Labor productivity in Europe: Evidence from a sample of regions♦

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Abstract

The present paper aims at analyzing the sources of productivity in Europe to account for its recent underperformance and identify potential geographic idiosyncracies. We study the productivity performance and its sources in a sample of ten European regions belonging to four countries (France, Germany, Italy and Spain). Exploiting the increasing availability of disaggregated data at regional level in Europe, we propose both a descriptive statistics and an econometric analysis of productivity sources since 1995. Our main finding is that the sources of labor productivity are rather heterogeneous across our sample but may be associated with regional or national idiosyncracies.

Keywords: Labor productivity, productivity determinants, European regions.

JEL Classification: J24, O11, O18, O52.

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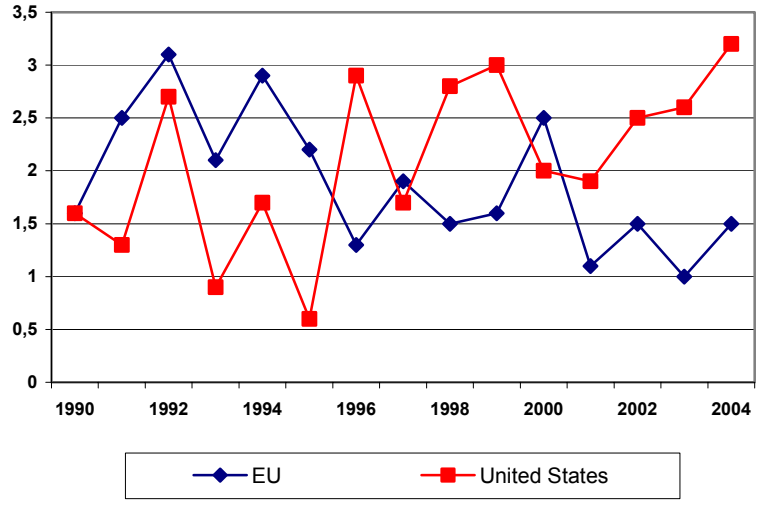
1. Introduction

The lower productivity performance in Europe relative to past performance and to the United States in the last decade has caused some concern about the income growth prospects in Europe and the widening gap with the US living standards (OECD, 2005; Estevão, 2004). The lack of productivity growth is widely seen as the culprit of the sluggish economic growth that Europe has experienced in the last few years and the strategies to remedy it have been high on the agenda of the European Union (European Commission, 2003, Sapir A., 2004). The EU productivity underperformance has raised questions about its causes and the channels through which economic policy could be effective to resume productivity growth.

While the catching-up of Europe with the United States in terms of GDP per capita levels came to an end in the mid seventies, labor productivity continued to grow until 1995. Some of the European productivity gains were used to increase leisure (lower weekly hours and early retirement age) rather than increasing income[1]. Since 1995 a "productivity problem" has emerged in Europe. As shown in Figure 1.1, the trend of European labor productivity growth has been declining while it has clearly picked up in the US over the same period.

Figure 1.1: Annual labor productivity growth (%) in the European Union (13 countries) and the United States, 1990-2004.
(Source: OECD)



Productivity and income growth are the determinants of the rise in the living standards. They are related to each other but their relationship is complex. Productivity gains in general result in income growth but an economy may grow (at least for some time) without productivity growth. In the latter case, economic growth is driven by demand and is usually considered as unsustainable. On the other hand, productivity may grow

[1] Traditionally, GDP per capita can be decomposed in the following way: *GDP per capita = Productivity per hour worked × Total hours worked × Participation arte × Share of adult population able to work*. GDP per capita is an increasing function of each variable taken separately. From this equation, it is straightforward to observe that an increase in productivity leads to an increase in GDP per capita provided that the variations in the other variables do not totally offset the productivity gains. For instance, productivity gains may be used to work less rather than increase income. Nonetheless, those variables are interdependent and the final result on GDP per capita may be uncertain.

faster than income. In this case, productivity gains lead consumers to substitute income for leisure. This is often the argument put forward to explain the Europe-US income per capita and labor productivity differentials until 1995 (Blanchard, 2004). In the long run, however, income growth and productivity growth are expected theoretically to trend jointly provided that labor is relatively inelastic. As a result, the analysis of the sources of income growth should help identify the sources of (lack of) productivity growth.

The trend of the European average shown in Figure 1.1 masks a more disparate reality across European national economies. Although some convergence is at work, there are still significant national disparities defying univocal explanations. In turn, national economies may exhibit regional inequalities casting doubt on the relevance of the national level to account for the dispersion of productivity performance. Some studies have argued that the European integration process has favored specialization and convergence of regions across national borders rather than uniform geographic convergence (Quah 1997; Fatás, 1997). As integration progresses (reductions in trade costs), firms (at least in the industrial sector) become more geographically concentrated closing wage gaps. The empirical evidence in the US shows that income differentials across states are narrower than in Europe (Puga 1999). The evidence on the EU-US comparison of concentration of industries is much less clear (Combes and Overman 2004). However, according to the economic geography literature, the result of increasing integration is conditional on workers' mobility. If workers do not move, firms will have to move thus ending the agglomeration process and the firms' productivity gains (Puga 1999).

This paper aims at analyzing the sources of productivity in Europe to account for its recent underperformance and identify potential geographic idiosyncracies. To do so we study the productivity performance and the sources of productivity in a sample of ten European regions belonging to four countries (France, Germany, Italy and Spain). As argued above, the regional analysis is motivated by the possible existence of local factors driving productivity dynamics in the course of European integration. A regional analysis allows to shed some light on the relevance of either level -regional or national- to account for the sources of productivity in Europe. Exploiting the increasing availability of disaggregated data at regional level in Europe, we propose both a descriptive statistics and an econometric analysis of productivity sources in ten European regions since 1995.

This paper is organized as follows. Section 2 aims at studying GDP growth performance and its sources. Section 3 provides a statistical analysis of labor productivity performance. Section 4 proposes an econometric analysis of labor productivity determinants ten selected European regions to identify cross-sector factors. The final section concludes with policy implications.

2. GDP growth performance and its sources in ten European regions

2.1 Our sample

Productivity growth and income growth are related to each other. In order to learn more about the European productivity sources and its possible geographic differences, we examine the GDP growth performance and its sources in a few European regions. We voluntarily limited the number of regions to keep the empirical analysis easily tractable. We selected ten regions from four European countries: Languedoc-Roussillon, Midi-Pyrenées and Rhône-Alpes from France, Baden-Württemberg and Bayern from Germany, Lombardia, Piemonte and Veneto from Italy, and Catalunya from Spain.[2] All these regions share a common feature: no central government is located in any of these regions. Thus, the location of most of economic activities is not related to political power.

Table 2.1 Regional share in national output (%)
(Source: Eurostat and CRENOS database, calculus: authors)

	Regional share of their respective national output (%)		**Population (1000) and national share**			
	1977	**2002**	**1977**	*%*	**2002**	*%*
France						
Languedoc-Roussillon	*2.7*	*3.0*	*1803*	*3.4*	*2396*	*3.9*
Midi-Pyrenées	*3.3*	*3.8*	*2273*	*4.3*	*2637*	*4.4*
Rhône-Alpes	*9.1*	*9.6*	*4839*	*9.1*	*5893*	*9.8*
Germany						
Bayern	*16.6*	*17.4*	*10804*	*17.6*	*12329*	*14.9*
Baden-Württemberg	*15.8*	*14.8*	*9119*	*14.8*	*10692*	12.9
Italy						
Lombardia	*21.1*	*20.6*	*8802*	*15.7*	*9246*	*15.9*
Piemonte	*9.8*	*8.5*	*4493*	*8.0*	*4214*	*7.3*
Veneto	*8.4*	*9.0*	*4278*	*7.7*	*4530*	*7.8*
Spain						
Catalunya	*18.5*	*18.3*	*5972*	*15.9*	*6637*	*15.5*

Apart from that, regions of our sample differ in land size, in relative economic or demographic weights likewise the regions of all Europe. Despite this heterogeneity, a first characteristic that appears to be common to all of them is the strong stability of their share in national output and in national population (Table 2.1). The variations for Germany are due to the integration of the East German länders. Even in Spain where political and economic changes have been of great magnitude over this period, the economic weight of Catalunya has remained very stable.

[2] The addition of other European regions in the analysis is left for future work.

The composition of the output value shows that the economy of all regions is increasingly dominated by services with an approximate share of two-third in 2002 against a bit more than half in 1977 (Table 2.2 and Table 2.3). It turns out that the regions of our sample are more industrial than their national average except Languedoc-Roussillon, Midi-Pyrenées and Bayern in 1977 and 2002. The booming construction sector in Spain accounted for almost 10% of the total value added in 2002. Overall, the sector distribution of value added is relatively similar across regions and the slight cross-regional variations are due to the differences in the balance between industry and services. Again, stability has prevailed over time. The slight cross-regional differences have been very stable throughout the tertiarization of their economies.

Table 2.2: Sector shares in total value added in 1977 (%)
(Source: CRENOS database – Calculus: authors)

	Agriculture	Industry	Services
France	**5.0**	**39.4**	**55.6**
Languedoc-Roussillon	*10.9*	*30.1*	*59.0*
Midi-Pyrenées	*7.8*	*33.8*	*58.4*
Rhône-Alpes	*3.3*	*46.0*	*50.7*
Germany	**2.7**	**44.4**	**52.9**
Bayern	*4.0*	*42.5*	*53.5*
Baden-Württemberg	*2.4*	*50.8*	*46.8*
Italy	**7.9**	**39.9**	**52.2**
Lombardia	*3.5*	*52.0*	*44.5*
Piemonte	*4.7*	*51.7*	*43.6*
Veneto	*9.7*	*41.8*	*48.5*
Spain	**10.3**	**29.9**	**59.8**
Catalunya	*5.1*	*38.5*	*56.4*

2.2 Growth performance

Data on real GDP growth has been available in the Eurostat database since 2000. Over the period 2000-2003, it can be observed that there are significant growth differential across countries and within countries. The Spanish economy has grown much faster than the EU average in the last few years while the Italian and the German economies have lagged behind. It can also be observed regional disparities within countries. For example, in 2000, Lombardia grew at a rate of 2.5% against 3.6% for Veneto. In 2002 Rhône-Alpes posted a rate of 0.2% while Languedoc-Roussillon 1.7%.

Therefore, for a same year there exist significant regional variations even when regions are geographically very close to each other.

Table 2.3: Sector shares in total value added in 2002 (%)
(Source: EUROSTAT and IDESCAT – Calculus: authors)

	Agriculture	Industry (excl. construction)	Construction	Services
France	**2.5**	**23.5**	**4.7**	**69.3**
Languedoc-Roussillon	*4.4*	*12.9*	*5.7*	*76.9*
Midi-Pyrenées	*3.8*	*19.2*	*6.1*	*70.9*
Rhône-Alpes	*1.5*	*25.5*	*5.6*	*67.4*
Germany	**1.1**	**27.6**	**4.3**	**67.1**
Bayern	*1.2*	*25.9*	*4.5*	*68.4*
Baden-Württemberg	*0.8*	*32.0*	*4.8*	*62.4*
Italy	**2.5**	**25.8**	**4.7**	**67.0**
Lombardia	*1.5*	*29.0*	*4.0*	*65.5*
Piemonte	*1.9*	*27.1*	*5.0*	*65.9*
Veneto	*2.8*	*27.7*	*5.7*	*63.9*
Spain	**3.4**	**18.0**	**9.6**	**65.0**
Catalunya	*1.5*	*25.5*	*8.0*	*65.0*

Table 2.4 Real GDP annual growth (%)
(Source: Eurostat)

	2000	2001	2002	2003
EU (15)	**3.6**	**1.7**	**1**	**…**
France	**4.1**	**2.1**	**1.2**	**0.8**
Languedoc-Roussillon	*3.5*	*3.8*	*1.7*	*3.0*
Midi-Pyrenées	*3.1*	*4.9*	*1.4*	*1.1*
Rhône-Alpes	*4.3*	*2.4*	*0.2*	*0.9*
Germany	**2.9**	**0.8**	**0.1**	**-0.1**
Bayern	*5.0*	*1.0*	*1.2*	*0.2*
Baden-Württemberg	*3.1*	*2.5*	*-0.9*	*-0.1*
Italy	**3.0**	**1.8**	**0.4**	**0.3**
Lombardia	*2.5*	*1.9*	*0.2*	*-0.6*
Piemonte	*2.8*	*0.8*	*-0.5*	*-0.5*
Veneto	*3.6*	*0.6*	*-0.7*	*0.4*
Spain	**5.0**	**3.5**	**2.7**	**3.0**
Catalunya	*3.4*	*3.5*	*2.3*	*2.8*

2.3 Demand and output analysis

What are the sources of growth in these regions between 1995 and 2002 ? To answer this question we examine the demand and the supply. Given the absence of data for the demand components of GDP growth at regional level, we present results only at national level. Table 2.5 shows the average annual variation of the demand components for France, Germany, Italy and Spain. The trade sector was very dynamic in all countries. Imports grew faster than exports except in Germany. Spain posted a higher growth rate than

its neighbors over the period under study while Germany and Italy experienced difficult years.

Table 2.5: Average annual growth rates of demand components at constant prices 1996-2003 (%, price=1995) (Source: EUROSTAT – Calculus: authors)

	GDP	Private consumption	Public consumption	Gross fixed capital formation	Exports	Imports
France	2.3	2.4	1.8	2.9	5.3	5.7
Germany	1.4	1.3	1.1	-0.9	7.0	5.4
Italy	1.2	1.7	1.2	1.8	2.3	4.2
Spain	*3.7*	*3.6*	*3.7*	*5.9*	*7.2*	*8.9*

The analysis of the contribution of demand components to GDP growth allows us to identify the sources of GDP growth on the demand side (Table 2.6). Apart from Germany which has stagnated after the reunification, the contributions of demand components are relatively similar among France, Italy and Spain. Given its large weight in the demand, consumption growth (private and public) has been by far the main contributor to GDP growth. In Germany, the trade sector has been a very important contributor to GDP growth. The comparison of gross fixed capital formation contributions must be made with some caution. The breakdown of this data in Spain makes clear that business investment has been lagging behind real estate investment especially in the most recent years. Given this sector's share in the value added in Spain, it is not surprising that the contribution appears to be high. In Italy, the contribution is relatively high but the GDP growth rate was very low. However, the investment effort in Italy seems to have been the highest among these four countries (Table 2.7). Overall, the business investment effort in these four countries seems to have been limited during this period and weakly contributed to GDP growth. This result from the demand analysis offers a first indication on the possible cause of productivity underperformance. Business investment is a key determinant of productivity growth. Even though there is probably a lag between the realization of investment and the productivity gains, the demand analysis draws our attention to the weakness of investment in those countries in a period of technological boom.

Table 2.6: Average annual of demand components' contribution to GDP growth at constant prices 1996-2003 (%, price=1995) (Source: EUROSTAT – Calculus: authors)

	GDP	Private consumption	Public consumption	Gross fixed capital formation	Trade balance
France	100	58	20	0	-8
Germany	100	48	11	-7	48
Italy	100	81	17	31	-29
Spain	*100*	*63*	*20*	*40*	*-23*

Table 2.7 : GFCF per unit per of employment
(Source: EUROSTAT – calculus: authors)

	Average Annual Growth (1995-2002) (%)
France	**2.2**
Languedoc-Roussillon	*-0.4*
Midi-Pyrenées	*1.5*
Rhône-Alpes	*3.5*
Germany	**-1.5**
Bayern	*-0.1*
Baden-Württemberg	*0.3*
Italy	**5.5**
Lombardia	*6.0*
Piemonte	*4.9*
Veneto	*5.8*
Spain	**3.7**
Catalunya	*2.0*

The analysis of output yields a very clear-cut result and confirms the rapid tertiarization of the European economies (Tables 2.8 and 2.9). The sector of services has grown faster than any other sector in all the regions. Given the size of this sector in the total value added, its contribution to GDP growth reaches a minimum of 70%. In Germany, the contribution of the industrial sector in Baden-Württemberg and in Bayern has been positive and sizeable while it has been slightly negative on average in the country as a whole. The output analysis provides clear information on the sources of economic growth in the sample of our regions. The sector of services is the main engine of economic growth in the economies of these regions. Without the analysis of the employment data by sector we cannot yet conclude about the role of the services on productivity growth. However, given the size that this sector has taken and the strong development that it keeps posting in all regions, the overall productivity performance, good or bad, is surely influenced by what is going on in this sector.

Table 2.8: Average annual growth rates of GDP components at constant prices 1995-2002 (%, price=1995)
(Source: EUROSTAT and IDESCAT – Calculus: authors)

	Total gross V.A.	Agriculture	Industry	Construction	Services
France	**3.4**	**0.4**	**2.6**	**2.6**	**3.9**
Languedoc-Roussillon	4.2	2.1	3.7	4.8	4.4
Midi-Pyrenées	3.8	0.1	4.3	5.7	3.7
Rhône-Alpes	3.7	-0.1	3.0	3.6	4.1
Germany	**1.2**	**-0.4**	**-0.04**	**-4.37**	**2.21**
Bayern	2.2	-0.2	1.7	-1.7	2.8
Baden-Württemberg	2.3	-1.7	2.1	-0.4	2.5
Italy	**5.7**	**2.5**	**4.2**	**5.3**	**6.5**
Lombardia	5.6	3.9	3.6	4.4	6.8
Piemonte	5.2	0.8	2.8	5.7	6.3
Veneto	5.6	3.2	3.7	5.4	6.6
Spain	**6.1**	**1.6**	**4.1**	**8.9**	**6.1**
Catalunya	5.7	3.2	4.0	7.7	6.1

2.4 Sources of GDP growth: productivity growth versus labor input growth

The previous section focused on the sectors of the demand and the supply at the origin of GDP growth. The objective now is to assess the role of labor input as an engine of GDP growth. Given the evolution of the demography in most European countries, labor input growth cannot be an engine of GDP growth (Table 3.3). The employment/population ratio and the active population have grown very little since 1995 except in Spain where economic growth has been much higher. There are very few regional variations within countries. The statistics for Germany during the first half of the 1990s are biased by the evolution of the labor market in the Eastern Landers. Moreover, the labor force is ageing. The share of the 15-34 years-olds is decreasing everywhere except in Spain and Lombardia (Table 2.10). It can be concluded from these statistics that labor input has not been an engine of growth for most of the regions under study. Therefore, GDP growth relies on the evolution of productivity growth. The weak GDP growth in Europe can thus be associated with the productivity slowdown.

Table 2.9: Average annual contribution of output components to growth of total gross value added between 1996 and 2002 (%) (Source: EUROSTAT– Calculus: authors)

	Total gross value added	**Agriculture**	**Industry (excl. construction)**	**Construction**	**Services**
France	**100**	**0.3**	**18.19**	**3.7**	**77.8**
Languedoc-Roussillon	*100*	*2.4*	*11.5*	*6.4*	*79.8*
Midi-Pyrenées	*100*	*0.1*	*21.4*	*8.6*	*69.8*
Rhône-Alpes	*100*	*-0.05*	*21.2*	*5.4*	*73.5*
Germany	**100**	**-0.3**	**-1.08**	**-19.3**	**120.7**
Bayern	*100*	*-0.1*	*19.9*	*-4.0*	*84.2*
Baden-Württemberg	*100*	*-1.0*	*31.5*	*-1.0*	*70.5*
Italy	**100**	**1.2**	**20.1**	**4.4**	**74.3**
Lombardia	*100*	*1.2*	*21.3*	*3.5*	*74.0*
Piemonte	*100*	*0.3*	*16.1*	*5.5*	*78.1*
Veneto	*100*	*1.7*	*19.5*	*5.5*	*73.2*
Spain	**100**	**1.3**	**14.0**	**12.7**	**72.0**
Catalunya	*100*	*1.0*	*20.0*	*10.0*	*69.0*

Table 2.10 Average annual growth of employment/population ratio and active population (%)
(Source: EUROSTAT, Calculus: authors)

	Employment/ population	**Active population**		**Age: 15-34**	
	1995-2002	**1990-1995**	**1995-2001**	**1990-1995**	**1995-2001**
France	**0.8**	**0.8**	**0.6**	**-0.9**	**-0.7**
Languedoc-Roussillon	*0.8*	*2.4*	*-1.2*	*-0.2*	*-1.8*
Midi-Pyrenées	*0.9*	*0.1*	*1.3*	*-0.3*	*-0.2*
Rhône-Alpes	*0.1*	*2.4*	*0.1*	*3.1*	*-1.7*
Germany	**0.0**	**4.9**	**0.3**	**3.4**	**-2.3**
Bayern	*0.2*	*0.6*	*0.4*	*-0.5*	*-1.8*
Baden-Württemberg	*0.3*	*0.6*	*0.6*	*1.2*	*-3.5*
Italy	**1.2**	**-0.8**	**0.7**	**-1.0**	**-1.0**
Lombardia	*1.1*	*-0.5*	*1.1*	*0.6*	*1.1*
Piemonte	*1.1*	*-0.5*	*0.3*	*0.3*	*-1.5*
Veneto	*0.9*	*0.3*	*1.2*	*0.3*	*-1.4*
Spain	**3.2**	**0.8**	**2.7**	**1.5**	**3.5**
Catalunya	*2.3*	*1.0*	*2.6*	*1.0*	*4.3*

3. Statistical analysis of productivity

The previous section aimed at identifying the categories of the demand and the supply that have grown much or little in the recent years in order to learn where to focus our investigation to study productivity. In this section we present a statistical description of productivity level and growth in the ten regions.

3.1 Productivity growth

We will focus on labor productivity growth at national level. Regional data on labor productivity growth is not reliable enough to be taken into account and compared with national data. As shown in Table 3.1, there is a trend inversion between Europe and the United States in the nineties. The middle of this decade turns out to be the turning point. Labor productivity growth has strongly slowed down in Europe while it has accelerated in the US. This observation is confirmed by data on real unit labor costs as calculated by the European Commission (Table 3.2). The real unit labor cost represents another useful labor productivity indicator characterizing the evolution of wage compensation relative to the total value added generated by an economy. The negative sign indicates a labor productivity improvement. As it can be observed, the turning point of 1995 is confirmed. Spain has also

experienced a slowdown in productivity growth but stronger in the second half of the 1990s than in the last period.

Table 3.1 Average annual growth rate of GDP per hour worked (%)
(Source: OECD)

	1990-1995	1995-2000	2000-2004	1995-2004
France	2.1	2.2	1.8	2.0
Germany	3.0	2.1	1.5	1.7
Italy	2.3	0.9	0.2	0.5
Spain	1.9	0.5	1.2	0.9
United States	1.5	2.5	2.5	2.5
EU 13*	2.6	1.8	1.3	1.6

* excl. Austria and Luxembourg

Table 3.2 Average annual growth rate of real unit labor costs (%)
(Source: AMECO, European Commission)

	1990-1995	1995-2002	1995-2004
Spain	-0.2	-0.7	-0.8
France	-0.4	-0.1	-0.2
Germany	-0.6	-0.4	-0.5
Italy	-1.7	-0.7	-0.4

3.2 Productivity growth by sector

Section 2 provided evidence on the tertiarization of the economies in Europe. The sector of services was the fastest growing sector in all the regions of our sample. In terms of employment, the trends are similar. Employment in the industrial sector grew at best little except in Spain and even declined in Germany while in the services has constantly increased over the period. Since services are labor intensive, growth in this sector implies employment growth. What are the effects of employment variations on labor productivity growth in both sectors? Although the data at regional level by sector is not very reliable, Table 3.3 shows that labor productivity growth was higher in industry than in services except in Germany. We can then conclude with some caution due to the quality of the data that the sector of services is the main engine of productivity growth in the regions under study.

3.3 Productivity analysis in levels

The analysis of productivity in levels shows that there are important labor productivity disparities across our sample of European regions but these inequalities are reducing. Table 3.4 presents cross-regional comparisons for a few statistics. There is a convergence process in both GDP per capita and GDP per hour worked. However, the French regions and Piemonte and are catching up with the level of Baden-Württemberg while Lombardia has lost some of its advance and Catalunya has been distanced by the German region.

Table 3.3 Average annual growth rate labor productivity per hour worked 1995-2002 (%)
(Source: EUROSTAT and regional statistical offices – calculus: authors)

	Industry	**Services**
France	**3.9**	**5.0**
Languedoc-Roussillon	4.0	3.0
Midi-Pyrenées	4.5	2.4
Rhône-Alpes	4.1	2.7
Germany	**2.1**	**0.8**
Bayern	2.3	1.4
Baden-Württemberg	2.5	0.7
Italy	3.9	5.0
Lombardia	3.8	5.1
Piemonte	3.6	4.9
Veneto	3.5	5.0
Spain	**2.3**	**4.1**
Catalunya	2.4	4.2

Table 3.4 GDP per capita, per hour worked and labor input in level (Baden-Württemberg =100)
(Source: Eurostat and regional institutes of statistics – calculus: authors)

	Population		**GDP per capita**		**GDP per hour worked**		**Employment/ population**	
	1995	**2002**	**1995**	**2002**	**1995**	**2002**	**1995**	**2002**
France								
Languedoc-Roussillon	*21.5*	*22.6*	*66.1*	*67*	*76.5*	*80.2*	*71.2*	*73.7*
Midi-Pyrenées	*24.3*	*24.9*	*75.9*	*76.1*	*76.1*	*78.7*	*81.8*	*85.2*
Rhône-Alpes	*53.8*	*54.4*	*86.9*	*91.4*	*91.5*	*99.3*	*88.8*	*87.6*
Germany								
Bayern	*116.1*	*116.3*	*100.9*	*101.1*	*93.7*	*93*	*108.5*	*107.9*
Baden-Württemberg	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
Italy								
Lombardia	*86.4*	*85.2*	*114.5*	*113.6*	*120.9*	*108.0*	*89.1*	*94.6*
Piemonte	*41.5*	*39.7*	*101.6*	*85.4*	*67.5*	*68.7*	*91.4*	*96.9*
Veneto	*42.8*	*42.7*	*101.4*	*84.2*	*64.3*	*65.6*	*96.1*	*100.3*
Spain								
Catalunya	*59.4*	*59.8*	*80.0*	*90.0*	*84.2*	*77.0*	*83.4*	*95.7*

This observation at aggregate level seems to pinpoint national characteristics behind the cross-regional disparities. The number of regions in our study does not allow us to extrapolate for all Europe. However, this work draws our attention to the importance of national characteristics of production factors. For instance, human capital, physical capital and social

capital may be more affected by national characteristics than regional idiosyncracies. We would like to verify this hypothesis by looking at a more disaggregated level. Cross-regional comparisons can be made for the following sectors: manufacturing, construction, financial services and wholesale (Table 3.5).

Table 3.5 Productivity per hour worked and unit labor cost indicators
(Source: Eurostat and regional statistical offices, calculus: authors)

MANUFACTURING	***Productivity per hour worked***			***Unit labor cost***		
	1995	**1999**	**2002**	**1995**	**1999**	**2002**
France						
Languedoc-Roussillon	28.4	34.8	40.4	0.55	0.50	0.45
Midi-Pyrenées	26.8	30.6	37.7	0.64	0.64	0.52
Rhône-Alpes	28.0	33.5	39.6	0.65	0.62	0.59
Germany						
Bayern	31.7	34.6	37.8	0.74	0.72	0.75
Baden-Württemberg	31.2	34.7	38.7	0.76	0.72	0.73
Italy						
Lombardia	24.2	28.0	29.4	0.56	0.57	0.59
Piemonte	21.9	25.9	27.2	0.58	0.59	0.60
Veneto	19.4	22.8	25.2	0.55	0.56	0.58
Spain						
Catalunya	20.7	21.7	21.9	0.62	0.65	0.67

CONSTRUCTION	***Productivity per hour worked***			***Unit labor cost***		
	1995	**1999**	**2002**	**1995**	**1999**	**2002**
France						
Languedoc-Roussillon	21.1	21.3	27.7	0.55	0.57	0.53
Midi-Pyrenées	21.6	22.8	30.9	0.58	0.57	0.53
Rhône-Alpes	26.4	25.3	32.7	0.64	0.63	0.58
Germany						
Bayern	25.8	25.4	27.9	0.65	0.62	0.59
Baden-Württemberg	32.0	34.2	26.4	0.66	0.60	0.55
Italy						
Lombardia	8.2	10.1	10.8	0.47	0.43	0.45
Piemonte	19.0	21.8	26.9	0.30	0.34	0.31
Veneto	19.3	22.3	23.7	0.36	0.36	0.39
Spain						
Catalunya	16.6	15.1	17.8	0.57	0.68	0.58

FINANCE & REAL ESTATE	***Productivity per hour worked***			***Unit labor cost***		
	1995	**1999**	**2002**	**1995**	**1999**	**2002**
France						
Languedoc-Roussillon	71.1	75.1	81.2	0.23	0.24	0.29
Midi-Pyrenées	64.7	64.8	68.5	0.29	0.32	0.40
Rhône-Alpes	77.9	95.5	106.2	0.33	0.35	0.36
Germany						
Bayern	80.5	79.2	80.3	0.25	0.25	0.27
Baden-Württemberg	111.3	113.5*	115.2	0.25	0.27	0.30
Italy						
Lombardia	68.6	72.8	76.6	0.28	0.25	0.26
Piemonte	53.8	63.4	67.3	0.27	0.26	0.27
Veneto	58.0	68.4	74.1	0.22	0.21	0.21
Spain						
Catalunya	50.9	49.9	57.2	0.37	0.39	0.40

* 1998

WHOLESALE	***Productivity per hour worked***			***Unit labor cost***		
	1995	**1999**	**2002**	**1995**	**1999**	**2002**
France						
Languedoc-Roussillon	22.5	24.5	26.5	0.60	0.59	0.61
Midi-Pyrenées	25.6	26.0	28.5	0.54	0.56	0.58
Rhône-Alpes	31.2	31.8	39.3	0.62	0.61	0.62
Germany						
Bayern	24.4	24.4	25.9	0.68	0.66	0.66
Baden-Württemberg	34.5	35.6	41.5	0.68	0.66	0.64
Italy						
Lombardia	34.4	50.7	67.3	0.39	0.41	0.44
Piemonte	24.8	30.3	33.7	0.33	0.33	0.34
Veneto	25.1	30.5	33.2	0.35	0.36	0.37
Spain						
Catalunya	23.4	26.1	33.0	0.40	0.39	0.40

In manufacturing, our hypothesis seems to be confirmed. The productivity levels are very close among regions within a country rather than across national borders. In construction, the levels of productivity are fairly homogenous across all regions. In financial services, productivity levels are much heterogeneous and seem to depend on regional specialization

(e.g. Rhône-Alpes and Baden-Württemberg). Finally, in wholesale, another subsector of services, productivity levels also seem to depend on regional specialization and regional disparities within a same country are substantially large.

Our findings are therefore mixed. There seems to be national characteristics influencing regional productivity levels especially in manufacturing (a capital intensive sector) while in other sectors like services regional specialization turns out to be more determinant. The analysis of the sources of labor productivity level is carried out by econometric methods in the next section.

4. Econometric analysis of labor productivity determinants in 1995-2002 in a sample of European regions

The aim of this section is to run regressions to identify the statistically significant determinants of labor productivity in a sample of European regions between 1995 and 2002.
We selected a sample of ten representative European regions (according to the availability of data). The econometric exercise is complementary to the descriptive statistics carried out in the previous sections. Productivity decomposition cannot exhaust all the many factors which may influence the determination of productivity. Some of these factors, such as institutional ones, will have an effect on productivity regardless of sectors. The econometric analysis can thus confirm results obtained with descriptive statistics and offer new ones considering additional variables. The method that we adopted is dictated by the availability of data and the number of observations. For individual regions, data and observations are limited and the dependent variable has to be labor productivity by sector. The estimations thus yield results from a cross section of the ten the selected sectors. In order to increase the confidence in our results we carry out estimations by using two different measures of labor productivity: productivity per hour worked and unit labor cost. The first indicator measures the output generated by one hour of labor while the second evaluates the labor cost incurred for one unit of output. Obviously, an increase in the first indicator means a rise in productivity while an increase in the second indicator means a decline in productivity. Therefore, a positive relationship with one of the indicators should be of opposite sign with the other, provided that the results are consistent. The use of both indicators enables us to check the validity of the results of either one. However it should be stressed at this stage that the results are more unstable with the unit labor costs' estimations. Our conclusions therefore rely more on the results obtained with productivity per hour worked.
Among the determinants we include in the regressions, a few of them are parts of the computation of labor productivity measures such as employment or the hours worked. As theory suggests[3] we should expect that productivity per hour worked is inversely related to

[3] If we assume that the economy can be represented by a production function with constant returns to scale, then marginal productivity of labor is decreasing.

employment and the hours worked, while the relationship is positive in the case of unit labor cost. As for employment, we use two different measures: employment by region and by sector in absolute value and employment by region and by sector as a share of total regional employment.

Another two possible relevant determinants for productivity are human capital and gross fixed capital formation (GFCF). Human capital is an indicator of the quality evolution of the labor force and GFCF measures the variation in the physical capital stock. For both variables we expect a higher labor productivity if there is an increase in either of the two indicators. To take the quality of the physical capital stock into account we propose to include the number of patents as a regressor. We assume that patents proxy the for the technological level of sectors, and hence the quality of investments in physical capital realized in these sectors.

4.1 Labor productivity determinants

For each region of our sample we build a cross section dataset by gathering information on a number of variables for the period 1995-2002. Moreover, for each year we select the information referring to six sectors: manufacturing, construction, electricity, finance, wholesale and public administration.[4] The first three sectors belong to the industry whereas the remaining three to services. Therefore, for each vector of variables we have 48 observations. Some adjustments take place because there can be some missing data for a year or a series depending on the availability of the data from the regional statistical offices. The only exception is Baden-Württemberg, for which the full sample reduces to 40 observations. Due to a lack of detailed data we were forced to merge the construction and electricity sectors.

We build a labor productivity indicator by computing (for each region, each sector and every year) the ratio between the value added and the number of employment multiplied by the annual average working hours by employee.[5] In addition, we compute the unit labor costs by computing (again for each region, each sector and every year) the ratio between the total regional compensation of employees and the total regional value added.[6]

For each region, the equation we estimate is the following:

[4] This classification is proponed by EUROSTAT statistics and in the Appendix we provide a full description of the sectors as well as the correspondence with the NACE 1.1 Classification.

[5] By using employment and average working hours of employees we assume that employees and self employed people work an equivalent number of hours. See the appendix for a more detailed description of the definition and contents of the series we use.

[6] We proxy the regional total compensation (by sector) with the total compensation by employees, due to a lack of data on compensation for self employed people. This choice is not expected to produce high distortion because according to the data available (from EUROSTAT) the proportion of self-employed people always accounts for less than 10 % of the total regional employment.

$$F_{ih} = \alpha_{ih} + \underline{\beta_{ih}\, x_{ih}} + \varepsilon_{ih}$$

where *Fih* is one of the productivity indicators (by year *i* and sector *h*), αih is a constant, *xih* is the vector of regressors and εih are the errors terms (assumed *i.i.d*). Given the quite small sample of observations, our estimation technique is the OLS corrected by White method (for controlling heteroskedasticity problems). Because of a lack of degree of freedom, we are not able to control either for temporal fixed effects or sector effects. Since our purpose is also to investigate on the possible effects by sector in determining regional productivity we introduce two dummies: one for industry and another for electricity. The former refers to the three sectors of our sample that belong to industry, while the latter concern a very particular sector. These two dummies help to control for fixed effects. Before going further, it should be mentioned that the estimations carried out for Catalunya and for the European regions differ in one aspect. The data on gross fixed capital formation (GFCF) is available for each of the six selected sectors in the European regions but it is not for Catalunya. As a result, the data on GFCF in Catalunya represents an aggregate level of investment that is useful to control the econometric results. Unfortunately, due to this lack of data, we cannot draw any conclusion for a very important determinant of productivity in this region.

Box 4.1. Variables : Regional estimations

PROD*hij*= Productivity index in region *h* and sector *i* computed as the ratio between the value of the value added in sector *i* and the total employment (in sector *i*) multiplied by the annual average working hours per worker (in industry or services according which category sector *i* belong to) for each year *j*. (Source: EUROSTAT)

ULC*hij*= Productivity index in region *h* and sector *i* computed as the ratio between the value of the total compensation in sector *i* and the total employment (in sector *i*) multiplied by the annual average working hours per worker (in industry or services according which category sector *i* belong to) for each year *j*. (Source: EUROSTAT and regional statistics)

EMPLOY*hij*: Employment in sector *i*, in region *h*, for each year *j*. (Source: EUROSTAT)

EMPLOY_S*hij*: Ratio between the employment in sector *i*, in region *h*, for each year *j* and the total employment in in region *h*, for each year *j* (Source: EUROSTAT)

I_S_HOURS*hij*: Annual average working hours per worker in industry or services according which category sector *i* belongs to, for each year *j* by region *h* (Source: regional statistics)

EQ_T*hj*: Human capital index computed as
1) Catalunya: the ratio between the number of employees in industry or services (according which category sector *i* belongs to) with a higher degree and the total employment in industry for each region *h* and year *j*. (Source: IVIE and EUROSTAT)
2) Other regions: the ratio between the number of human resources in science and technology and the total employment for each region *h* and year *j*. (Source: EUROSTAT)

GFCF*hij*: gross fixed capital formation computed as
1) Catalunya: value of the gross fixed capital formation in industry or services according which category sector *i* belongs to, by region *h* and in year *j*. (Source: regional statistics)
2) Other regions: in region *h* value of the gross fixed capital formation in sector *i*, and in year *j*. (Source: EUROSTAT)

GFCF_S*hij*: Value of GFCF*hij* as a share of the value added in region h for each year j (Source: EUROTAT and regional statistics)

D_ELECTRICITY: Dummy for electricity sector
D_INDUSTRY: Dummy for sectors belonging to the industry category

4.2 Similarities and differences

The results of the different estimations for the labor productivity are presented in Tables 4.1 and 4.2.[7] The former refers to the study of productivity per hour worked and the latter to unit labor cost.

Employment and hours

Looking at the estimation for the European regions, we can observe two determinants that are statistically significant and common to all the regions of our sample. The relationship between employment or annual average working hours (when significant) and productivity per hour worked is negative for all. These results are confirmed when using unit labor cost as the dependent variable. The only exception is Bayern, because we were forced to exclude such a variable for its high collinearity with the human capital. These two robust results are in line with the theory since an increase in employment and a decrease in hours should result in lower productivity. It is possible that our regions under study attract skilled labor but also much unskilled labor, in services for example, and, overall, the increase in employment clearly contributes negatively to productivity.

Industry and electricity dummies

The dummies for industry and electricity are statistically significant and display the same sign.[8] Therefore, in those three regions, industry seems to contribute positively to productivity and services negatively. In Rhône-Alpes, the signs of the dummies are reverse.
This confirms that services the industrial sector, facing more international competition, reduction in personnel and working hours, tends to contribute positively to labour productivity.

Human capital

More surprisingly is the lack of robustness of the positive relationship of human capital with productivity per hour worked. This determinant is not always statistically significant in our estimations. Perhaps, it can be argued that the returns to human capital are diminishing and are less likely to be noticeable in well-endowed regions than in less advanced regions. Another explanation can be again the service sector. It is plausible that the lack of competition in this sector staves off the potential benefits from better human capital. This could result in this sector in an inefficient matching between a traditional demand for low-skilled labor and an increasingly skilled supply. Human capital is statistically significant and positive in

[7] More details are available upon request.
[8] We checked the robustness of the results by replacing the industry with the service dummy. Results are available upon request.

Catalunya and Rhône-Alpes, while it is not significant in all the other regions. These differences should not lead to clear-cut conclusions. Human capital is very difficult to measure and remains a long-debated issue in empirical economics.

Gross fixed capital formation

This variable turns out to be a very important determinant of productivity in all the region of our sample excepting Lombardia. Estimations for unit labor costs confirm the robustness of this result. Gross fixed capital formation can be seen as the key determinant of labor productivity in the EU, irrespective of the type of region we are referring to.

To sum up:

a. In all the regions of our sample, labor productivity per hour worked is strongly and negatively associated with the level of the employment.
b. Human capital is not a statistical robust determinant for productivity for all the regions of our sample. Catalunya is the only region in which it appears to be relatively important.
c. Gross fixed capital formation (as a share of value added) is significant for all but one regions.
d. Sector dummies are almost always statistically significant. This implies that labor productivity is not homogeneous across sectors. Heterogeneity exists and it is important. Unfortunately, we do not have enough data to study it more thoroughly.

5. Conclusions and policy considerations

The main finding of this paper is that the sources of labor productivity are rather heterogeneous across the regions of our sample and these sources are related either with regional or national idiosyncracies. The descriptive analysis points out the national influence on the sources of labor productivity in manufacturing for example and regional specificities in sectors of services. The econometric analysis confirmed the existence of heterogeneity of productivity determinants. Yet business investment seems to be a key determinant to improve labor productivity. The results are less convincing for human capital. This might be due to the difficulty of measuring adequately human capital. The European integration already provides incentives for more concentration in some sectors to yield productivity gains. However, a lot remains to be done by national governments to support investment in physical and human capital. The condition for the productivity growth to pick up is to adopt structural reforms to increase competition on the goods and labor markets. Some of these reforms should be

Table 4.1: Econometric estimations

Dependent variable: **Productivity per hour worked**

Method of estimation**: OLS (with White correction)**

Values in brackets: **Standard Error**

	Languedoc Roussillon	**Midi Pyrenées**	**Rhône Alpes**	**Bayern**	**Baden Württemebrg**	**Lombardia**	**Piemonte**	**Veneto**	**Catalunya**
C	0.228*** (0.05)	0.23** (0.074)	-0.08 (0.05)	0.14* (0.08)	1.11 (1.619)	0.68 (0.72)	0.199 (0.203)	0.064 (0.133)	0.71*** (0.193)
EMPLOY	-0.0001*** (2.24 E-05)	-9.95 E-05*** (1.54 E-05)	-8.44 E-05*** (1.79 E-05)	-9.95 E-06*** (1.23 E-06)	-9.48 E-05*** (6.35 E-06)	-2.42 E-05* (1.19 E-05)	-6.83E-05*** (1.04 E-05)	-4.08 E-05*** (4.33 E-06)	-8.68 E-05*** (1.08 E-05)
I_S_HOURS	-0.0001*** (2.36 E-05)	-0.0001** (3.75 E-05)		-0.0001 E-05** (4.39E-05)	-0.0007 (0.0008)	-0.0004 (0.0004)	-0.0001 (0.0001)	-4.52 E-05 (8.58 E-05)	-0.0004*** (0.0001)
D_ELECTRICITY		0.019*** (0.006)	-0.022** (0.011)			0.109*** (0.021)			0.090*** (0.008)
D_INDUSTRY	-0.009 (0.005)	-0.004 (0.005)	-0.011 (0.008)	0.018** (0.003)	0.129*** (0.039)	0.04 (0.09)	0.017 (0.027)	0.009 (0.017)	0.051** (0.015)
EQ_T	-0.016 (0.063)	-0.046 (0.052)	0.32** (0.132)	0.16 (0.09)	-0.564 (1.06)	0.003* (0.001)		0.013 (0.055)	0.002*** (0.0005)
GFCF_VA	0.107*** (0.018)	0.100*** (0.234)	0.197*** (0.031)	0.19*** (0.007)	1.34*** (0.07)	-0.14 (0.09)	0.256*** (0.045)	0.253*** (0.017)	-16.61*** (4.61)
Adj R-squared	0.89	0.91	0.69	0.97	0.96	0.73	0.72	0.92	0.85
N. Obs.	48	48	48	40	40	42	48	48	42

Level of significance: ***1 %, ** 5%. *10%

Table 4.2: Econometric estimation

Dependent variable: **Unit Labor costs**

Method of estimation**: OLS (with White correction)**

Values in brackets: **Standard Error**

	Languedoc Roussillon	**Midi Pyrenées**	**Rhône Alpes**	**Bayern**	**Baden Württemebrg**	**Lombardia**	**Piemonte**	**Veneto**	**Catalunya**
C	-0.57 (0.404)	-0.92 (0.59)	1.43*** (0.41)	1.31 (3.18	-0.507 (5.788)	-2.86*** (0.311)	0.945 (2.79)	0.225 (2.872)	3.24 (2.69)
EMPLOY	0.002*** (0.0001)	0.002*** (0.0001)	1.23 E-05 (8.58 E-05)		0.0002*** (3.60 E-05)	0.0002** (6.37 E-05)	0.0006*** (4.48 E-05)	0.0004*** (3.99 E-05)	
EMPLOY_S									-0.56** (0.16)
I_S_HOURS	0.0005** (0.0002)	0.0007** (0.0003)	-0.003 (0.0003)	-1.52 E-05 (0.002	9.63 E-05 (0.0027)	0.002*** (0.0002)	-0.0003 (0.0017)	0.0001 (0.002)	-0.002 (0.002)
D_ELECTRICITY			0.102 (0.06)			-0.56*** (0.048)			-0.244 (0.164)
D_INDUSTRY	0.167*** (0.035)	0.157*** (0.033)	-0.176*** (0.05)	0.003 (0.14	-0.031 (0.135)		0.149 (0.352)	-0.005 (0.366)	0.61** (0.23)
EQ_T	0.137 (0.444)	0.33 (0.35)		-1.31 (1.62)	2.06 (5.02)	0.007 (0.006)		-0.055 (0.765)	0.009* (0.005)
GFCF						-2.60 E-05*** (5.15 E-06)	-0.725 (0.853)		
GFCF_VA	-0.384*** (0.095)	-0.332*** (0.089)	-1.75*** (0.212)	-1.237** (0.139)	-0.84*** (0.204)		-0.319 (0.253)	-0.564** (0.189)	-109.76** (47.48)
Adj R-squared	0.92	0.94	0.70	0.70	0.64	0.88	0.44	0.37	0.55
N. Obs.	48	48	48	32	39	42	48	48	42

Level of significance: ***1 %, ** 5%. *10%

adopted during periods of strong economic growth to alleviate the social costs of them. Education and training on the job should be encouraged by public and fiscal policies

5.1 Competition on the goods market

The introduction of the Euro has increased price competition due to higher transparency and the elimination of price discrimination strategies. Therefore, the competition on the goods market in Europe has already become tougher. However, economic policy should foster more competition on this market for two main reasons:

- First, given the impossibility of using monetary instruments at the local or even national level, competition policy on the goods market is the only instrument that the regional authorities can use to put prices under control and foster competitiveness.

- Second, higher competition obliges firms to realize not only capacity investments but also efficiency investments to survive.

Therefore, economic policy at regional level should alleviate bureaucracy as much as possible to make business creation as easy as possible. Productivity growth often comes with new firms bringing up-to-date technologies and human capital. This increases competition with the older firms. Moreover, firms should be encouraged to increase in size to be able to make large-scale investments not to form monopolies but to create a network of medium-high enterprises. A distinctive characteristic of the firms in the United States is that new firms increase in size much more rapidly than the firms in Europe (Scarpetta, Hemmings, Tressel and Woo, 2002).

5.2 Labor market competition

Labor market policies are the most controversial and politically the most difficult to apply. The theoretical and empirical labor market literature gives pros and cons arguments about labor market flexibility. On the one hand, more flexibility may be favorable to innovation through reallocation of labor resources towards innovating firms (Acemoglu and Pischke 1988 and Hobjijn and Jovanovic, 2001). However, too much flexibility can increase job turnover and prevents the consolidation of relationships

between employees and employers. Long-term relationships in the firms are sometimes necessary to carry out long-term investments (Amable and Ernst, 2003). Moreover, the very protective labor markets and the high level of labor productivity per hour worked in France, Germany and Belgium suggest that tight labor legislation may force firms to adopt innovating technologies to survive (Acemoglu, 2003). However, in a changing environment like the one following the increase in competition in the European goods market, a too protective labor market may result in the deterioration of firms' profitability. This profitability loss can in turn reduce the investment effort. As a result, some labor market flexibility should be allowed for the increase in competition on the goods market to be effective. A more protective labor legislation is often associated with a dual labor market. There is a market with permanent contract and a high level of protection and a market with temporary contract. This is the case in countries like France, Portugal, Sweden and Spain. According to OECD, Spain has the highest share (37%) of temporary contracts among OECD countries. In general, this creates distortions in the allocation of labor resources but it introduces some flexibility.

5.3 Investment in human capital and technology

The Sapir report (2004) argues that a possible strategy to increase productivity is to support production factors such as human and physical capital as well as the business environment or the degree of openness to trade. Our econometric results showed that, in the leading regions in Europe such as Baden Württemberg and Rhône-Alpes, gross fixed capital formation was one of the main determinants of productivity. There is room for effort at the European level to financially support investment in research and development. The composition of the EU budget has evolved in this direction. University reforms should also be adopted by national member states to increase research activity and diffusion. Universities and research institutes could also be created by the EU setting the standards of higher education and fostering competition among universities in Europe.

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7. Appendix : Composition by sector for regional regressions

Our classification follows that proposed by EUROSTAT that bases on standard classification NACE branches REV 1.1. Here you are the references:

- Industry : from C to F, included (including Construction)
- Services: from G to P, included (excluding extra territorial organization and bodies)

- Manufacturing: D

- Construction: F

- Electricity, gas and water supply (short name: electricity): E

- Wholesale and retail trade, repair of motor vehicles, hotels/restaurants, transport, storage, communication (short name: wholesale): from G to I, included,

- Financial intermediation, real estates renting and business activity (short name: finance): from J to K, included

- Public Administration and defense, compulsory social security, education, health and social work, other community, social and personal service activities, private household with employed persons (short name: Public administration): from L to P, included.