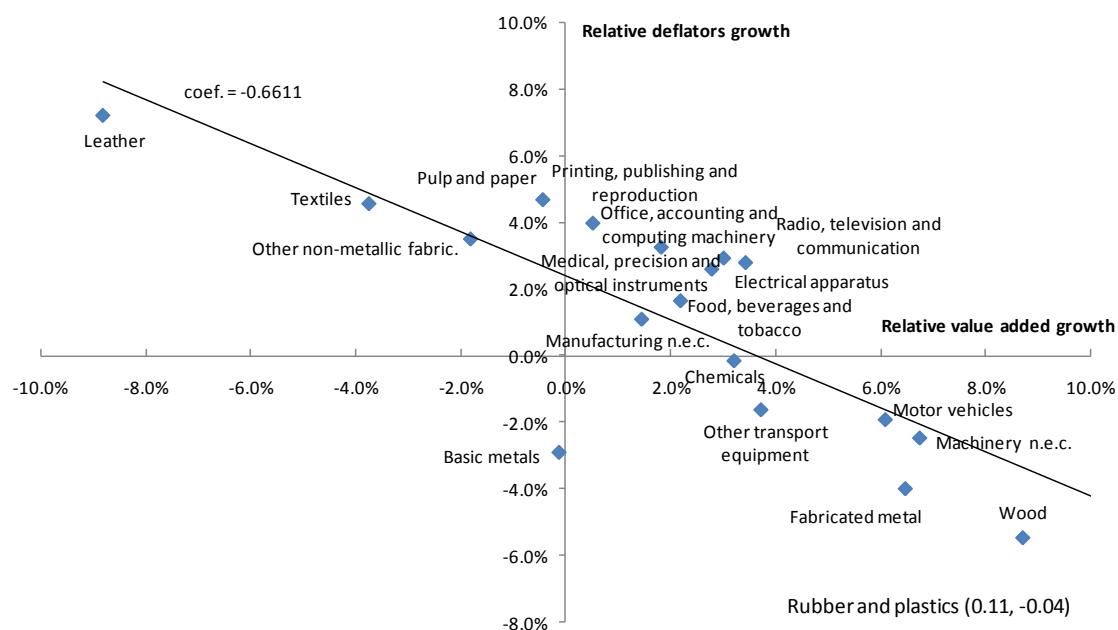
Source: EUKLEMS, March 2008 release.

For each sub-period, the overall evolution of the relative position of Belgian manufacturing results from divergent evolutions at industry level as illustrated by the decomposition of manufacturing into 19 industries<sup>5</sup>. The relative importance of those 19 industries for the Belgian economy for each sub-period is given in Annex 1.

<sup>5</sup> Given the erratic movements of Coke, refined petroleum products and nuclear fuel (NACE 23), this industry is not taken into account.

During the period 1970-1975, 4 industries, Paper, Textiles, Leather and Other non-metallic fabrications, recorded a deterioration of both their relative European position and their relative prices (North-West quadrant of Graph 3) while 7 industries, among which Vehicles industry and Chemicals, were able to improve both their relative position and their relative prices (South-East quadrant of Graph 3).

**Graph 3 – Evolution of relative value added and prices of Belgian manufacturing industries in the EU15, average annual growth rate, %, 1970-1975**

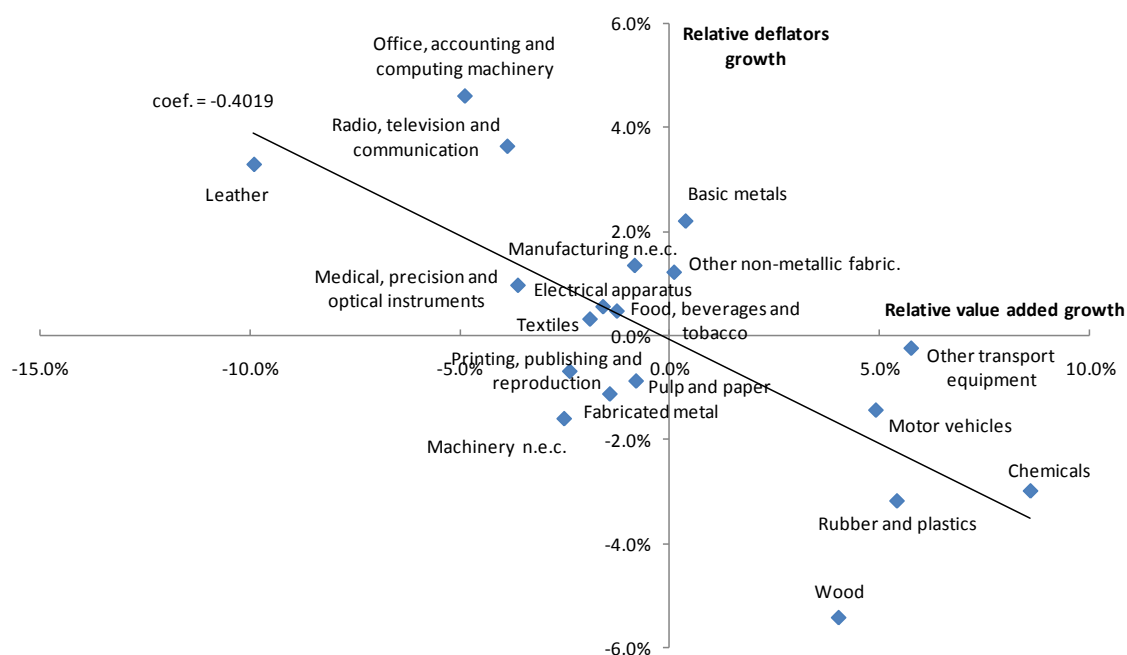


Source: EUKLEMS, March 2008 release.

This period was characterized by a majority of manufacturing industries being successful in improving their relative European positioning even though they recorded a deterioration of their relative prices, as it was for example the case of all ICT industries. Therefore, manufacturing as a whole was able to improve its position by more than 2% despite slightly increasing relative prices.

Over 1975-1980, 8 industries including ICT industries as well as Textiles, recorded a deterioration of both their relative position and their relative prices (North-West quadrant of Graph 4), while 5 industries representing slightly less than one fifth of total manufacturing value added were able to improve both their relative position and their relative prices (South-East quadrant of Graph 4).

**Graph 4 – Evolution of relative value added and prices of Belgian manufacturing industries in the EU15, average annual growth rate, %, 1975-1980**

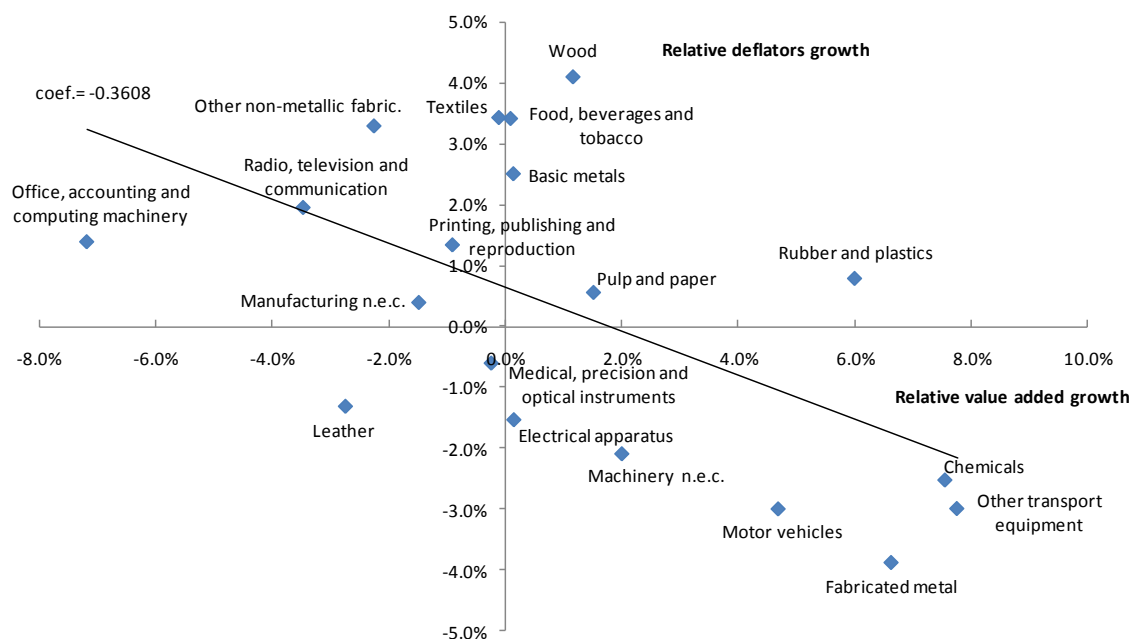


Source: EUKLEMS, March 2008 release.

Overall, a majority of industries, 12 out of 19, recorded a deterioration of their European position. However, given the weight of the 7 industries recording an improvement, manufacturing as a whole was able to improve its relative position in the EU15. This improvement was accompanied by a decrease in relative prices.

Over the period 1980-1985, the North-West quadrant (Graph 5) gathered 6 industries which accounted for 23% of total manufacturing value added and the South-East quadrant was also occupied by 6 industries representing 44% of total manufacturing value added.

**Graph 5 – Evolution of relative value added and prices of Belgian manufacturing industries in the EU15, average annual growth rate, %, 1980-1985**

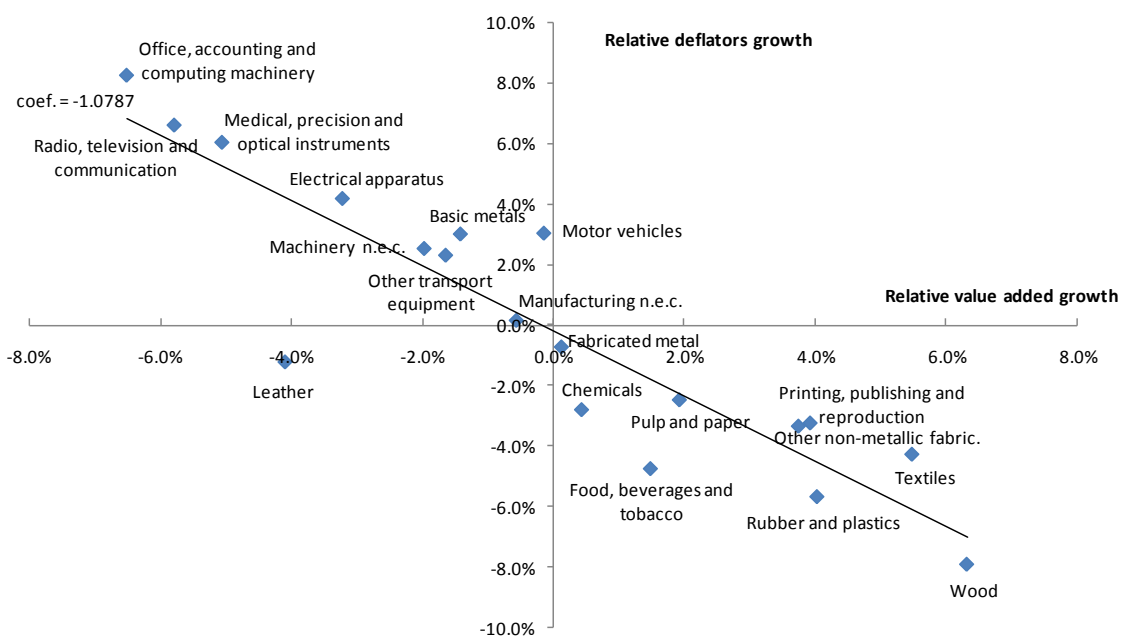


Source: EUKLEMS, March 2008 release.

With 11 industries being able to improve their relative position in Europe, manufacturing as a whole recorded the largest increase in its relative share in the EU15 despite the limited decrease of its relative prices. The devaluation of the Belgian franc (1982) partly explains for this good performance.

Over 1985-1990, the negative relation between relative value added growth and relative prices growth was validated for all manufacturing industries except for one (Leather). 9 industries among which all ICT industries and Metals, recorded a deterioration of both their relative European position and their relative prices and 9 industries representing 56% of total manufacturing value added improved both their relative European position and their relative prices.

**Graph 6 – Evolution of relative value added and prices of Belgian manufacturing industries in the EU15, average annual growth rate, %, 1985-1990**



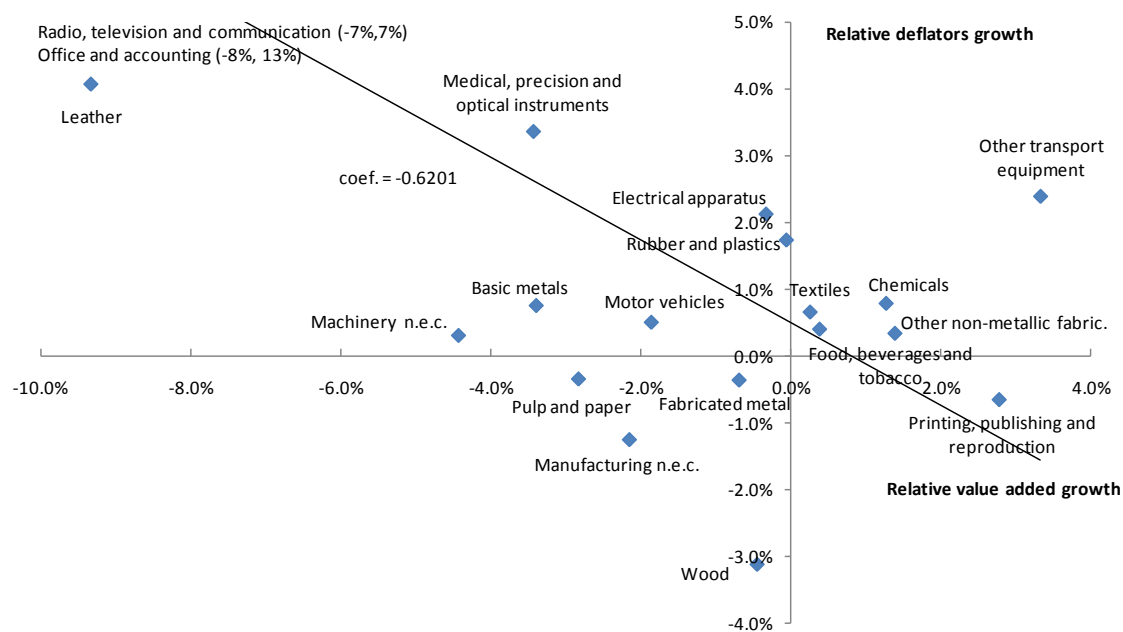
Source: EUKLEMS, March 2008 release.

As the industries recording an improvement in their relative European position, accounted for the majority of manufacturing value added, manufacturing as a whole improved its European relative positioning and its relative prices.



Over 1990-1995, the negative relation between the evolution of the relative position and of the relative prices was only validated for 41% of manufacturing value added, with 9 industries recording a deterioration and only 1 industry recording an improvement.

**Graph 7 – Evolution of relative value added and prices of Belgian manufacturing industries in the EU15, average annual growth rate, %, 1990-1995**

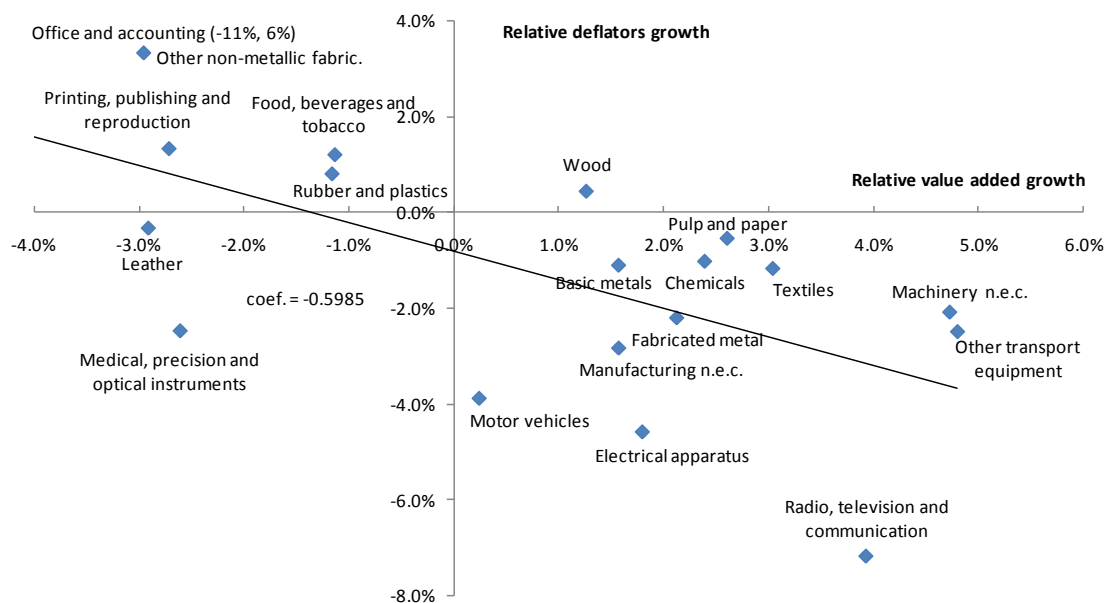


Source: EUKLEMS, March 2008 release.

Given that only 6 industries were able to improve their relative position, manufacturing as a whole saw a deterioration of its relative position in the EU15. That deterioration was accompanied by a quasi equal deterioration of relative prices.

During the period 1995-2000, 5 industries were located in the North-West quadrant (Graph 8) and 11 industries were situated in the South-East quadrant accounting for the bulk of manufacturing total value added.

**Graph 8 – Evolution of relative value added and prices of Belgian manufacturing industries in the EU15, average annual growth rate, %, 1995-2000**

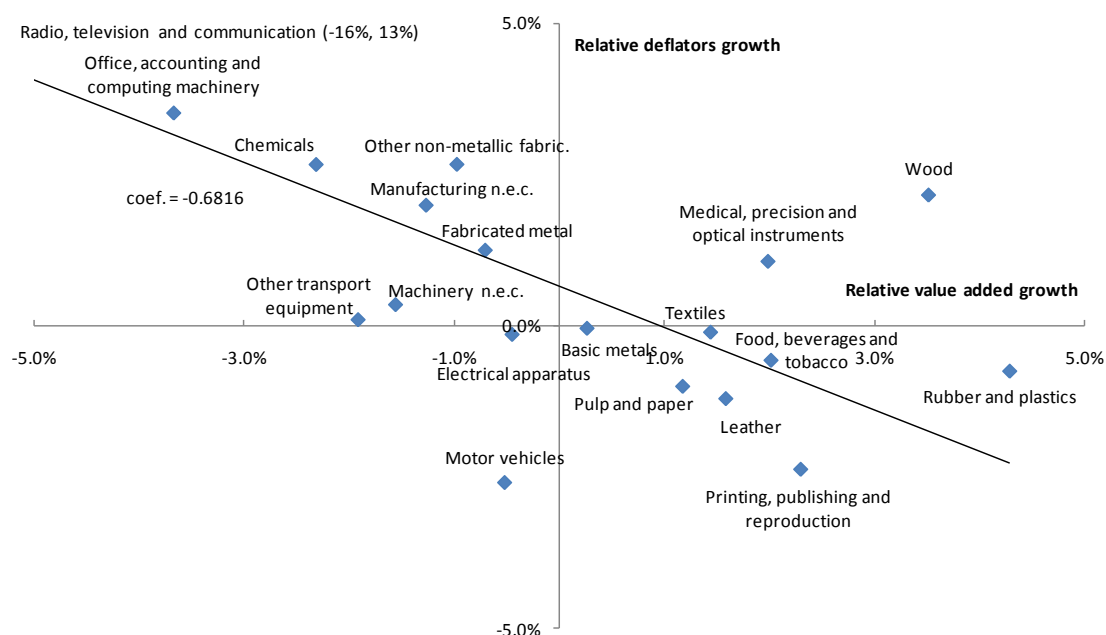


Source: EUKLEMS, March 2008 release.

During this period, which included the crisis caused by the bust of the dotcom bubble, manufacturing was able to improve both its relative position in the EU15 and its relative prices.

Finally, over 2000-2005, 8 industries among which important sectors such as Chemicals, recorded a deterioration of both their relative position and their relative prices, whereas 7 smaller industries improved both their relative position and their relative prices.

**Graph 9 – Evolution of relative value added and prices of Belgian manufacturing industries in the EU15, average annual growth rate, %, 2000-2005**



Source: EUKLEMS, March 2008 release.

Overall, manufacturing recorded a deterioration of both its relative position in the EU15 and its relative prices.

Analysing the positioning of each industry across the sub-periods sheds light on the main structural evolutions of the Belgian manufacturing over the last 35 years.

The restructuring of traditional industries, characterized by rationalisation investment and reduction of their weight in the Belgian economy, was coupled with a deterioration of their relative position in the EU15; for Textile, this was particularly true until the mid-eighties and for Metals and Machinery between 1985 and 1995. On the other hand, Chemicals are the only industry which continuously improved its relative position in all sub-periods except during the most recent one. This improvement went hand in hand with an increase in its relative importance in the Belgian economy: the share of Chemicals in Belgian value added in volume increased from 1% on average in 1970-1975 to 4% on average in 2000-2005. Wood industry also realized a constant improvement of its relative position in the EU15, except during 1990-1995. However, its relative importance in Belgian economy remained marginal (from 0.2% on average in 1970-1975 to 0.3% on average in 2000-2005). Motor vehicles fabrication increased its relative importance in Belgian value added from 1970-1975 (1% on average) until 1985-1990 (2% on average). Since the mid-eighties, this industry has seen a deterioration of its relative position both in Belgium and in the EU15. Another alarming evolution concerns the Belgian position in Europe of ICT industries (NACE 30 to 33). Over 1970-1975, all those industries, which accounted for 2.3% of Belgian value added in volume, recorded an improvement of their relative position

in the EU15. Since then, those industries have recorded a deterioration of both their relative position in Europe and in Belgium. Over 2000-2005, ICT industries accounted for 1.9% of Belgian value added in volume. The deterioration was particularly noticeable for Office, accounting and computing machinery and for Radio, television and communication. The Belgian economy seems to have missed the most recent technological revolution, at least from ICT producers' point of view.

Over the period 1970-2005, at the European scale, Belgian manufacturing has mainly increased its specialisation in industries of which the European average annual growth rate was relatively weak with Chemicals and Rubber and plastics as main exceptions (see Annex 1).

## 2.2. Market services

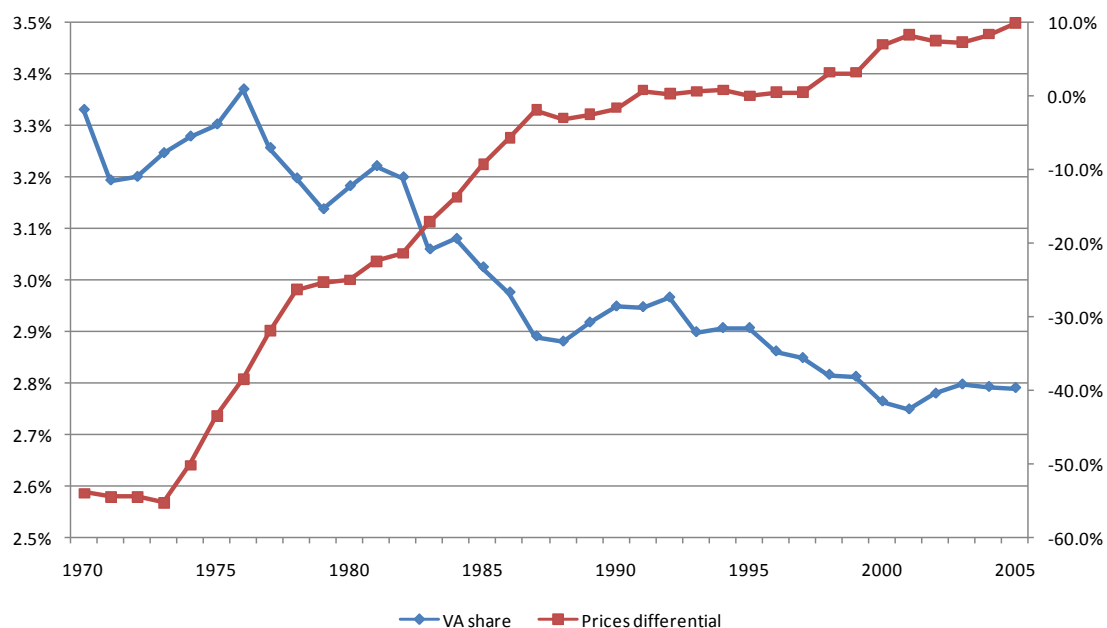
The same analysis is implemented for market services which include trade (G), hotels and restaurant (H), transport, storage and communication (I), financial activities (J) and real estate, renting and business activities (K). However, statistical problems surrounding service activities have to be taken into account; value added is more difficult to measure in services than in manufacturing given the intangible nature of the production and decomposition of evolutions into volume and price changes is also more difficult to implement.

Over 1970-2005, the share of Belgian market services in the EU15 market services value added decreased from 3.33% to 2.79%<sup>6</sup>. However, as illustrated in Graph 10, the trough has been reached in 2000 at 2.70% and since then, the share has slightly increased. That evolution was concomitant with a fast increase in relative prices between 1973 and 1987, followed by a slower growth. Since 1997, increases in relative prices have again slightly accelerated.

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<sup>6</sup> Even if their share in European value added has decreased, market services recorded a value added increase of 157% between 1970 and 2005 against 207% for the EU15. Moreover, 1% of the EU15 market services value added at constant prices represented in 2005 35.4% of the Belgian market services value added.

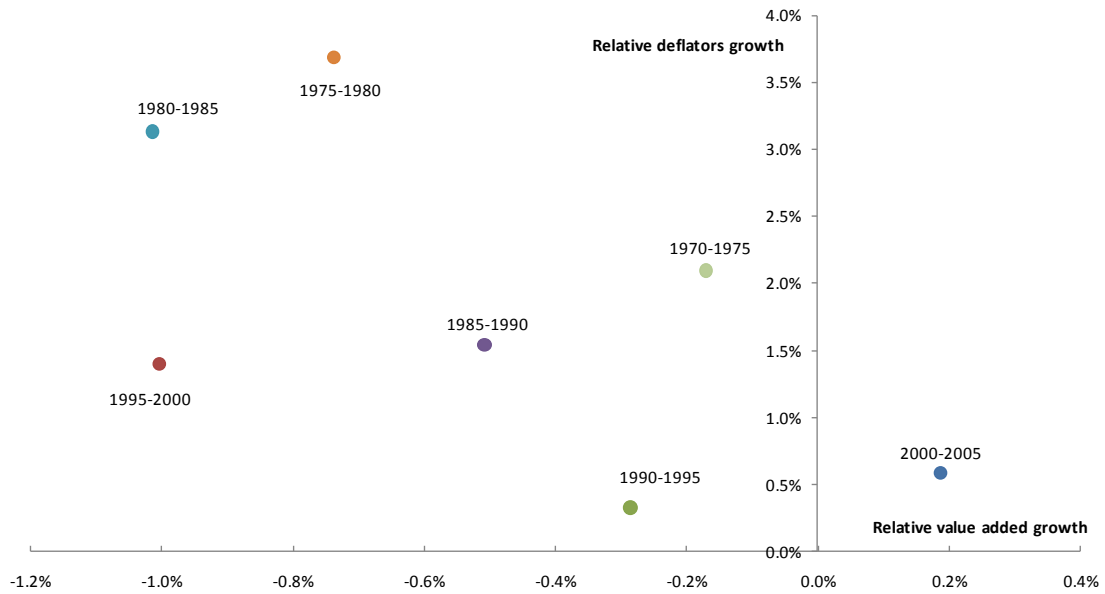
**Graph 10 – Share of Belgian market services in the EU15 market services value added in volume (left scale) and prices differential, logarithm of Belgian value added deflator index on the EU15 value added deflator index, 1995=100 (right scale)**



Source: EUKLEMS, March 2008 release.

The negative relationship between the average annual growth rates of relative value added and of relative deflators is shown in Graph 11 for all sub-periods of 5 years, except for the most recent one, 2000-2005. During that period, Belgian market services were, for the first time, able to slightly improve their relative European position despite the continuous deterioration of their relative prices.

**Graph 11 – Evolution of relative value added and prices of Belgian market services in the EU15, average annual growth rate, %**

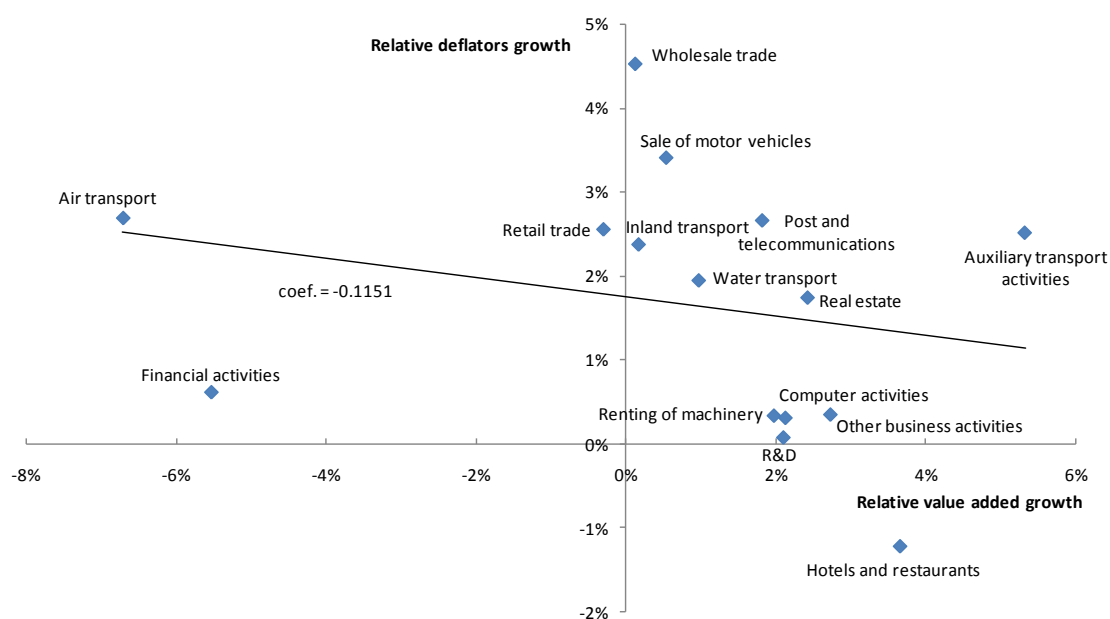


Source: EUKLEMS, March 2008 release.

For each sub-period, the global evolution of the relative position of Belgian market services results from divergent evolutions at industry level as illustrated by the decomposition of market services into 15 industries.

Over 1970-1975, 3 market services had a negative evolution of their relative value added combined with a deterioration of their relative prices. For two of them, Air transport and Financial activities, the deterioration of the relative position was particularly pronounced. During this period, only one industry, Hotels and restaurants was able to improve both its relative European position and its relative prices.

**Graph 12 – Evolution of relative value added and prices of Belgian market services in the EU15, average annual growth rate, %, 1970-1975**



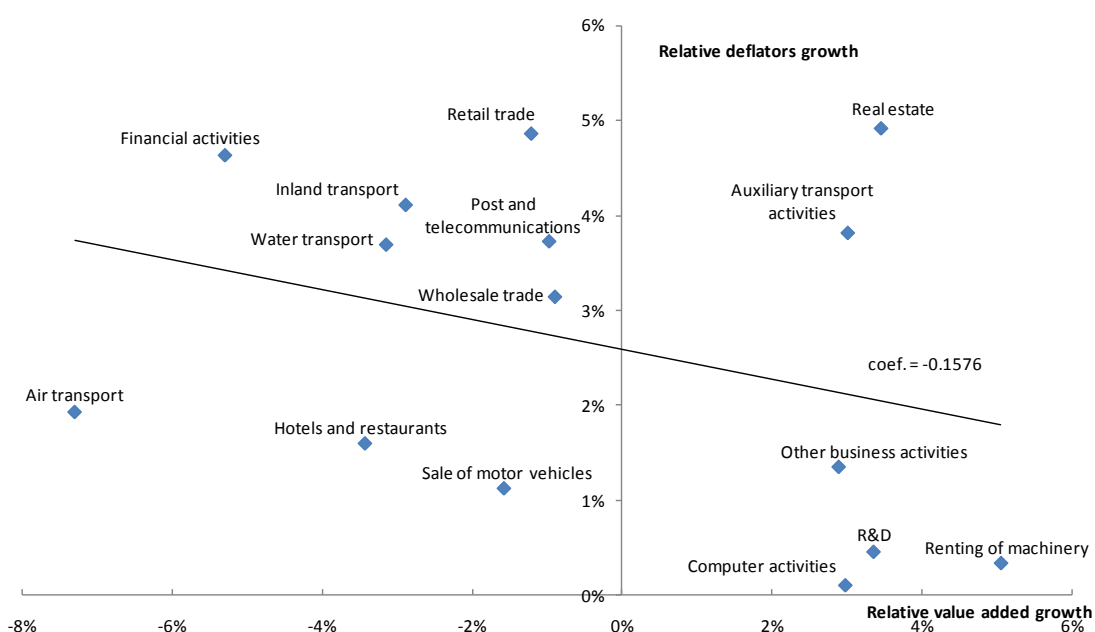
Source: EUKLEMS, March 2008 release.

On the whole, given the weight of the industries which recorded a strong deterioration of their relative position, Belgian market services recorded a slightly slower increase in value added than the one recorded by market services in the EU15. At the same time, relative prices increased by more than 2% per year.

The relative position of many market services deteriorated during 1975-1980: 9 industries representing 69% of Belgian market services value added, recorded a slower growth of their relative value added and a faster increase in their relative prices.

Over this period, all services industries recorded a deterioration of their relative prices, even those which managed to improve their relative position in the EU15.

**Graph 13 – Evolution of relative value added and prices of Belgian market services in the EU15, average annual growth rate, %, 1975-1980**



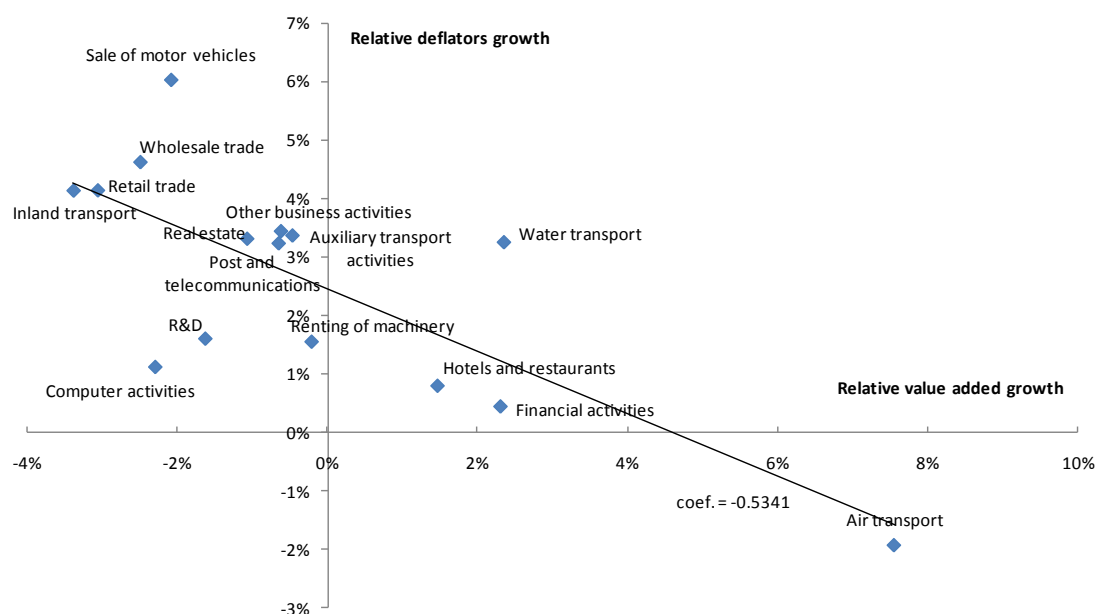
Source: EUKLEMS, March 2008 release.

Belgian market services as a whole recorded a deterioration of its relative position and the strongest deterioration of its relative prices (by more than 3% of annual growth rate).



The previously observed deterioration continued over 1980-1985, with 11 industries accounting for the bulk of total Belgian market services value added, located in the North-West quadrant of Graph 14. Air transport was the only service that was able to improve both its relative European position and its relative prices.

**Graph 14 – Evolution of relative value added and prices of Belgian market services in the EU15, average annual growth rate, %, 1980-1985**

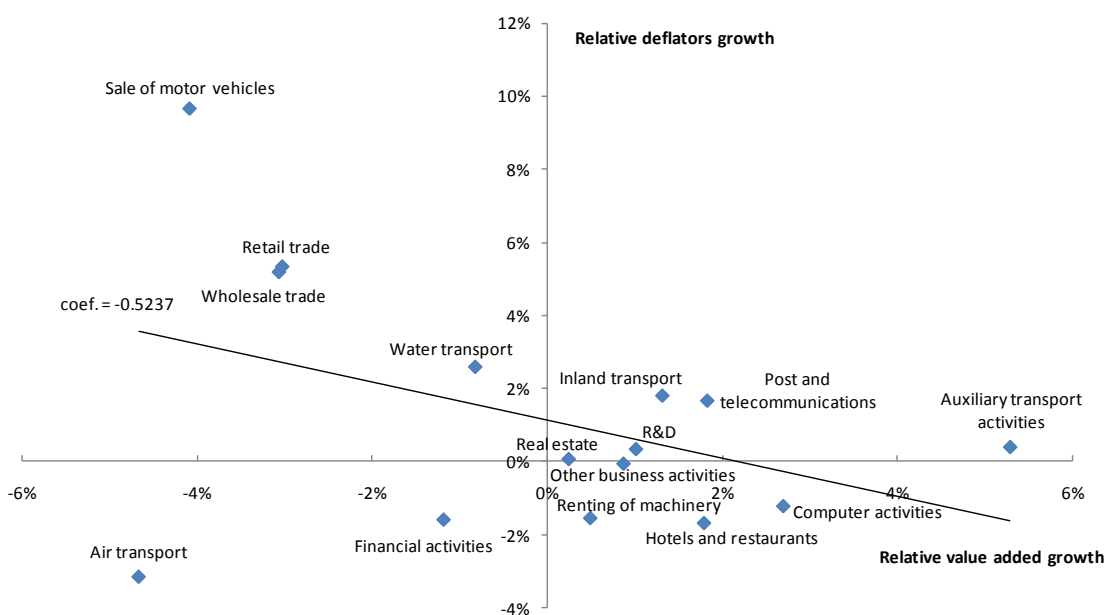


Source: EUKLEMS, March 2008 release.

This period was again characterised by a deterioration of the relative position of Belgian market services considered as a whole. This deterioration was even more pronounced than the one observed during the previous period. It was also concomitant with a strong deterioration of relative prices. As in the case of manufacturing, the Belgian franc devaluation played a role in its unfavourable relative prices evolution.

Over 1985-1990, 4 services mainly linked to Distribution activities were situated in the North-West quadrant of Graph 15 and 4 services among which activities related to Business services in the South-East quadrant.

**Graph 15 – Evolution of relative value added and prices of Belgian market services in the EU15, average annual growth rate, %, 1985-1990**

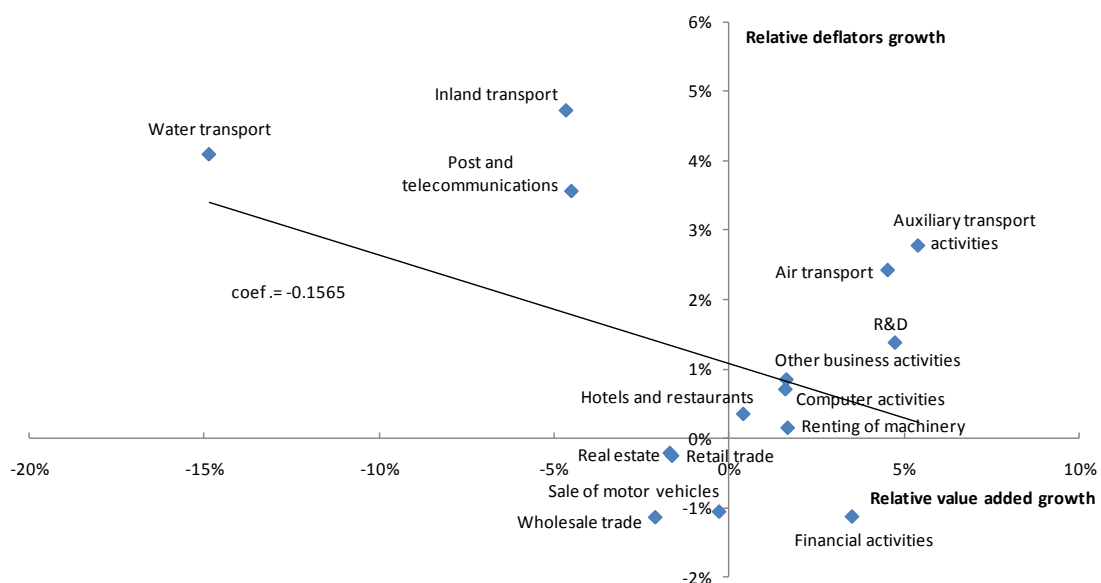


Source: EUKLEMS, March 2008 release.

On the whole, the relative position of Belgian market services continued to deteriorate but at a slower pace than during 1980-1985. At the same time, the rhythm of relative prices deterioration was cut by half (slightly above 1.5% per year) in comparison to the previous period.

Over 1990-1995, 3 services recorded a deterioration of both their relative European position and their relative prices, while only Financial activities improved both its relative European position and its relative prices.

**Graph 16 – Evolution of relative value added and prices of Belgian market services in the EU15, average annual growth rate, %, 1990-1995**

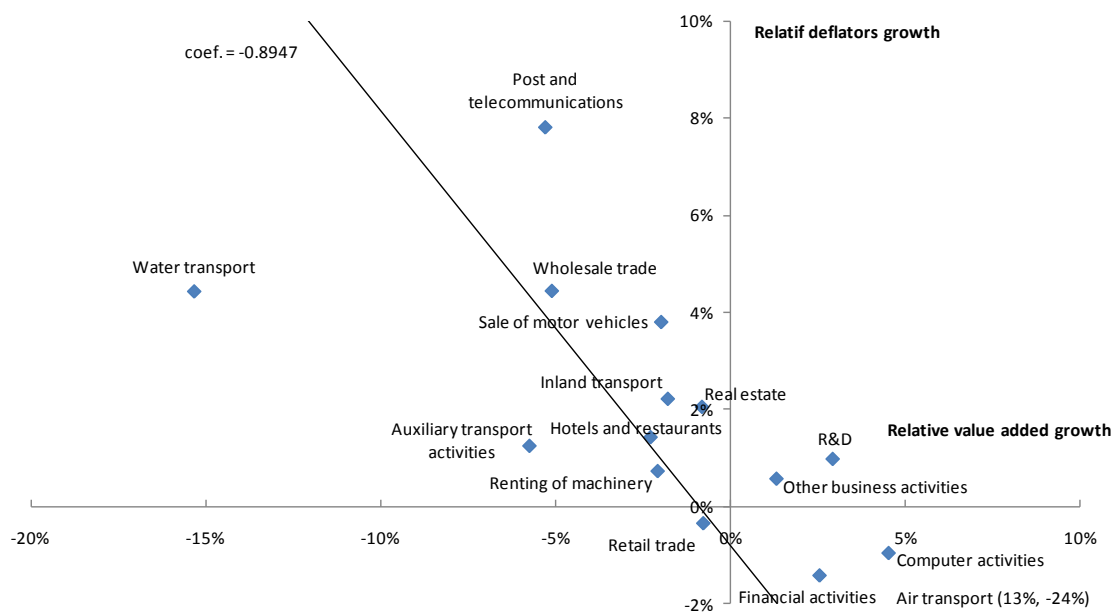


Source: EUKLEMS, March 2008 release.

Overall, Belgian market services value added grew at a slightly slower pace than European market services value added, while relative prices increases were very limited in comparison with other periods.

Over 1995-2000, 9 services were confronted with a deterioration of both relative value added growth and relative prices growth. They accounted for the major part of Belgian market services value added in volume. On the contrary, 3 services managed to improve both their relative position and their relative prices.

**Graph 17 – Evolution of relative value added and prices of Belgian market services in the EU15, average annual growth rate, %, 1995-2000**

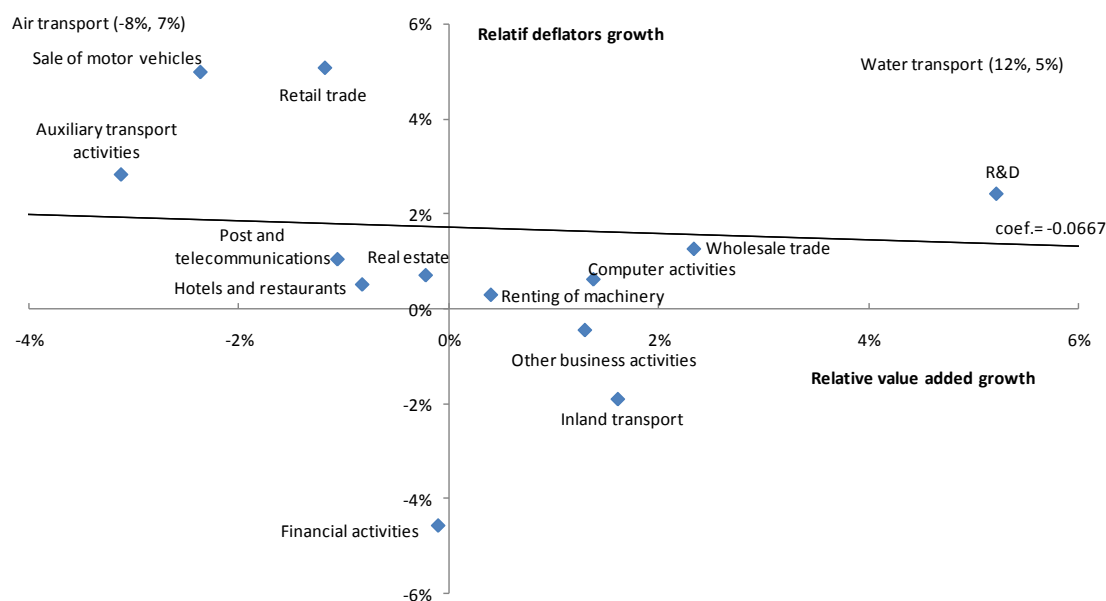


Source: EUKLEMS, March 2008 release.

Market services as a whole recorded one of the worst deteriorations of their relative position in the EU15 even if relative prices increases were relatively limited.

Over the most recent period, 7 services were located in the North-East quadrant and only 2 services in the South-West quadrant of Graph 18. However, 7 services industries were able to improve their position in Europe.

**Graph 18 – Evolution of relative value added and prices of Belgian market services in the EU15, average annual growth rate, %, 2000-2005**



Source: EUKLEMS, March 2008 release.

The most recent period is the first to be characterized by an overall improvement of the relative position of the Belgian market services in the EU15 despite the continuous deterioration of their relative prices.

The analysis of changes across periods underlines the declining importance of Distribution activities (NACE G merging 50, 51, 52). Since 1975, they have recorded a nearly constant deterioration of their relative position in the EU15. Their relative importance in Belgian value added also declined from 17% on average over 1970-1975 to 11% on average over 2000-2005. On the other hand, Renting activities and Business services (NACE 71 to 74) have constantly improved their relative position in the EU15, except during the period 1980-1985. Those activities have also become more and more important for the Belgian economy: over 2000-2005 on average, they accounted for 12% of Belgian total value added against only 4% on average over 1970-1975. Even if Post and telecommunications have increased their weight in the Belgian economy, from 2% of total value added over 1970-1975 to 3% over 2000-2005, they have expanded at a slower pace than their European counterparts since 1990 and the beginning of the liberalisation of the communications sector in Europe. This is another sign that Belgium is not a European leader in the ICT revolution.

Over 1970-2005 and within the EU15, the increase in Belgian market services specialisation occurred in Hotels and restaurants which are one of the less dynamic European market services and in Business activities which are the second most dynamic European market services after Post and communication (see Annex 1).

### 3. Econometric analysis

#### 3.1. Basic equation

The aim of this section is to econometrically verify and quantify the graphically visible relation between the share of Belgian industries in the EU15 value added in volume ( $\ln(VABE/VAEU)$ ) and the relative value added deflators ( $\ln(PXBE/PXEU)$ ). The basic equation to be tested has the following form:

$$(1) \ln(VABE/VAEU) = \alpha + \beta \ln(PXBE/PXEU) + \varepsilon$$

However, it is possible that value added in volume does not react immediately to changes in relative prices given, for example, lags needed to adapt sales contracts or time needed by customers to find new suppliers. Results of lagged panel equation for all sectors, manufacturing and market services (presented in Annex 2) show that 3-years lagged relative prices have still a significant impact on the Belgian share in value added of the EU15. Therefore, an error correction model (ECM) specification allowing the distinction between a contemporaneous effect and a long term effect is used to estimate the relation<sup>7</sup>:

$$(2) \Delta \ln(VABE_i/VAEU_i) = \alpha + \beta \Delta \ln(PXBE_i/PXEU_i) + \delta \ln(VABE_i/VAEU_i)_{t-1} + \gamma \ln(PXBE_i/PXEU_i)_{t-1} + \varepsilon_i$$

In this equation the subscript, *i*, identifies an individual industry. Indeed, analysing this relation at the highest level of disaggregation allows to take into account industry's prices adaptations specificities. This is why panel regression has been used to analyse data<sup>8</sup>.

Table 1 presents the results for the panel regression for 19 manufacturing industries and for 8 market services over 1970-2005.

**Table 1 – ECM results for prices equation, 1970-2005**

	Manufacturing	Market services
Short term prices $\beta$	-0.49***	-0.26***
Relative position-1 $\delta$	-0.11***	-0.15**
Relative prices-1 $\gamma$	-0.13***	-0.08***
E Price	-1.19	-0.57
$R^2_A$	0.33	0.17
DW	1.97	2.00

\*, \*\*, \*\*\*: significant at respectively 10, 5, 1%.

Estimation method: Panel with fixed effect, residuals heteroscedasticity robust test. For manufacturing, F-test of  $\alpha$   $F(18,643)=4.5751$ , P-value=[.0000] and Hausman test  $CHISQ(1)=29.071$ , P-value=[.0000]. For market services, F-test of  $\alpha$   $F(7,269)=4.3927$ , P-value=[.0001] and Hausman test  $CHISQ(1)=3.1483$ , P-value=[.0760].

<sup>7</sup> In the logarithmic ECM framework, the short term elasticity is  $\beta$  and the long term price elasticity is given by the formula:  $\xi = \gamma / -\delta$ . In the equation, the subscript *t* for time period has been omitted.

<sup>8</sup> The choice between random and fixed effect models has been based on the result of the Hausman test.

In the short run, the evolution of the relative deflator has a significant negative impact on the evolution of the relative position of both manufacturing industries and market services ( $\beta$  in Table 1).

In the long run, this negative relation is also verified for both groups of industries. Long term price elasticity equals -0.57 for market services which is about half of the value of the long term price elasticity for manufacturing (-1.20). Moreover,  $R^2$  statistic is much larger for manufacturing industries than for market services indicating that relative prices and their evolutions are less suitable to explain the relative position of market services than of manufacturing industries.

The relative evolution of prices, measured by value added deflators, has a negative short term and long term impact on the share of European value added produced in Belgium. However, as expected given the degree of homogeneity of products and of competition, the relative price elasticity is much larger for manufacturing than for market services.

### 3.2. Components of relative prices

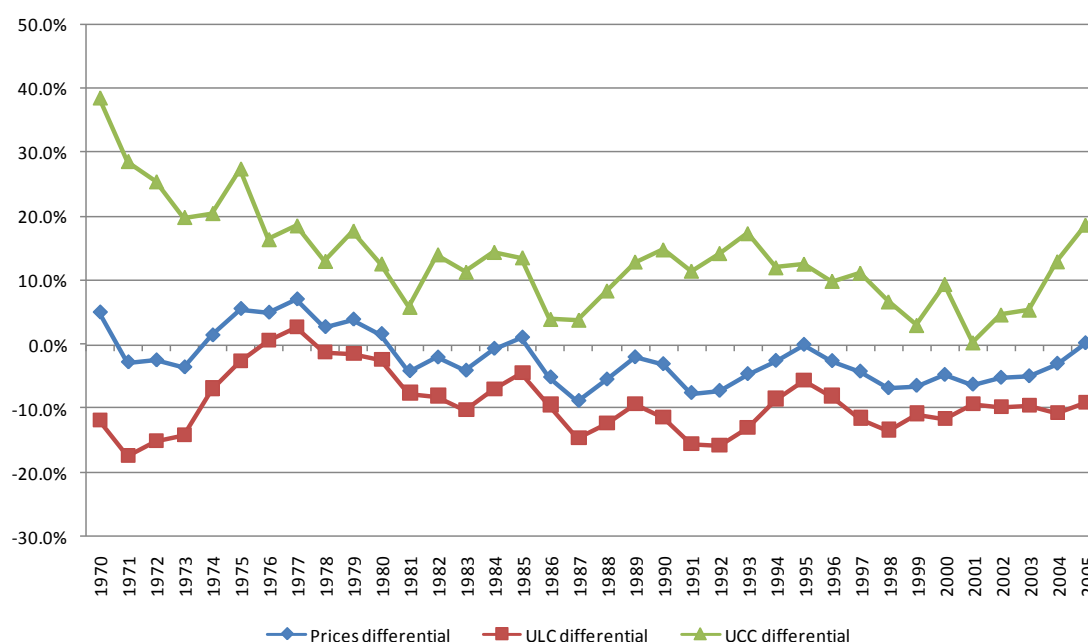
Prices increase when the unit cost of factors of production, labour or capital, increases, all things being equal elsewhere. The unit cost of factors increases when the hourly wage increases faster than labour productivity growth or when the compensation for one capital unit increases faster than capital productivity growth. The expected relation between the relative unit costs and the relative value added is therefore negative: if the unit labour cost or unit capital cost increases faster in a Belgian industry than in Europe on average, the value added growth of the Belgian industry is expected to grow slower than the European one, which leads to a deterioration of its relative position in the EU15. Given data available in the EUKLEMS database, relative prices may be disentangled into relative unit labour costs ( $\ln(ULCBE_i/ULCEU_i)$ ) and relative unit capital costs ( $\ln(UCCBE_i/UCCEU_i)$ ). However, those two variables have to be analysed with caution given assumptions prevailing to the database construction. Indeed, one of the main assumptions in the EUKLEMS database is the absence of economic profit which allows defining endogenously capital remuneration as nominal value added minus labour compensation. This assumption implies that all factors leading to changes in value added which are not due to changes in labour compensation are interpreted as changes in capital remuneration. For example, an increase in competition leading to a decrease in mark-up will be translated in a decrease in capital remuneration as estimated in the database, and therefore, to a decrease in unit capital cost.

Before presenting the results, it could be useful to recall the main trends of prices, unit labour costs and unit capital costs differentials. As illustrated in Graph 19 for manufacturing and Graph 20 for market services, relative prices were more influenced by relative unit labour costs than by relative unit capital costs. This is not surprising given the importance of the labour factor in the production function.



For manufacturing, the decrease in relative prices recorded between 1976 and the beginning of the eighties was due to a decrease in both relative unit labour and unit capital costs. Over 1986 to 1993, divergences appeared in the evolution of the two relative unit costs with a stabilisation of relative unit labour costs and an increase in relative unit capital costs. From 1993 until 2001, both relative capital and labour unit costs decreased. However, since 2001, the previously mentioned divergence has reappeared, which explains the recent increase in relative prices.

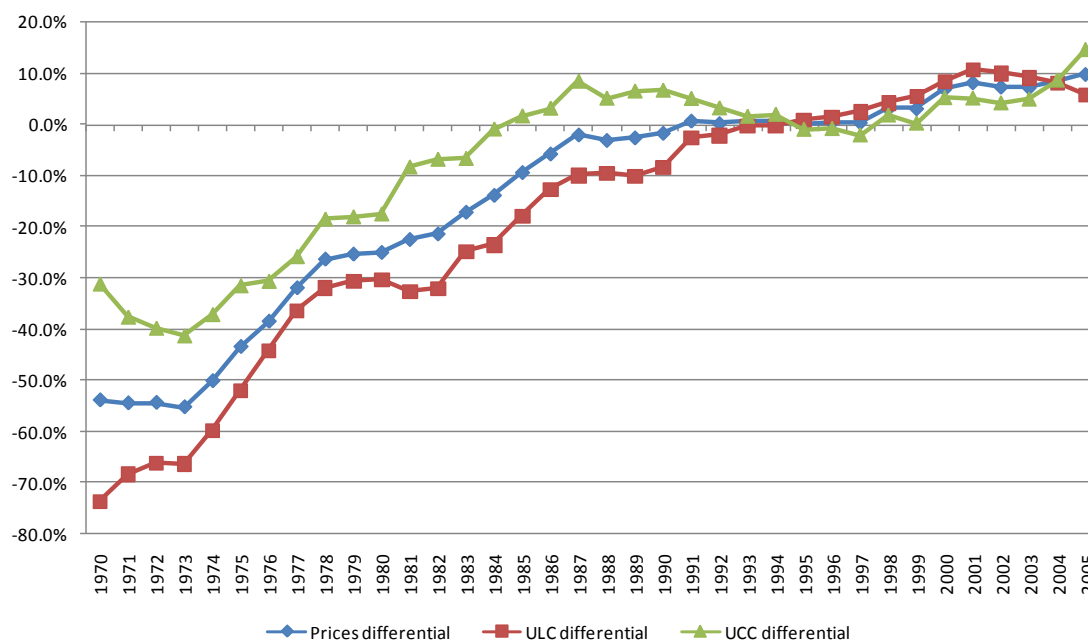
**Graph 19 – Prices, unit labour cost and unit capital cost differentials, manufacturing, 1970-2005, %**



Source: EUKLEMS, March 2008 release FPB calculations.

For market services, relative prices evolution has been mainly driven by relative unit labour costs which increased by steps from 1973 to 2000. From 1973 until 1987, relative unit capital costs also increased rapidly before decreasing until 1997, allowing for a quasi-stabilisation of relative prices between 1991 and 1997. The most recent years were characterised by the same evolutions of relative unit costs than those for manufacturing: a slight decrease of relative unit labour cost combined with a large increase in relative unit capital cost leading to an increase in relative prices.

**Graph 20 – Prices, unit labour cost and unit capital cost differentials, market services, 1970-2005, %**



Source: EUKLEMS, March 2008 release FPB calculations.

The basic equation can be rewritten in order to identify the respective effects of the two components of relative prices variations:

$$\begin{aligned}
 (3) \quad \Delta \ln(VABE_i / VAEU_i) = & \alpha_i + \beta \Delta \ln(ULCBE_i / ULCEU_i) + \phi \Delta \ln(UCCBE_i / UCCEU_i) \\
 & + \delta \ln(VABE_i / VAEU_i)_{t-1} + \gamma \ln(ULCBE_i / ULCEU_i)_{t-1} \\
 & + \lambda \ln(UCCBE_i / UCCEU_i)_{t-1} + \varepsilon_i
 \end{aligned}$$

However, in order to calculate relative unit capital costs, Motor vehicles industry has to be merged with Other transport vehicles industry because of data availability, leading to 18 industries in manufacturing.

The visual observation of the importance of relative unit labour costs is confirmed by the results of the regression given in Table 2. For manufacturing, both relative unit costs have a positive short term impact on the share of Belgian manufacturing value added in European manufacturing value added ( $\beta$  and  $\phi$  in Table 2) but the coefficient of relative unit capital costs is very close to zero. In the long run, only relative unit labour costs present a significant negative elasticity (-1.03), smaller than the long term prices elasticity (for memory this elasticity is given in the last line of Table 2).

**Table 2 – ECM results for ULC and ucc equation, 1970-2005**

	Manufacturing	Market services
Short term ULC $\beta$	-0.47***	-0.47***
Short term UCC $\phi$	-0.04**	0.16***
Relative position-1 $\delta$	-0.10***	-0.13***
Relative ULC-1 $\gamma$	-0.10***	-0.10***
Relative UCC-1 $\lambda$	0.01	0.02**
E ULC	-1.03	-0.77
E UCC		0.14
R2A	0.37	0.46
DW	2.00	1.89
E PRICE	-1.19	-0.57

\*, \*\*, \*\*\*: significant at respectively 10, 5, 1%.

Estimation method: Panel with fixed effect, residuals heteroscedasticity robust test. For manufacturing, F-test  $F(17,607)=5.1820$ , P-value=[.0000] and hausman test  $CHISQ(3)=206.55$ , P-value=[.0000] and for market services, F-test  $F(7,267)=4.4164$ , P-value=[.0001] and hausman test  $CHISQ(3)=68.182$ , P-value=[.0000].

For market services, the short term coefficient of relative unit labour costs is significant and very close to the coefficient for manufacturing ( $\beta$  in Table 2). The long term relative unit labour costs elasticity, however, is much lower than for manufacturing. For market services, the relative unit labour costs elasticity is also higher than the relative prices elasticity.

The main divergence in the results comes from the coefficients of relative unit capital cost ( $\phi$  and E UCC in Table 2). For market services, those coefficients, both in short and long term, are positive. These counterintuitive results could be explained by assumptions founding unit capital cost estimation. As already mentioned, an increase in competition which decreases mark-ups is translated into a decrease of capital compensation and, therefore, into a decrease of unit capital cost. If Belgian market services have been liberalised at a slower pace than the European ones, relative unit capital cost has increased without leading to a decrease in their market as it remained protected.

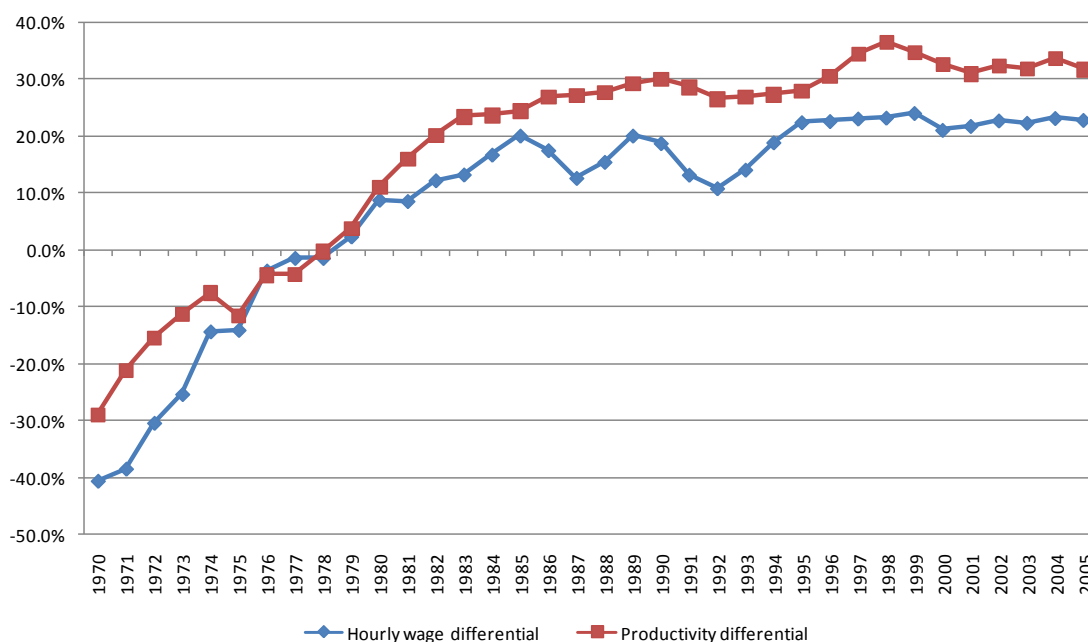
The replacement of relative prices by relative unit costs in the equation has improved the adjusted R<sup>2</sup> indicating that changes in relative position are better explained by changes in relative unit costs than by changes in relative prices. This improvement is more pronounced for market services than for manufacturing.

It is even possible to go further in the analysis and to decompose relative labour cost into relative hourly wage ( $\ln(HWBE_i/HWEU_i)$ ) and relative hourly productivity ( $\ln(PRODBE_i/PRODEU_i)$ ). Keeping the same econometric specification, the equation to be tested becomes:

$$(4) \quad \Delta \ln(VABE_i/VAEU_i) = \alpha_i + \beta \Delta \ln(HWBE_i/HWEU_i) + \nu \Delta \ln(PRODBE_i/PRODEU_i) + \phi \Delta \ln(UCCBE_i/UCCEU_i) + \delta \ln(VABE_i/VAEU_i)_{t-1} + \gamma \ln(HWBE_i/HWEU_i)_{t-1} + \pi \ln(PRODBE_i/PRODEU_i)_{t-1} + \lambda \ln(UCCBE_i/UCCEU_i)_{t-1} + \varepsilon_i$$

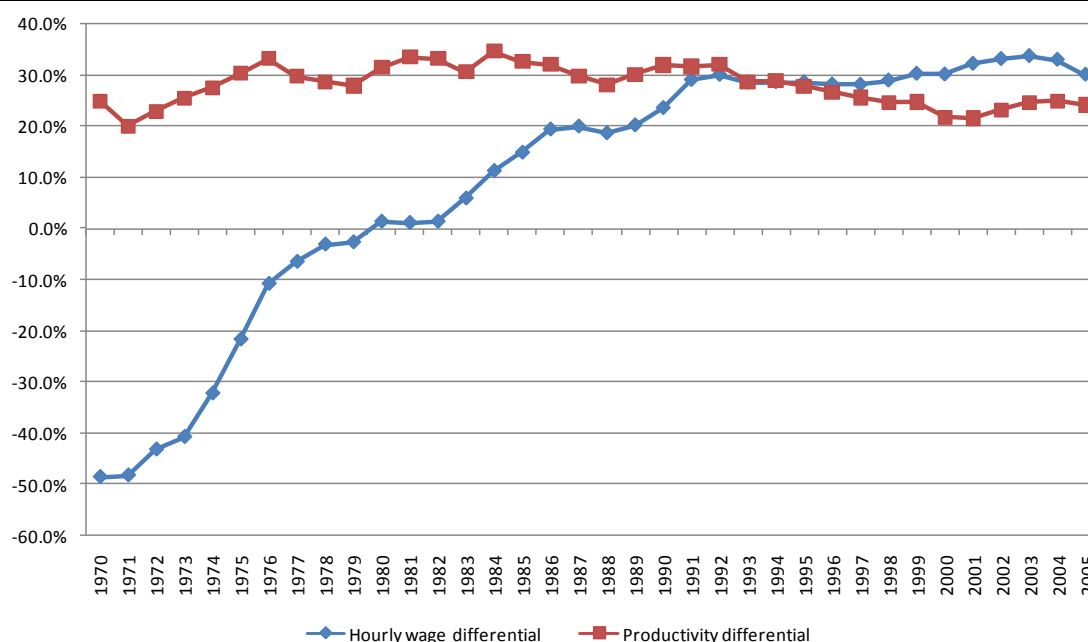
Before analysing the econometric results, it could be useful to have a look at some important evolutions of hourly wage and productivity differentials between Belgium and the EU15. As illustrated in Graph 21, hourly wage and productivity differential for manufacturing has been positive since 1979. Moreover, productivity differential has been higher than hourly wages differential. The difference between the two curves reached its maximum at the beginning of the nineties. Since then, the difference has decreased.

**Graph 21 – Hourly wage and productivity differentials, manufacturing, 1970-2005, %**



Source: EUKLEMS, March 2008 release FPB calculations.

As illustrated in Graph 22, market services differentials have evolved in a very different way than manufacturing differentials. Hourly wage differential was strongly negative at the beginning of the period and constantly increased until 1992, becoming positive in 1979. By contrast, productivity differential has been always positive but has markedly declined over 1992-2000. Since then, it has recorded a rebound. Since 1995, hourly wage differential has been higher than productivity differential. Since 2002, however, the difference between the two differentials has decreased.

**Graph 22 – Hourly wage and productivity differentials, market services, 1970-2005, %**

Source: EUKLEMS, March 2008 release FPB calculations.

As shown in Table 3, for Belgian manufacturing, a faster increase in productivity than the European counterparts has a positive impact on the relative position in the EU15 (coefficient  $\nu$ ). The long term positive effect of relative productivity is also significant (line E PROD in Table 3). The productivity elasticity is slightly above 1.

As expected, the relative hourly wage has a negative short term ( $\beta$  in Table 3) as well as long term impact (E WAG in Table 3) on the relative position of Belgian manufacturing. The long term negative effect is higher than the short term effect.

**Table 3 – ECM results for relative hourly wages, productivity and ucc, 1970-2005**

	Manufacturing	Market services
Short term wage $\beta$	-0.15**	-0.06**
Short term productivity $\nu$	0.82***	0.86***
Short term UCC $\phi$	-0.02	0.02
Relative position-1 $\delta$	-0.07***	-0.00
Relative wage-1 $\gamma$	-0.03***	0.01
Relative productivity-1 $\pi$	0.07***	0.00
Relative UCC-1 $\lambda$	-0.01	0.00
E WAG	-0.52	
E PROD	1.04	
E UCC		
R2A	0.75	0.88
DW	1.47	1.41

\*, \*\*, \*\*\*: significant at respectively 10, 5, 1%.

Estimation method: Panel OLSQ with fixed effect for manufacturing and random effect for market services, residuals heteroscedasticity robust test. For manufacturing,  $F(17,605)=5.6772$ ,  $P\text{-value}=[.0000]$  and hausman test  $CHISQ(3)=146.88$ ,  $P\text{-value}=[.0000]$ . For market services,  $F\text{-test } F(7,265)=2.7787$ ,  $P\text{-value}=[.0084]$  and hausman test  $CHISQ(5)=7.5047$ ,  $P\text{-value}=[.1857]$ .

For manufacturing, the value of the relative productivity elasticity is much higher than the value of the relative hourly wages elasticity. This means that policy designed to restore competitiveness based on productivity improvement has a stronger positive long term impact than policy based on wage moderation.

For market services, the only significant coefficients are those of short term impact. As expected, relative hourly wages have a negative short term impact on the relative European position of market services while relative productivity has a positive short term impact, close to 1. However, in the long run, no variable has a significant coefficient.

### 3.3. Components of labour productivity growth

Previous results have underlined the importance of relative productivity to maintain and strengthen the relative position of Belgium in the EU15. It is, therefore, important to better understand movements in relative productivity. According to the growth accounting framework, three factors can be at the origin of productivity growth: the increase in capital per worker (called capital deepening or CD) resulting from an increase in the capital intensity of productive process, the change in labour composition in favour of more productive workers (called labour composition effect or LCE) and the change of all other elements which influence the efficiency with which labour and capital are combined to produce and which are gathered in the concept of Total Factor Productivity (TFP). TFP increase captures the improvement of capacity to innovate in new or improved products and in new organisations and processes of production as well as all other factors which are not included in the labour composition effect or in capital deepening.

The EUKLEMS database offers the opportunity to implement this labour productivity growth decomposition for Belgium and for the EU10<sup>9</sup> for 12 manufacturing industries and 4 market services<sup>10</sup> over the period 1981-2005. This decomposition allows the construction of indices (with basis 1980) for each component of productivity growth for Belgian and European industries. It is therefore straightforward to construct three relative productivity components (CD, LCE and TFP) by taking the difference in logarithms between the Belgian and the European indices. Therefore, relative labour productivity might be replaced in the previous equation by its three components. However, as denominator of unit capital cost is capital productivity and as capital productivity is function of TFP and the inverse of capital deepening (L/K), relative unit capital cost is removed from the equation to be tested.

Before analysing the econometric results, it is interesting to have an overall view of the evolutions of the three productivity components for manufacturing and for market services.

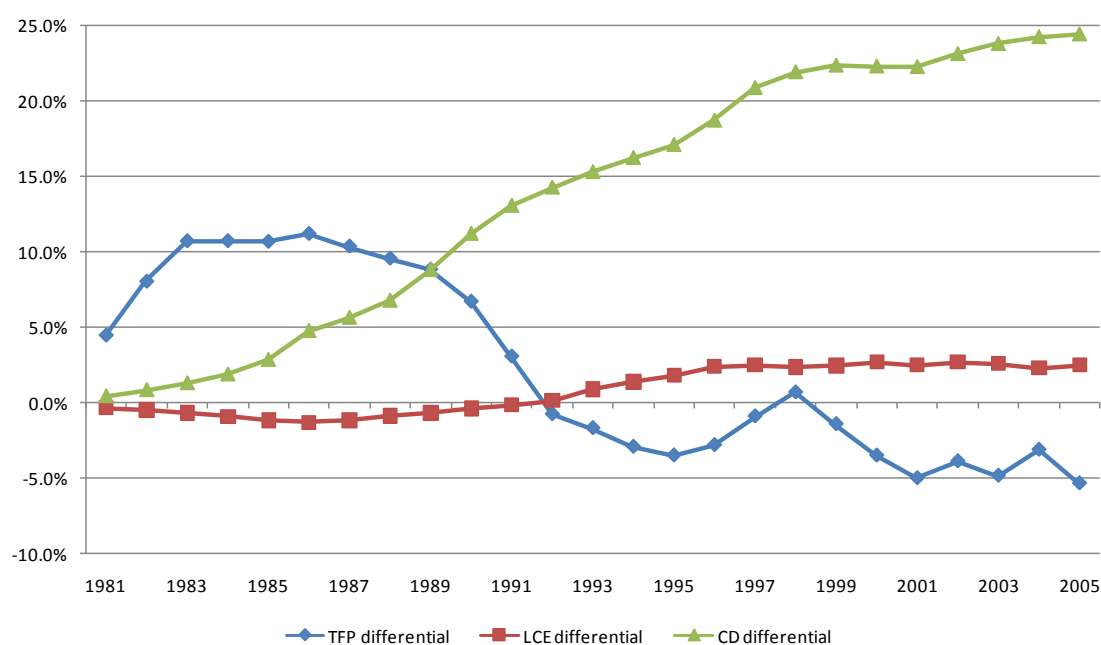
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<sup>9</sup> These 10 countries are Austria, Belgium, Denmark, Spain, Finland, France, Germany, Italy, the Netherlands and the United Kingdom.

<sup>10</sup> As more disaggregated data are not available, it is not possible to remove Real estate activities from Business services (industry K). Given the instability of this category of services, industry K is removed from the panel.

As illustrated in Graph 23 for manufacturing, capital deepening differential was positive and on an increasing trend over the whole period. This evolution is consistent with the widespread view of a strongly capitalistic Belgian manufacturing. The labour composition effect differential was at first slightly negative between 1981 and 1991 before becoming positive for the rest of the period. Changes in the labour characteristics have been more favourable to productivity in the Belgian manufacturing than in the European one (EU10). The TFP differential was positive and increased until 1986, afterwards it decreased until 1995, and became negative in 1992. The second half of the nineties was characterised by a new increase resulting in a slightly positive differential in 1998. Since then, TFP differential has been negative and on a decreasing trend.

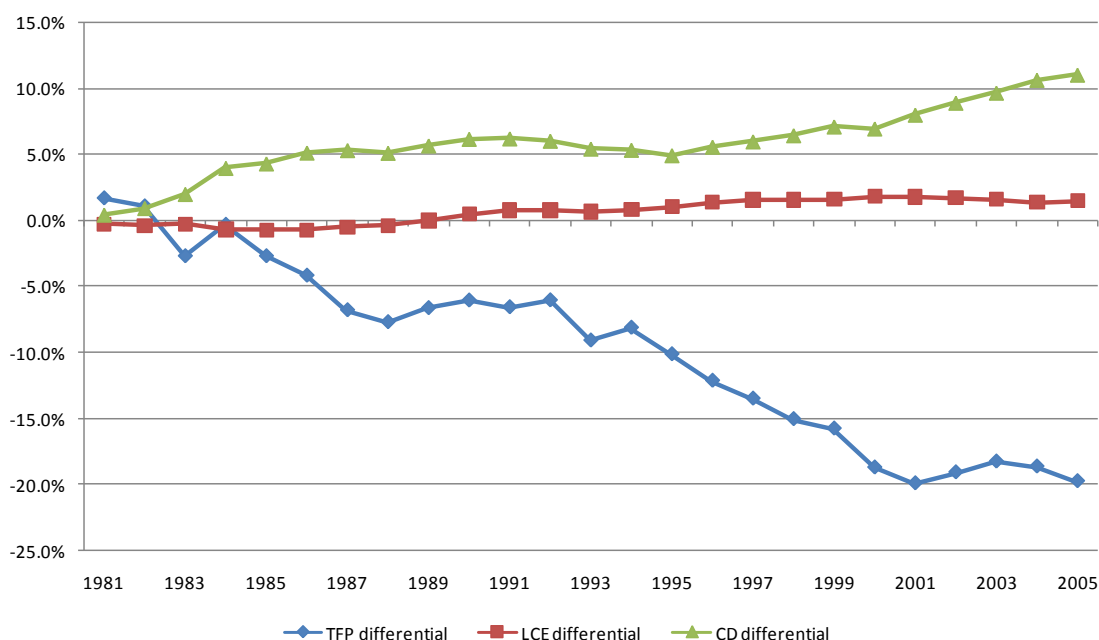
**Graph 23 – TFP, LCE and CD differential, manufacturing, 1981-2005, %**



Source: EUKLEMS, March 2008 release FPB calculations.

As illustrated in Graph 24, capital deepening differential was also positive for market services even if it remained largely smaller than the differential recorded for manufacturing. Since the mid-nineties, this differential has increased more rapidly. This acceleration could be partly due to ICT investments. Indeed, since 1994, relative ICT capital deepening, which was negative since the mid-eighties, became positive, Belgian services catching up on other European countries in the progressive introduction of these new technologies in their production function.

**Graph 24 – TFP, LCE and CD differential, market services, 1981-2005, %**



Source: EUKLEMS, March 2008 release FPB calculations.

The labour composition effect differential follows the same pattern as the manufacturing one but at a lower amplitude. The TFP differential adopts a totally different pattern than in manufacturing, and has been negative since the mid-eighties. This differential was on a negative trend until 2001, afterwards it recorded a small rebound. In 2005, TFP differential reached again its 2001 level.

In order to assess the respective impact of those three components on the relative position, the equation becomes for each industry *i*:

$$\begin{aligned} \Delta \ln(VABE_i/VAEU_i) = & \alpha_i + \beta \Delta \ln(HWBE_i/HWEU_i) + \nu \Delta \ln(TFPBE_i/TFPEU_i) + \xi \Delta \ln(LCEBE_i/LCEEU_i) \\ & + \phi \Delta \ln(CDBE_i/CDEU_i) + \delta \ln(VABE_i/VAEU_i)_{t-1} + \gamma \ln(HWBE_i/HWEU_i)_{t-1} \\ & + \pi \ln(TFPBE_i/TFPEU_i)_{t-1} + \varphi \ln(LCEBE_i/LCEEU_i)_{t-1} + \lambda \ln(CDBE_i/CDEU_i)_{t-1} + \varepsilon_i \end{aligned}$$

Results presented in Table 4 show that for manufacturing, the short term impact of relative TFP ( $\nu$  in Table 4) is significant, positive and equal to 1. This is due to the residual nature of the TFP. This implies that the cyclical movements are fully translated in TFP movements. Relative hourly



wages have also a significant coefficient, negative as expected but very close to 0 ( $\beta$  in Table 4). Finally, the relative labour composition effect also has a significant positive short term impact on the relative European position of Belgian manufacturing ( $\xi$  in Table 4).

Short term coefficients of market services present values close to the ones of manufacturing, except for the relative labour composition effect, which has a much higher positive short term impact for market services than for manufacturing.

**Table 4 – ECM results for components of labour productivity growth, 1981-2005**

	Manufacturing	Market services
Short term wage $\beta$	-0.03**	-0.09
Short term TFP $\nu$	0.98***	0.94***
Short term LCE $\xi$	0.59***	1.16***
Short term CD $\phi$	0.21	0.20
Relative position-1 $\delta$	-0.06**	-0.05***
Relative wage-1 $\gamma$	-0.03*	0.02
Relative TFP-1 $\pi$	0.07***	0.04**
Relative LCE-1 $\varphi$	-0.01	0.03
Relative CD-1 $\lambda$	0.06**	-0.02
E WAG	-0.50	
E TFP	1.26	0.81
E LCE		
E CD	1.00	
R2A	0.88	0.90
DW	1.24	1.52

\*, \*\*, \*\*\*: significant at respectively 10, 5, 1%.

Estimation method: OLSQ and Panel OLSQ with fixed effect, residuals heteroscedasticity robust test. For manufacturing, F test  $F(11,267)=5.2153$ , P-value=[.0000] and hausman test  $CHISQ(3)=16.962$ , P-value=[.0007]. For market services, hausman test  $CHISQ(2) = 47.344$ , P-value = [.0000].

In the long run, three elasticities have been calculated for manufacturing. As expected, the elasticity of relative hourly wages is negative. Among the components of productivity, relative TFP presents the largest elasticity for manufacturing followed by relative capital deepening.

The only significant long term effect for market services is produced by relative TFP. Its elasticity is positive but smaller than the manufacturing one.

## 4. Conclusion

Over 1970-2005, the evolution of the relative share of Belgian value added in the EU15 was influenced by relative value added deflator changes. The graphical analysis indicates a negative relationship between change in relative value added and changes in relative prices for the majority of manufacturing industries and market services. The econometric analysis confirms this negative relationship, which underlines a much higher long term impact than short term one. As expected, given the degree of homogeneity of products and of markets opening, the relative price elasticity is much higher for manufacturing than for market services. As relative unit labour cost replaces relative price in the equation, the negative relation is confirmed by econometric results. However, this elasticity is smaller than the relative price elasticity in the case of manufacturing and is higher in the case of market services. When relative unit labour cost is decomposed into its two components, relative hourly wages and relative productivity, the two have a significant influence on the relative position of manufacturing, but relative productivity has a higher elasticity than relative hourly wages.

When considering the relative position in the EU10 over 1981-2005, results give a negative relative hourly wages elasticity for manufacturing that is very close to that resulting from the comparison with the EU15 for 1970-2005. The analysis goes a step further by introducing a decomposition of the relative productivity into three elements: relative TFP, relative labour composition effect and relative capital deepening. This decomposition underlines the importance of relative TFP for manufacturing and market services. Relative capital deepening is also an important long-term determinant of the relative position of manufacturing in the EU10.

From an economic policy point of view, the analysis shows that the law in favour of the promotion of growth and the safeguard of competitiveness has allowed a stabilisation of relative wages. Econometric results, on the other hand, justify the implementation of this law with the importance of the relative unit labour cost elasticity. These results also underline the importance of taking into account the two parts of labour cost: the hourly wage and productivity. In the long run, policies designed to promote productivity and, in particular, TFP gains have larger impact than wage moderation policies. However, these policies are more difficult to define and implement. Indeed, links between policy instruments such as direct R&D subsidies or R&D enhancing taxation, and TFP growth are not straightforward. Moreover, the majority of these instruments have a direct budgetary cost and are therefore subject to trade-offs. A better understanding of TFP determinants in order to define the most efficient instruments is therefore a crucial step forward in the research programme.

## Annex 1: Relative importance of industries for the Belgian economy and in the EU15

**Table 5 – Share of manufacturing industries in Belgian value added in volume terms in Total industry, average on 5-year period, %**

	1970-75	1975-80	1980-85	1985-90	1990-95	1995-00	2000-05
Total Manufacturing	19.2	19.0	20.6	21.7	20.4	20.7	19.8
Food	3.1	2.8	2.7	2.8	2.6	2.5	2.3
Textile	2.0	1.3	1.2	1.2	1.2	1.3	1.0
Leather	0.5	0.2	0.2	0.1	0.1	0.1	0.0
Wood	0.2	0.2	0.2	0.3	0.3	0.3	0.3
Paper	0.7	0.5	0.6	0.6	0.6	0.5	0.6
Edition, printing	1.0	0.8	0.8	0.9	1.0	1.0	0.9
Coke and nuclear power	0.3	0.6	0.7	0.7	0.5	0.3	0.2
Chemicals	1.0	1.5	2.6	3.3	3.5	4.2	4.1
Rubber, plastics	0.2	0.3	0.4	0.6	0.7	0.7	0.8
Non-metallic fabrications	1.2	1.1	1.0	1.0	1.1	1.0	0.9
Basic metal	2.3	2.0	2.2	2.2	1.7	1.6	1.6
Fabricated metal	1.7	1.7	1.5	1.4	1.4	1.5	1.5
Machinery	1.8	1.8	1.7	1.6	1.2	1.3	1.2
Office, accounting, computer	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Electrical apparatus	1.2	1.2	1.2	1.1	0.9	0.9	0.9
Radio, television, communication	0.8	0.8	0.8	0.7	0.6	0.9	0.8
Medical, precision instruments	1.3	1.5	1.9	2.0	1.8	1.8	1.7
Motor vehicles	1.3	1.5	1.9	2.0	1.8	1.8	1.7
Other transport vehicles	0.2	0.2	0.2	0.2	0.2	0.3	0.3
Other manufacturing	1.2	1.1	0.8	0.8	0.6	0.6	0.6

Due to the use of Tornqvist index in aggregation of individual industries volume variables, the sum of industries share does not correspond exactly to total manufacturing and total industries.

**Table 6 – Share of market services in value added in volume terms in Total industry, average on 5-year period, %**

	1970-75	1975-80	1980-85	1985-90	1990-95	1995-00	2000-05
Total market services	43.0	43.5	44.4	44.7	47.0	47.9	49.6
Sale of motor vehicles	2.2	2.2	1.9	1.7	1.6	1.4	1.3
Wholesale	9.5	9.3	8.3	7.6	7.1	6.1	6.4
Retail trade	5.5	5.4	4.9	4.4	4.1	3.8	3.7
Hotels and restaurants	1.9	1.6	1.5	1.6	1.6	1.5	1.4
Transport	5.3	5.1	4.8	4.9	5.8	5.6	5.3
Post and communication	1.7	1.8	1.9	2.2	2.6	2.4	2.9
Financial activities	6.4	5.7	5.4	5.4	5.7	7.2	7.9
Business services	4.2	5.2	6.1	7.2	8.5	10.5	11.6

Due to the use of Tornqvist index in aggregation of individual industries volume variables, the sum of industries share does not correspond exactly to total market services and total industries.

**Table 7 – Share of Belgian manufacturing industries in European manufacturing industries value added in volume terms, 1970 and 2005, and annual average growth rate of European value added over 1970-2005, %**

	1970	2005	European Annual average growth rate
Total Manufacturing	2.05	2.81	1.73
Food	3.00 (4)	3.62 (4)	1.17
Textile	2.47 (9)	3.09 (6)	-0.79
Leather	3.51 (3)	0.57	-0.70
Wood	0.65	2.23	1.76
Paper	2.52 (8)	2.95 (7)	1.58
Edition, printing	2.17	2.59 (9)	1.54
Coke and nuclear power	1.33	4.73 (2)	-1.07
Chemicals	1.64	4.72 (3)	4.01
Rubber, plastics	0.54	2.32	3.55
Non-metallic fabrications	2.89 (6)	2.52 (10)	1.64
Basic metal	5.88 (2)	5.17 (1)	1.33
Fabricated metal	1.13	2.11	0.33
Machinery	1.42	1.65	1.19
Office, accounting, computer	2.86 (7)	0.39	6.96
Electrical apparatus	2.90 (5)	2.87 (8)	1.81
Radio, television, communication	7.56 (1)	1.77	6.48
Medical, precision instruments	1.66	1.00	3.83
Motor vehicles	1.73	3.38 (5)	1.95
Other transport vehicles	0.55	1.64	1.36
Other manufacturing	2.17 (10)	1.84	0.83

In brackets: rank of the 10 highest shares.

**Table 8 – Share of Belgian market services in European market services value added in volume terms, 1970 and 2005, and annual average growth rate of European value added over 1970-2005, %**

	1970	2005	European Annual average growth rate
Total market services	3.33	2.79	3.20
Sale of motor vehicles	3.54 (5)	1.96	2.12
Wholesale	7.12 (1)	4.07 (1)	2.66
Retail trade	3.81 (3)	2.18 (5)	2.40
Hotels and restaurants	1.70	1.77	1.37
Transport	3.76 (4)	2.91 (3)	3.07
Post and communication	2.88	1.86	5.26
Financial activities	4.45 (2)	3.69 (2)	3.02
Business services	2.01	2.72 (4)	3.71

In brackets: rank of the 5 highest shares.

## Annex 2

**Table 9 – Lagged effect of prices on relative value added**

$$\ln(VABE_i/VAEU_i) = \alpha + \beta_1 \ln(PXBE_i/PXEU_i) + \beta_2 \ln(PXBE_i/PXEU_i)_{t-1} + \beta_3 \ln(PXBE_i/PXEU_i)_{t-2} + \beta_4 \ln(PXBE_i/PXEU_i)_{t-3} + \varepsilon_i$$

	$\beta_1$	$\beta_2$	$\beta_3$	$\beta_4$	NOBS
Total economy	-0.55***	0.03	-0.14	-0.26***	891
Manufacturing	-0.64**	-0.01	-0.14	-0.37***	627
Market services	-0.33**	0.06	-0.11	-0.18	264

\*, \*\*, \*\*\*: significant at respectively 10, 5, 1%.

Panel OLSQ with random effect (Hausman-test), residuals heteroscedasticity robust test.

## Annex 3

**Table 10 – Correlation between unit labour cost and unit capital cost, 1970-2005**

	ULC-UCC
Manufacturing	0.50541
Market services	0.52585

**Table 11 – Correlation between relative hourly wages, productivity and unit capital cost, 1970-2005**

	Wages-PROD	Wages-UCC	UCC-PROD
Manufacturing	0.28431	0.073638	-0.52035
Market services	0.38887	0.42322	-0.14059

**Table 12 – Correlation between relative TFP, LCE, CD, and hourly wages**

	TFP-LCE	TFP-CD	LCE-CD	TFP-SAL	LCE-SAL	CD-SAL
Manufacturing	0.045721	-0.26169	0.48056	-0.10729	0.27756	0.052634
Market services	-0.42181	-0.4294	0.81411	-0.14929	0.40094	0.21849