Productivity performance in three small European countries: Austria, Belgium and the Netherlands

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Abstract

This paper describes and analyses the productivity performance of three small European countries: Austria, Belgium and the Netherlands. It uses the EUKLEMS database for describing productivity developments for those countries in an international perspective. This paper particularly explores three specific topics for the three countries considered: i) catching up or falling behind?, ii) productivity in market services, iii) industrial specialisation and structural change. Productivity levels of Austria, Belgium, and the Netherlands are high. However, both labour productivity growth rates and MFP growth rates in Austria, Belgium, and the Netherlands have been considerably lower than in the United States since the mid 1990s. To some extent, these lower growth rates are owing to the disappearance of the catch up bonus diminishing the possibility to learn from the United States.

Jel Classification - O30, O47, O57.

Keywords: Labour productivity, Multi Factor Productivity, catch up, market services, and specialisation.

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1. Introduction

The launch of the Lisbon strategy in 2000 was strongly motivated by the observation of a declining trend in European labour productivity growth over the preceding decade. As productivity growth in the United States (US) accelerated after 1995, this divergent evolution indicates that, after a process of catching up to the US productivity level that started after the World War II, the European productivity levels ceased to converge to the US level after 1995. The widening gap in productivity performance was first attributed to a differential in the productivity growth of ICT producer industries and later on to divergences in productivity growth of ICT user industries and particularly in ICT user market services.[1]

However, this development for Europe as a whole does not necessarily apply to all European countries considered individually. Actually, the second half of the nineties was also a period of increasing divergences in productivity growth patterns inside the European Union. The productivity performances of the Scandinavian countries are, for example, in line with those of America but are far from the Spanish or Italian developments.

The main objective of this paper is to analyse the productivity performance of three small, and open European countries: Austria, Belgium and the Netherlands. If only because of their language and historical cultural background, Belgium and the Netherlands are closely linked to each other. But also in economic perspective both countries are strongly related as the bilateral export and import consider a substantial amount in the overall trade of both countries. Austria seems to be the odd one out. Nevertheless, there are a number of similarities between Austria and the other two countries as well. Each country is small, reflected in a relatively low total Gross Domestic Product (GDP) in a European perspective, but exhibits high levels of per capita income. Moreover, the economies are open with a high share of service industries. Finally, the countries are all bordered on Germany being one of their most important European trading partner.

This paper explores three specific themes for the three countries considered: i) catching up or falling behind?, ii) productivity in market services, iii) industrial specialisation and structural change.
From World War II up to the mid 90s, Europe's productivity growth was substantial. Most European countries benefited from high productivity levels of the US by adaptation of leading technologies. Since 1995, labour productivity growth of the majority of European countries including Austria, Belgium and the Netherlands has slowed down, whereas productivity growth significantly has accelerated in the US. It raises the issue that Europe might be the victim of its own success as its catch-up bonus might have disappeared. As a starter for an in-depth analysis on convergence to the technological frontier and its determinants later on, section 3 provides a descriptive overview of industries catching up or falling behind US-industries in terms of productivity level over time.

The second topic (section 4) takes a closer look at the productivity performance of market services. During the period 1995-2004, labour productivity growth in market services decreased in Austria and Belgium but increased rapidly in the US and, at a slower pace, in the Netherlands. The decomposition of labour productivity growth over the periods 1985-1994 and 1995-2004 allows to underline common patterns of development and divergences between the three European countries and the US. Trying to explain the observed differences, a number of potential factors are taken into consideration: productivity levels, ICT accumulation and use, labour qualifications, R&D and innovation and regulations.

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[1] For a recent detailed analysis see van Ark, O'Mahony and Ypma (2007) and European Commission (2008).

The third topic (section 5) addresses the industrial specialisation and structural change in the three countries, taking an EU-aggregate and the US as benchmarks for additional comparison. We use a new sectoral taxonomy that categorises both manufacturing and service industries by their educational intensity and combine it with the OECD definition of high-tech manufacturing. After reviewing the theoretical literature on human capital and resources for explanations of sector specificity in educational intensity, we summarise the major patterns and changes of specialisation in terms of sector types. Finally, we apply the growth accounting method to investigate the differences between industry types in terms of the various factor contributions to aggregate growth.

This paper employs the November 2007 release of the EUKLEMS database, which gives a wide-ranging overview of outputs, inputs and productivity at the aggregated level and at the industry level of more than 25-30 European countries and the US, up to 35 years of data. It is the first data set to present homogeneous variables on growth and productivity for European countries and the US. This EUKLEMS database offers, amongst others, a measure of capital input by calculating capital services rather than capital stocks.

The paper is organized as follows. Section 2 discusses the major trends in output and productivity growth at the aggregated level for Austria, Belgium and the Netherlands in an international perspective. It also provides summary results for each individual country at lower levels of aggregation with respect to labour productivity and the contributions from capital, labour and multi factor productivity growth (MFP) to labour productivity growth. Section 3 presents evidence on catching up or falling behind by sectors. Section 4 focuses on the determinants of the productivity performance of market services. Section 5 addresses the industrial specialisation and structural change in the three countries. Finally, section 6 summarises and concludes.

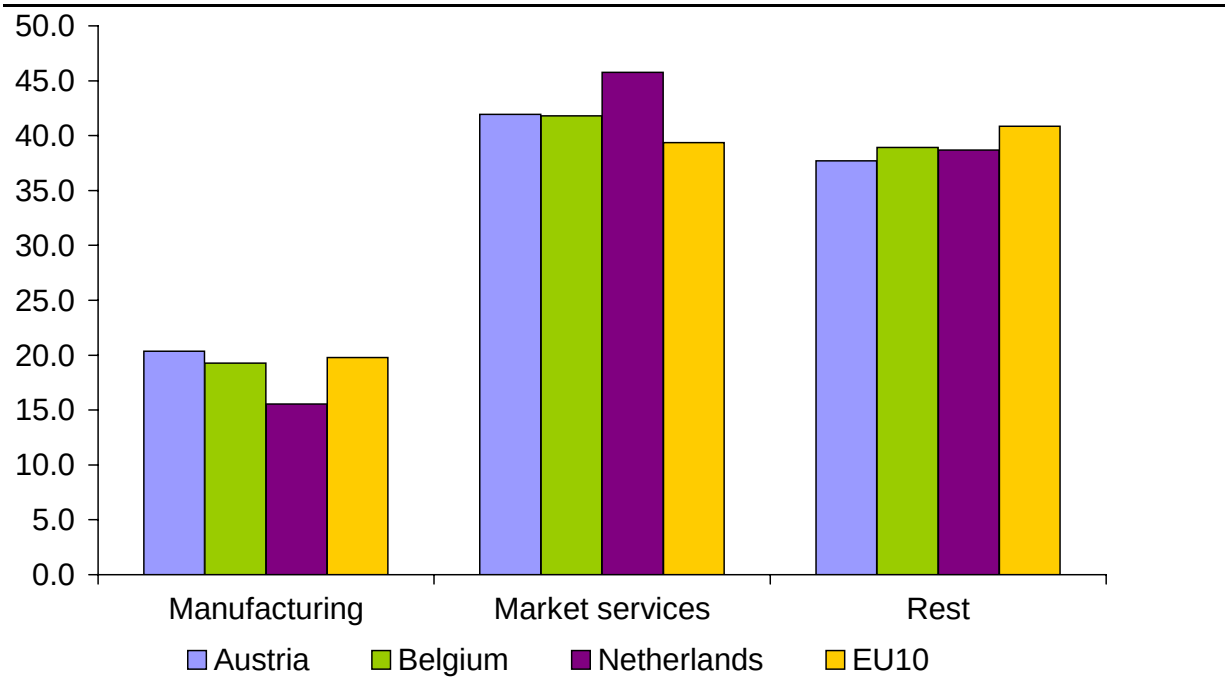
2. General overview of economic performance

This section provides a general overview of the economic performance of the three countries involved. Section 2.1 starts with highlighting some stylized facts and discusses the major trends in output and productivity growth at the aggregated level for Austria, Belgium and the Netherlands in an international perspective. Sections 2.2 to 2.4 present more detailed results for each country individually. It focuses on whether certain developments at the aggregated level are driven by generic issues across industries or by specific industries.

2.1. Introduction

Austria, Belgium and the Netherlands are relatively small in terms of their population and their area in an international perspective. This is also reflected in their share of EU's GDP as a whole. The shares of Austria, Belgium, and the Netherlands are 2.2, 2.6 and 4.4 percent respectively. Hence, the Netherlands is twice as large as Austria, but also considerable larger than Belgium.

Graph 1: Market structure of economies (gross value added, current prices), 2000



Source: Own calculations with EUKLEMS database.

In contrast, the difference in economic market structure is not large between the countries. Graph 1 divides the economy into three parts: manufacturing industries, market services and the rest of the economy (i.e. non-market services, energy and agriculture). As one would expect for countries with high levels of per capita income, the largest part of each economy consists of market services.[2] The Dutch market services sector is relatively the biggest with a share of more than 45 percent in the total economy. The manufacturing industry is relatively mostly present in Austria, whereas the Dutch counterpart is relatively small. These specialization patterns are extensively discussed in section 6.

[2] Three main market services industries are identified in the EUKLEMS database (see Annex 1 for a description of NACE codes): i) Distribution includes NACE codes G (50 to 52) and I without post and telecommunication (60 to 63); ii) Finance and business services includes NACE codes J (65 to 67) and K without real estate

Table 1: Gross value added, hours worked and labour productivity growth, 1970-2005
(average annual growth rate, %)

	1970-1995	1995-2005	2000-2005
Gross value added			
EU15	2.5	2.1	1.6
Austria	2.8	2.2	1.5
Belgium	2.5	2.0	1.4
Netherlands	2.7	2.5	1.2
US	2.7	3.1	2.4
Total hours worked			
EU15	-0.2	0.8	0.5
Austria	-0.2	0.7	0.6
Belgium	-0.6	0.8	0.3
Netherlands	0.1	1.0	-0.2
US	1.5	0.8	-0.3
GVA per hour worked			
EU 15	2.7	1.4	1.1
Austria	3.0	1.5	0.9
Belgium	3.1	1.2	1.1
Netherlands	2.6	1.5	1.4
US	1.2	2.3	2.7

Source: Own calculations with EUKLEMS database.

In line with the developments in the EU15, average GDP-growth of each of the three countries is slightly lower from 1995-2005 than from 1970-1995 (see table 1). The main factors behind economic growth are the structural growth rate of labour supply and the structural growth rate of labour productivity. Looking at those pillars, the growth performance has undergone a noticeable change. There has been a switch from productivity driven growth in the period 1970-1995 to relatively more labour-intensive growth since the mid 1990s in the EU15 including Austria, Belgium and the Netherlands. Due to lower levels of unemployment and higher participation rates (especially of women), labour supply increased considerably resulting in higher total hours worked. The improvement in the European employment situation has gone together with a slowdown in productivity growth. Given the ageing of the EU-population, this might be reason for concern as economic growth potential will depend more heavily on productivity gains.

Labour productivity growth in the EU15 slowed considerably from 2.5 per cent from 1970-1995 to 1.4 per cent from 1995-2004. Austria and Belgium predominantly have experienced lower labour productivity growth rates since the mid 1990s. Although present, the productivity slowdown is less pronounced for the Dutch economy. Additionally, Austria's labour productivity performance in the early 2000s is particularly low.

activities (71 to 74); iii) personal services consist of NACE codes H (55), O (90 to 93) and P (95).

Using the EUKLEMS-growth accounting method based on the framework developed by Jorgenson and associates (see, Timmer et al., 2007), table 2 presents the decomposition of labour productivity growth into the contribution of inputs for the market economy. It distinguishes the following proximate sources: labour composition, capital input growth per hour worked and contribution of multifactor productivity (MFP). MFP growth measures the change in output that cannot be explained by changes in inputs. It captures anything that changes the relation between measured input and measured output. Excluding measurement errors, MFP growth indicates the effects of (technological) innovations including organizational - and institutional changes. Capital deepening is further divided into ICT-capital services and non-ICT capital services. Due to data availability, the period is from 1980 onwards and therefore not directly comparable to the results in table 1.[3] Moreover, table 2 shows the results for the market economy, neglecting non-market industries where productivity is notoriously difficult to measure (see e.g., O'Mahony, 2007).

Table 2 : Labour productivity decomposition for market economy
(average annual growth rate, %)

Country	Period	Total	Labour composition	NICT Capital deepening	ICT Capital deepening	MFP
EU15	1980-1995	2.6	0.3	0.8	0.4	1.1
	1995-2005	1.5	0.2	0.4	0.5	0.3
Austria	1980-1995	2.8	0.3	0.6	0.4	1.5
	1995-2005	2.0	0.2	0.1	0.6	1.2
Belgium	1986-1995	2.1	0.4	1.0	0.6	0.1
	1995-2005	1.6	0.2	0.4	0.8	0.2
The Netherlands	1980-1995	1.3	0.2	0.3	0.4	0.4
	1995-2005	2.1	0.2	0.1	0.6	1.1
US	1980-1995	1.5	0.3	0.2	0.5	0.6
	1995-2005	3.0	0.2	0.4	0.7	1.6

Source: Own calculations with EUKLEMS database.

MFP growth contributes most to the slowdown of labour productivity growth in the EU15 countries after the mid 1990s. However, this development is not the same for each European country individually, particularly not for Austria, Belgium and the Netherlands. Austria corresponds only to some extent to developments witnessed across the EU as a whole. Its MFP growth rate was annually 0.3 percent points lower in the period 1995-2005 than in the period 1980-1995. The labour productivity slowdown in Austria is mainly caused by lower contributions of non-ICT capital deepening. The MFP contribution in Belgium turns out to be very small for the market economy as a whole over time. MFP increased with only 0.2 percent yearly. Similar to Austria, the lower labour productivity growth rates are due to lower contributions of non-ICT capital deepening. Finally, the Netherlands is clearly an exception across Europe and with respect to Austria and Belgium in particular as MFP growth considerably improved since 1995.

[3] For Belgium, only figures from 1986 to 2005 are available.

The good productivity performance of the US since the mid 1990s has been in the spotlights for several years now. Many studies have analysed and documented the potential reasons for the sharp rise in the productivity growth after a quarter century of sluggish improvements. Broad consensus exists that the acceleration in the second half of the 1990s can be partly attributed to ICT. Remarkably, table 2 shows that of the total speedup of 1.5 percentage point between the period 1980-1995 and 1995-2005 only a fraction is directly related to ICT, reflected in the larger contribution of ICT-capital deepening. More precisely, only 0.2 percent point of the acceleration of labour productivity growth can be attributed to more intensive use of ICT. Higher MFP accounts for the largest part of the acceleration in the US.

Comparison of the latest US-productivity performance to the ones of Austria, Belgium and the Netherlands shows that the recent gap in labour productivity growth rates is hardly due to respectively labour composition effects, ICT or non-ICT capital deepening, but mainly due to different MFP growth rates. As we will show hereafter, the difference in those growth rates between the US and the three countries are largely located in market services.

2.2. Austria: new challenges and opportunities from bordering transition

Since the beginning of the 1990s, the Austrian economy faced major challenges in terms of increasing competition and widespread fears of relocation of production posed by the economic transition in the Central and Eastern European countries. At the same time, many Austrian companies have seized the opportunities by expanding exports, foreign direct investment or various forms of new co-operations. Due to the relatively close spatial proximity, joint ventures with East European firms became manageable even for small and medium sized enterprises (Peneder and Stehrer, 2007).

How did the Austrian economy respond to these challenges in terms of output and productivity performance? Whereas between 1970 and 1995 the average annual growth of gross value added amounted to 2.8%, and 2.9% from 1995 to 2000, it was only 1.5% from 2000 to 2005 (see table 3). This growth slowdown must partly be accrued to the effects of fiscal consolidation at the macro level, but is also evident in the particularly strong decline of growth in the non-market services. Even more alarming is the steady drop in labour productivity from 3.0% per year in the period from 1970 to 1995 to 2.1% per year from 1995 to 2000, and 0.9% from 2000 to 2005. Growth has become more labour intensive after 1995 than in the period before, with a very slight but still positive growth in terms of total persons engaged as well as hours worked. This development is entirely due to the weak productivity performance of the services sector, whereas the goods producing industries maintained their high level of labour productivity growth, at the cost of a respective decline of employment and hours worked.

Table 3: Austria: Gross value added, hours worked and labour productivity growth, 1970-2005
(average annual growth rate, %)

	(annual average volume growth rates, in %)				Average share in total hours worked (%)	Contribution to LP growth in total industries
	Gross Value Added	Total persons engaged	Total hours worked	GVA per hour worked		
1970-1995						
TOTAL INDUSTRIES	2.8	0.1	-0.2	3.0	100.0	3.0
.Electrical machinery, post and communication	5.2	0.5	0.0	5.2	4.1	0.2
.Manufacturing, excluding electrical	2.4	-1.0	-1.6	4.0	21.1	1.0
.Other goods producing industries	1.7	-2.0	-1.9	3.6	21.1	1.0
.Distribution services	3.4	1.2	0.5	3.0	19.9	0.5
.Finance and business services	4.5	3.7	2.9	1.6	6.4	0.1
.Personal and social services	1.5	1.4	0.5	1.0	9.8	0.1
.Non-market services	2.6	2.2	1.5	1.1	17.6	0.1
.Reallocation of labour effect						0.0
1995-2005						
TOTAL INDUSTRIES	2.2	0.6	0.7	1.5	100.0	1.5
.Electrical machinery, post and communication	2.8	-1.5	-1.5	4.3	3.5	0.2
.Manufacturing, excluding electrical	3.0	-0.9	-1.4	4.4	15.1	0.7
.Other goods producing industries	1.9	-1.2	-1.6	3.5	15.5	0.6
.Distribution services	2.1	0.7	0.6	1.5	21.3	0.3
.Finance and business services	3.4	5.2	5.4	-2.0	11.9	-0.2
.Personal and social services	1.2	1.3	1.4	-0.2	11.2	0.0
.Non-market services	1.4	1.3	1.5	-0.3	21.5	-0.1
.Reallocation of labour effect						-0.1
1995-2000						
TOTAL INDUSTRIES	2.9	1.0	0.8	2.1	100.0	2.1
.Electrical machinery, post and communication	3.0	-0.3	-0.8	3.8	3.7	0.1
.Manufacturing, excluding electrical	4.3	-0.8	-1.9	6.2	16.0	1.0
.Other goods producing industries	2.3	-0.8	-2.2	4.4	16.5	0.8
.Distribution services	3.5	0.9	0.8	2.7	21.3	0.6
.Finance and business services	5.1	7.6	7.5	-2.4	10.5	-0.2
.Personal and social services	1.2	1.6	1.8	-0.6	11.0	-0.1
.Non-market services	1.2	1.3	1.7	-0.6	21.1	-0.1
.Reallocation of labour effect						-0.1
2000-2005						
TOTAL INDUSTRIES	1.5	0.3	0.6	0.9	100.0	0.9
.Electrical machinery, post and communication	2.6	-2.7	-2.2	4.8	3.4	0.2
.Manufacturing, excluding electrical	1.8	-1.0	-0.9	2.7	14.3	0.4
.Other goods producing industries	1.6	-1.5	-1.0	2.7	14.4	0.4
.Distribution services	0.8	0.4	0.4	0.4	21.3	0.1
.Finance and business services	1.8	2.9	3.4	-1.6	13.4	-0.1
.Personal and social services	1.3	1.0	1.1	0.2	11.4	0.0
.Non-market services	1.5	1.2	1.2	-0.1	21.9	0.0
.Reallocation of labour effect						-0.1

When focusing on the market economy, the average annual growth of labour productivity was 2.0% in the period from 1995 to 2005 (see table 4). This can be decomposed into an average annual contribution of 0.2 percentage points from labour inputs, and 0.6 percentage points from capital services (almost all of that contribution accrues to ICT capital), and 1.2 percentage points contribution from MFP growth. The MFP contribution since 1995 is only slightly below its long-term average. It is highest in the goods producing industries, below average in the distribution services, and negative in the finance and business services as well as the personal and social services. However, the latter two sectors are notoriously prone to difficulties in measuring the volume of output. Their negative MFP contributions must therefore be interpreted with a considerable degree of caution.

Table 4: Austria: Labour productivity growth by industry, 1980-2005

(average annual growth rate, %)

	LP	*LC*	K/H	*KIT/H*	*KNIT/H*	*MFP*
	(1)=(2)+(3)+(6)	(2)	(3)=(4)+(5)	(4)	(5)	(6)
1980-1995						
MARKET ECONOMY	2.8	0.3	1.0	0.4	0.6	1.5
.Electrical machinery, post and communication	5.7	0.2	2.0	1.4	0.6	3.4
.Manufacturing, excluding electrical	3.8	0.3	1.1	0.2	0.9	2.4
.Other goods producing industries	2.7	0.1	0.7	0.1	0.7	1.8
.Market services	1.9	0.4	0.9	0.4	0.4	0.6
..Distribution services	2.3	0.3	0.9	0.4	0.5	1.2
..Finance and business services	1.9	0.5	1.1	0.8	0.3	0.3
..Personal and social services	0.1	0.7	0.4	0.1	0.2	-0.9
1995-2005						
MARKET ECONOMY	2.0	0.2	0.6	0.6	0.1	1.2
.Electrical machinery, post and communication	4.3	0.3	1.5	1.1	0.5	2.5
.Manufacturing, excluding electrical	4.4	0.3	0.9	0.4	0.4	3.3
.Other goods producing industries	3.5	0.2	0.4	0.1	0.3	2.9
.Market services	0.3	0.2	0.6	0.7	-0.1	-0.4
..Distribution services	1.5	0.1	0.6	0.6	0.0	0.8
..Finance and business services	-2.0	0.2	0.5	1.0	-0.5	-2.7
..Personal and social services	-0.2	0.2	0.2	0.3	0.0	-0.6
1995-2000						
MARKET ECONOMY	2.9	0.2	0.8	0.7	0.1	1.8
.Electrical machinery, post and communication	3.8	0.3	2.0	1.5	0.5	1.6
.Manufacturing, excluding electrical	6.2	0.3	1.2	0.5	0.6	4.7
.Other goods producing industries	4.4	0.1	0.8	0.2	0.7	3.5
.Market services	0.9	0.2	0.7	0.8	-0.2	0.0
..Distribution services	2.7	0.2	0.8	0.7	0.1	1.6
..Finance and business services	-2.4	0.2	0.1	1.2	-1.1	-2.7
..Personal and social services	-0.6	0.3	0.2	0.3	-0.1	-1.0
2000-2005						
MARKET ECONOMY	1.1	0.2	0.4	0.4	0.0	0.5
.Electrical machinery, post and communication	4.8	0.3	1.1	0.6	0.5	3.4
.Manufacturing, excluding electrical	2.7	0.2	0.6	0.3	0.3	1.8
.Other goods producing industries	2.7	0.3	0.0	0.1	-0.1	2.4
.Market services	-0.2	0.1	0.6	0.6	0.0	-0.9
..Distribution services	0.4	0.0	0.4	0.4	0.0	0.0
..Finance and business services	-1.6	0.2	0.9	0.9	0.1	-2.7
..Personal and social services	0.2	0.2	0.3	0.2	0.0	-0.2

Notes:
This table gives for each industry a decomposition of labourproductivity growth into the contributions of inputs and MFP
LP= Value Added per hour worked
LC= Contribution of Labour composition
K/H= Contribution of Capital input growth per hour worked
KIT/H= Contribution of ICT capital per hour worked
KNIT/H= Contribution of Non-ICT capital per hour worked
MFP= Contribution of Multi factor productivity growth
NB MFP growth rates might differ from Table 2, due to negative asset rental price and due to reallocation effects

To summarise, the goods producing industries, although declining in relative importance, have successfully coped with the challenges of the past decade through exposure to international competition, and have seized the new opportunities. Conversely, the disappointing productivity performance in the ICT-intensive financial and business services points towards lacking complementary investments, e.g. in organisational innovation or skill upgrading. Difficulties in measuring the true volume of output is likely to be an additional cause.

2.3. Belgium: from labour productivity growth to labour input growth

Value added growth for the Belgian economy has slowed down during the period 1995–2005, especially during the second half of this period, despite enhanced labour input growth (see table 5).

Table 5: Belgium: Gross value added, hours worked and labour productivity growth, 1970-2005
(average annual growth rate, %)

	(annual average volume growth rates, in %)				Average share in total hours worked (%)	Contribution to LP growth in total industries
	Gross Value Added	Total persons engaged	Total hours worked	GVA per hour worked		
1970-1995						
TOTAL INDUSTRIES	2.5	0.2	-0.6	3.1	100.0	3.1
.Electrical machinery, post and communication	3.3	-1.0	-1.5	4.8	4.9	0.2
.Manufacturing, excluding electrical	3.1	-2.1	-2.7	5.9	23.4	1.7
.Other goods producing industries	1.0	-1.7	-2.6	3.6	12.1	0.6
.Distribution services	1.2	0.1	-0.6	1.8	20.7	0.4
.Finance and business services	3.1	3.1	2.6	0.5	9.6	0.0
.Personal and social services	2.9	1.0	0.0	2.9	7.2	0.2
.Non-market services	3.0	2.0	1.2	1.8	22.1	0.3
.Reallocation of labour effect						-0.3
1995-2005						
TOTAL INDUSTRIES	2.0	0.9	0.8	1.2	100.0	1.2
.Electrical machinery, post and communication	4.2	-1.1	-1.4	5.6	3.8	0.2
.Manufacturing, excluding electrical	1.4	-1.1	-1.2	2.6	16.0	0.5
.Other goods producing industries	1.9	-0.7	-0.4	2.2	9.0	0.2
.Distribution services	1.1	0.7	0.6	0.6	19.9	0.1
.Finance and business services	4.5	3.0	3.4	1.0	17.3	0.2
.Personal and social services	0.2	0.6	0.4	-0.2	7.6	0.0
.Non-market services	1.3	1.5	1.3	0.0	26.3	0.0
.Reallocation of labour effect						0.0
1995-2000						
TOTAL INDUSTRIES	2.5	1.1	1.3	1.2	100.0	1.2
.Electrical machinery, post and communication	6.2	0.0	-0.2	6.4	4.0	0.3
.Manufacturing, excluding electrical	2.4	-0.7	-0.5	2.9	16.8	0.5
.Other goods producing industries	3.1	-0.6	0.4	2.7	9.3	0.3
.Distribution services	0.3	0.5	0.7	-0.4	20.1	-0.1
.Finance and business services	6.2	4.7	5.3	1.0	16.3	0.1
.Personal and social services	1.2	0.8	0.7	0.5	7.7	0.0
.Non-market services	1.4	1.3	1.3	0.1	25.9	0.0
.Reallocation of labour effect						0.1
2000-2005						
TOTAL INDUSTRIES	1.4	0.6	0.3	1.1	100.0	1.1
.Electrical machinery, post and communication	2.2	-2.2	-2.7	4.8	3.6	0.2
.Manufacturing, excluding electrical	0.4	-1.5	-1.8	2.2	15.3	0.4
.Other goods producing industries	0.6	-0.8	-1.2	1.8	8.8	0.2
.Distribution services	1.9	0.9	0.4	1.5	19.8	0.3
.Finance and business services	2.7	1.3	1.6	1.1	18.4	0.2
.Personal and social services	-0.9	0.4	0.1	-0.9	7.5	-0.1
.Non-market services	1.3	1.7	1.4	0.0	26.6	0.0
.Reallocation of labour effect						0.0

On annual average, total hours worked have increased by 0.8% over 1995-2005 up from -0.6% between 1970 and 1995. Due to deindustrialization, labour input growth has been negative in almost all manufacturing industries in both periods, although to a lesser extent between 1995 and 2005 than between 1970 and 1995. In most service industries, in particular in finance and business services, total working hours increased substantially. However, during the most recent period, 2000-2005, the job creation in services decelerated and the job destruction in manufacturing accelerated, leading to a

slight annual average increase in total hours worked of 0.3%. During this period, annual value added growth markedly decelerated, reaching 1.4%, due to the large decline of the labour contribution.
Those trends in value added and working hours explain why Belgium has recorded decreasing though still positive labour productivity growth rates between 1970 and 2005. Annual average labour productivity growth accelerated between the two main periods for only two industries, namely Electrical machinery and the post and communication services and Finance and business services. The contribution to aggregate labour productivity growth of these two industries has also risen in relative terms. The contribution of the other manufacturing industries has been on the decline in both absolute and relative terms. During the most recent period, 2000-2005, Distribution services also recorded a large acceleration in yearly labour productivity growth.

Annual labour productivity growth for the market economy declined to 1.6% during the period 1995-2005, after amounting 2.1% over 1986-1995 (see table 6). Over 1995-2005, the main productivity growth contribution came from capital deepening and especially from ICT capital deepening. The labour composition effect was also positive but smaller than the effect recorded during the previous period, 1986-1995. The MFP contribution was also slightly positive for the market economy and of the same magnitude than the labour composition effect. It slightly accelerated during the first half of the 2000s.

At the industry level, the strong productivity growth of Electrical machinery, post and communication was mainly due to a strong increase in MFP contribution and in ICT capital deepening. In general, all manufacturing sectors recorded an increase in MFP contribution over 1995-2005 in comparison with 1986-1995. By the opposite, all services sector recorded a negative MFP contribution except Finance and business services.

During the most recent period, 2000-2005, market services labour productivity growth accelerated mainly due to an acceleration of the productivity growth of Distribution services. This evolution is explained by a substantial reduction of the negative contribution of MFP in this sector over 2000-2005 in comparison to 1995-2000.

Table 6: Belgium: Labour productivity growth by industry, 1986-2005

(average annual growth rate, %)

	LP	*LC*	K/H	*KIT/H*	*KNIT/H*	MFP
	(1)=(2)+(3)+(6)	(2)	(3)=(4)+(5)	(4)	(5)	(6)
1986-1995						
MARKET ECONOMY	2.1	0.4	1.6	0.6	1.0	0.1
.Electrical machinery, post and communication	3.9	0.4	2.2	1.3	0.9	1.2
.Manufacturing, excluding electrical	3.5	0.5	2.7	0.6	2.1	0.3
.Other goods producing industries	2.8	0.3	1.2	0.2	1.0	1.2
.Market services	1.0	0.4	1.1	0.6	0.4	-0.5
..Distribution services	1.3	0.6	2.0	0.8	1.2	-1.2
..Finance and business services	-0.5	0.2	-0.2	0.3	-0.6	-0.4
..Personal and social services	2.3	0.6	1.4	0.6	0.8	0.4
1995-2005						
MARKET ECONOMY	1.6	0.2	1.2	0.8	0.4	0.2
.Electrical machinery, post and communication	5.6	0.4	2.5	1.6	0.8	2.8
.Manufacturing, excluding electrical	2.6	0.3	1.7	0.6	1.1	0.6
.Other goods producing industries	2.2	0.0	0.8	0.3	0.5	1.4
.Market services	0.9	0.2	1.1	0.8	0.2	-0.4
..Distribution services	0.6	0.3	1.8	1.1	0.6	-1.5
..Finance and business services	1.0	0.1	0.3	0.6	-0.2	0.6
..Personal and social services	-0.2	0.2	1.0	0.6	0.5	-1.5
1995-2000						
MARKET ECONOMY	1.7	0.2	1.3	1.0	0.3	0.1
.Electrical machinery, post and communication	6.4	0.5	3.2	2.5	0.7	2.8
.Manufacturing, excluding electrical	2.9	0.3	2.0	0.7	1.3	0.6
.Other goods producing industries	2.7	0.0	0.5	0.4	0.2	2.1
.Market services	0.6	0.2	1.1	1.1	0.0	-0.8
..Distribution services	-0.4	0.3	2.2	1.6	0.6	-2.9
..Finance and business services	1.0	0.2	0.0	0.7	-0.7	0.9
..Personal and social services	0.5	0.3	1.1	0.7	0.4	-0.9
2000-2005						
MARKET ECONOMY	1.6	0.2	1.1	0.5	0.5	0.3
.Electrical machinery, post and communication	4.8	0.3	1.7	0.8	0.9	2.8
.Manufacturing, excluding electrical	2.2	0.3	1.3	0.4	0.9	0.6
.Other goods producing industries	1.8	0.0	1.1	0.3	0.8	0.6
.Market services	1.2	0.1	1.0	0.6	0.4	0.0
..Distribution services	1.5	0.3	1.3	0.7	0.6	-0.1
..Finance and business services	1.1	0.0	0.7	0.5	0.2	0.4
..Personal and social services	-0.9	0.2	0.9	0.4	0.5	-2.0

Notes:
This table gives for each industry a decomposition of labourproductivity growth into the contributions of inputs and MFP
LP= Value Added per hour worked
LC= Contribution of Labour composition
K/H= Contribution of Capital input growth per hour worked
KIT/H= Contribution of ICT capital per hour worked
KNIT/H= Contribution of Non-ICT capital per hour worked
MFP= Contribution of Multi factor productivity growth
NB MFP growth rates might differ from Table 2, due to negative asset rental price and due to reallocation effects

2.4. The Netherlands: accelerating productivity growth

From 1970-2005, the Dutch economy has grown at approximately 2.5 per cent per year, with little difference in aggregate growth between the two sub periods, 1970-1995 and 1995-2005 (see table 7). As discussed, during the 1970-1995 period growth was mainly driven by labour productivity growth, whereas in the period 1995-2005 total hours were nearly as important for economic growth as labour productivity. But leaving the large non-market service sector aside, the picture for the Netherlands looks considerably better. In particular the significant acceleration in labour productivity in the Distribution services has helped to raise productivity in the market economy (see also section 3 and particularly section 4). While the Electrical machinery sector (which includes ICT production and communi-

cation services) also shows rapid productivity growth, its contribution to aggregate productivity is limited due to the small size of the industry, and it remained constant as labour input in this sector declined.

Table 7: Netherlands: Gross value added, hours worked and labour productivity growth, 1970-2005 *(average annual growth rate, %)*

	(annual average volume growth rates, in %)				Average share in total hours worked (%)	Contribution to LP growth in total industries
	Gross Value Added	Total persons engaged	Total hours worked	GVA per hour worked		
1970-1995						
TOTAL INDUSTRIES	2.7	1.1	0.1	2.6	100.0	2.6
.Electrical machinery, post and communication	3.1	-0.6	-1.2	4.3	3.8	0.2
.Manufacturing, excluding electrical	2.5	-0.8	-1.6	4.1	17.7	0.9
.Other goods producing industries	2.1	-0.8	-1.4	3.5	14.9	0.6
.Distribution services	2.7	1.1	0.3	2.4	22.0	0.5
.Finance and business services	4.4	3.4	2.9	1.5	11.4	0.1
.Personal and social services	0.0	2.4	0.9	-0.9	8.2	-0.1
.Non-market services	2.9	2.1	0.9	2.0	22.1	0.3
.Reallocation of labour effect						-0.1
1995-2005						
TOTAL INDUSTRIES	2.5	1.4	1.0	1.5	100.0	1.5
.Electrical machinery, post and communication	7.5	-0.5	-0.5	8.0	2.8	0.2
.Manufacturing, excluding electrical	1.7	-1.0	-1.1	2.8	12.7	0.4
.Other goods producing industries	0.5	0.1	0.4	0.1	12.2	0.0
.Distribution services	3.7	1.3	0.4	3.3	22.1	0.8
.Finance and business services	3.8	2.9	2.6	1.1	19.0	0.2
.Personal and social services	1.8	0.7	1.1	0.6	9.6	0.1
.Non-market services	1.7	2.4	2.0	-0.3	21.6	-0.1
.Reallocation of labour effect						-0.1
1995-2000						
TOTAL INDUSTRIES	3.8	2.5	2.2	1.6	100.0	1.6
.Electrical machinery, post and communication	12.0	2.7	2.4	9.6	2.9	0.3
.Manufacturing, excluding electrical	2.7	0.2	0.1	2.7	13.3	0.4
.Other goods producing industries	1.1	1.5	2.5	-1.5	12.3	-0.2
.Distribution services	5.8	2.7	1.5	4.2	22.4	1.0
.Finance and business services	6.2	5.8	5.6	0.6	18.6	0.1
.Personal and social services	3.9	1.5	2.2	1.7	9.7	0.2
.Non-market services	1.6	2.0	1.3	-0.6	20.7	-0.1
.Reallocation of labour effect						0.0
2000-2005						
TOTAL INDUSTRIES	1.2	0.2	-0.2	1.4	100.0	1.4
.Electrical machinery, post and communication	2.9	-3.6	-3.5	6.4	2.8	0.2
.Manufacturing, excluding electrical	0.7	-2.1	-2.3	3.0	12.0	0.4
.Other goods producing industries	-0.1	-1.3	-1.7	1.7	12.1	0.2
.Distribution services	1.7	0.0	-0.7	2.4	21.8	0.5
.Finance and business services	1.3	0.0	-0.4	1.7	19.4	0.2
.Personal and social services	-0.4	-0.1	0.0	-0.5	9.6	0.0
.Non-market services	1.7	2.8	2.7	-1.0	22.2	-0.2
.Reallocation of labour effect						0.2

When focusing on the sources of labour productivity growth in the market economy, the two major contributors to growth are the shift of capital from non-ICT to ICT capital and the considerable improvement in MFP growth (see table 8). Particularly, the productivity performance of the Dutch distribution services is remarkable. To some extent, this might be an ICT-story reflected in higher contribution of ICT-capital, but the acceleration in MFP growth from 1980-1995 to 1995-2005 is also substantial. The performance of this industry contributes considerably to the closing of the gap in productivity performance between the manufacturing and the market services. It underlines the prevailing empirical

evidence that productivity improvements in services can be sizeable as well. While MFP growth in financial and business services is still negative, the MFP performance of this industry has also considerably improved relative to the pre-1995 period. However, here, the rapid increase in the contribution of ICT capital is not matched by a sufficiently rapid MFP growth.

Table 8: Netherlands: Labour productivity growth by industry, 1980-2005

(average annual growth rate, %)

	LP	*LC*	K/H	*KIT/H*	*KNIT/H*	MFP
	(1)=(2)+(3)+(6)	(2)	(3)=(4)+(5)	(4)	(5)	(6)
1980-1995						
MARKET ECONOMY	1.3	0.2	0.7	0.4	0.3	0.4
.Electrical machinery, post and communication	4.1	0.2	1.9	1.2	0.7	2.0
.Manufacturing, excluding electrical	3.0	0.3	1.0	0.4	0.6	1.7
.Other goods producing industries	1.7	0.1	1.3	0.1	1.2	0.3
.Market services	0.4	0.2	0.5	0.5	0.0	-0.3
..Distribution services	1.8	0.2	0.5	0.3	0.2	1.2
..Finance and business services	-0.3	0.1	0.4	0.7	-0.3	-0.9
..Personal and social services	-3.8	0.4	0.4	0.2	0.2	-4.6
1995-2005						
MARKET ECONOMY	2.1	0.2	0.7	0.6	0.1	1.1
.Electrical machinery, post and communication	8.0	0.3	2.7	1.2	1.5	5.0
.Manufacturing, excluding electrical	2.8	0.3	0.8	0.4	0.4	1.7
.Other goods producing industries	0.1	0.2	0.2	0.2	0.0	-0.4
.Market services	2.1	0.2	0.8	0.7	0.1	1.1
..Distribution services	3.3	0.1	0.7	0.5	0.2	2.5
..Finance and business services	1.1	0.4	1.0	1.0	0.0	-0.2
..Personal and social services	0.6	0.1	0.4	0.3	0.1	0.1
1995-2000						
MARKET ECONOMY	2.1	0.3	0.9	0.8	0.0	1.0
.Electrical machinery, post and communication	9.6	0.4	3.6	1.6	2.0	5.6
.Manufacturing, excluding electrical	2.7	0.3	0.9	0.6	0.3	1.4
.Other goods producing industries	-1.5	0.3	-0.1	0.3	-0.4	-1.7
.Market services	2.6	0.2	1.1	1.0	0.1	1.3
..Distribution services	4.2	0.2	0.8	0.7	0.2	3.2
..Finance and business services	0.6	0.4	1.3	1.4	-0.1	-1.0
..Personal and social services	1.7	-0.1	0.5	0.4	0.0	1.4
2000-2005						
MARKET ECONOMY	2.0	0.2	0.6	0.4	0.2	1.2
.Electrical machinery, post and communication	6.4	0.2	1.8	0.8	1.0	4.3
.Manufacturing, excluding electrical	3.0	0.3	0.8	0.2	0.5	2.0
.Other goods producing industries	1.7	0.2	0.6	0.1	0.4	0.9
.Market services	1.7	0.2	0.6	0.5	0.1	0.8
..Distribution services	2.4	0.1	0.6	0.4	0.2	1.8
..Finance and business services	1.7	0.3	0.7	0.7	0.1	0.6
..Personal and social services	-0.5	0.2	0.4	0.3	0.2	-1.1

Notes:
This table gives for each industry a decomposition of labourproductivity growth into the contributions of inputs and MFP
LP= Value Added per hour worked
LC= Contribution of Labour composition
K/H= Contribution of Capital input growth per hour worked
KIT/H= Contribution of ICT capital per hour worked
KNIT/H= Contribution of Non-ICT capital per hour worked
MFP= Contribution of Multi factor productivity growth
NB MFP growth rates might differ from Table 2, due to negative asset rental price and due to reallocation effects

Hence, without making 'it' in large proportions, just getting used to 'it' has led to a relatively good growth performance of the Dutch market economy relative to other EU member states, particularly in distribution services (see also section 4).

3. Catching up or falling behind?

This section provides an overview of industries catching up or falling behind US-industries in terms of productivity level over time. The analysis uses the US as benchmark reflecting its dominant position in technology and productivity. It starts at the aggregated level which may point to main characteristics underlying the developments over time. Additionally, the industry level may help to picture some important details absent at the aggregated level such as specific industry related problems.

3.1. Facts and figures

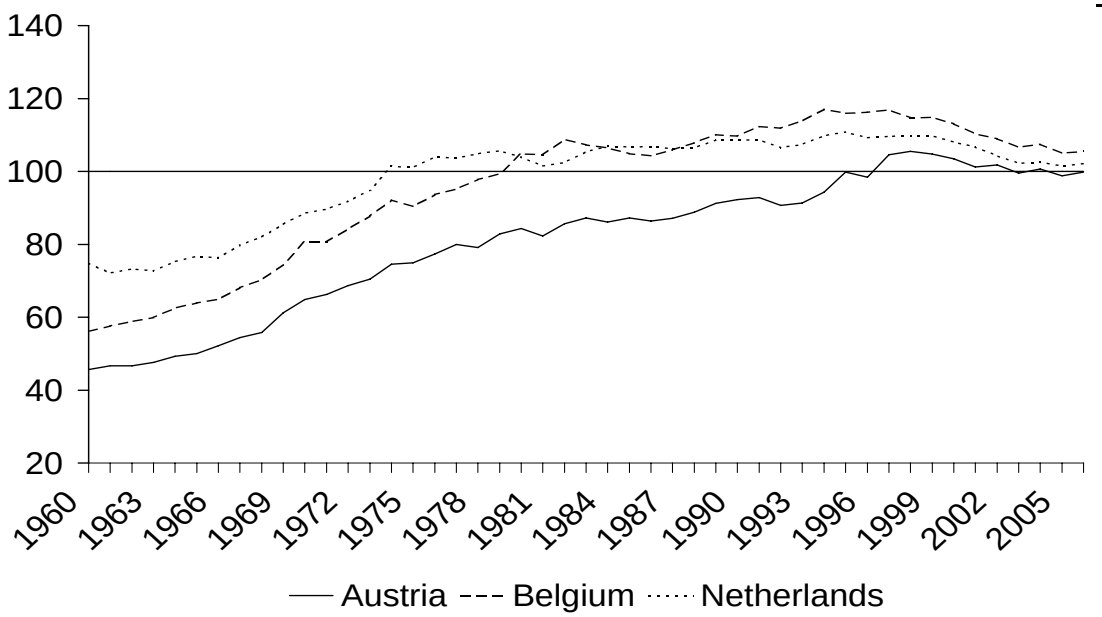
3.1.1. Aggregated level

Section 2 showed that the main problem with the current economic performance of the EU has not been creating new jobs but its labour productivity growth. Labour productivity growth has been slowing down over a long period, while US growth rate has increased since the mid 1990s after a period of stable and relatively low growth. The discrepancy in labour productivity growth between both continents is perhaps not large, but the course of change might be worrying, certainly in the light of the ambitious Lisbon objectives. Is there reason to be gloomy about the productivity performance of the European economy, and in particular the three countries concerned? The answer is not immediately clear if productivity levels are taken into account as so far we only have looked at growth rates.

Labour productivity per hour worked is high in many EU-countries. In Belgium and the Netherlands productivity is even higher than the US level, or as is the case for Austria, close to that level (see graph 2). The slowdown of labour productivity growth in each of the three countries is partly owing to their own success in productivity performance in the past (see e.g., Ederveen et al., 2005). In an historical perspective, all three countries clearly experienced a catch-up with the US after World War II. They managed to learn from US as leader in productivity by copying and adapting state-of-the-art technologies, resulting in relatively rapid growth rates. At the end of the 1990s, the labour productivity level in each country involved was higher than in the US.[4] The Netherlands was the first country that surpassed the United Stated, and Austria being the last one. Meanwhile Belgium has even gone beyond the Netherlands.

[4] Whether Belgium and the Netherlands both have higher productivity levels depends, amongst others, on the method of Purchasing Power Parity.

Graph 2: Labour productivity levels Austria, Belgium and the Netherlands versus US (=100), 1960-2006

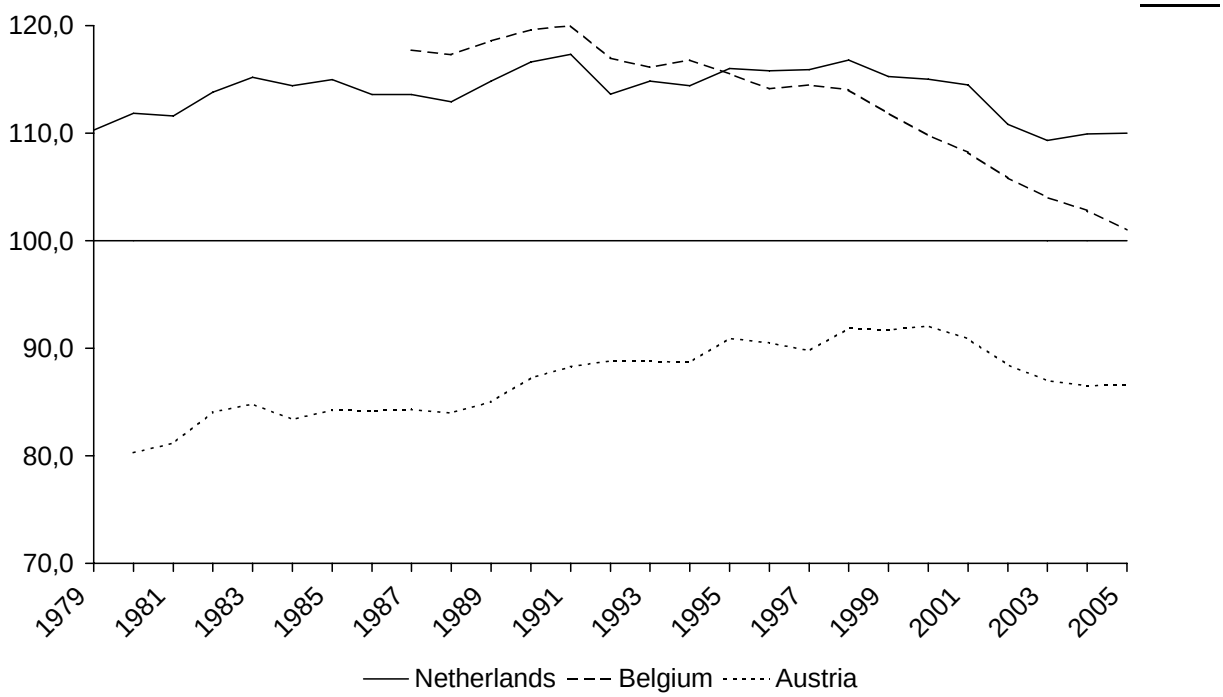


Source: GGDC, GDP per Hour, in 1990 GK $

A change in labour productivity confounds changes in capital deepening and MFP. The remainder of this section focuses on MFP for two reasons. First, the contribution of capital deepening, particularly non-ICT, is not the explanation for the productivity differential between the EU and the US as can be concluded from table 2 in section 2. Although the high EU-employment growth has contributed to the slowdown in labour productivity growth via a temporary reduction in capital intensity, it is unlikely, however, that a trade-off persists in the long run (see Huizinga and Broer (2004), Van Ark et al. (2004), European Commission (2008)). The second reason for focussing on MFP is that this productivity measure is more directly related to changes in technology and measuring the efficiency of an economy or industry. Moreover, long-run economic growth depends, besides the growth of the population, on technological progress.

Graph 3 presents first results for MFP-levels at the aggregated level for the three countries based on preliminary EUKLEMS-work on PPPs. MFP-levels are, however, not easy to measure and require relatively more data than labour productivity levels (see Inklaar and Timmer, 2008). Hence, the results have to be treated with caution. Again, the graph compares these levels with the one of the US as kind of representative of the best practice, or stated otherwise, the technology frontier. Due to data restrictions, the period is much shorter than for labour productivity. Nevertheless, some interesting results can be drawn from comparing graphs 2 and 3. First, with respect to the levels, Belgium and the Netherlands have a higher MFP-level than the US at the macro level, whereas Austria has a productivity level that is approximately 15 percent lower than the US. In fact, Belgium had been the productivity leader between the second halve of the 1980s and the first halve of the 1990s. From then on, the Netherlands has taken over the lead. This is different from the outcomes in graph 2. Apparently, Belgium's higher labour productivity level is driven by relatively higher capital intensity. Second, with respect to changes over time, growth rates of MFP in Belgium are relatively lower than in the US for a long time. In contrast, the growth rates in Austria and in the Netherlands have been lagging only since the end of the 1990s.

Graph 3: MFP-levels Austria, Belgium and the Netherlands versus US (=100), 1979-2005



Source: own calculations based on preliminary results Inklaar and Timmer (2008).

As discussed, both labour productivity growth rates and MFP growth rates in Austria, Belgium, and the Netherlands have been considerably lower than in the US since the mid 1990s. By now, the favourable position of the three countries compared to the US has almost been vanished in terms of labour productivity level. Belgium's lead in MFP-levels has been substantially reduced, while Austria is falling further behind. The MFP-level of the Netherlands is still favourable, but becoming less outstanding. In general, it looks like whether the three countries concerned are falling behind the American levels is just a matter of time. To some extent, the lower growth rates are due to the fact that the three countries have caught up with the US in the past. At the same time the advantage of backwardness or, stated otherwise, the catch up bonus seems to have simply disappeared, diminishing the possibility to learn from the US. Indeed, Ederveen et al. (2005) concludes that catching-up is to some extent behind the structural slowdown in productivity performance of the EU-countries.

Yet, is there reason for concern? The disappearance of the catch-up bonus seems to be only partially the explanation. Apparently, there is more going on. On the one hand, it could be the case that the fallback is mainly due to the outstanding productivity performance of the US. In a longer perspective, countries are leapfrogging and now it is just the US that is taking the lead (e.g. first mover advantage). On the other hand, and a more pessimistic view, the three economies are not ready for pushing out the production frontier itself and learning once more from the US-experiences and its innovations due to all kinds of barriers including market failures. The next subsection studies the productivity performance at lower levels of aggregation.

3.1.2. Industry level

Table 9 presents the number of industries that Belgium, the Netherlands, Austria or the US respectively had the leadership in MFP-levels of all available EUKLEMS countries in 1986 and 2004.[5] The table confirms the relatively good productivity performance of Belgium and the Netherlands.

Table 9: MFP leadership at the industry level, 1986 and 2004

	1986	2004
Austria	1	0
Belgium	4	1
The Netherlands	3	4
US	4	4

Source: Own calculations with EUKLEMS database.

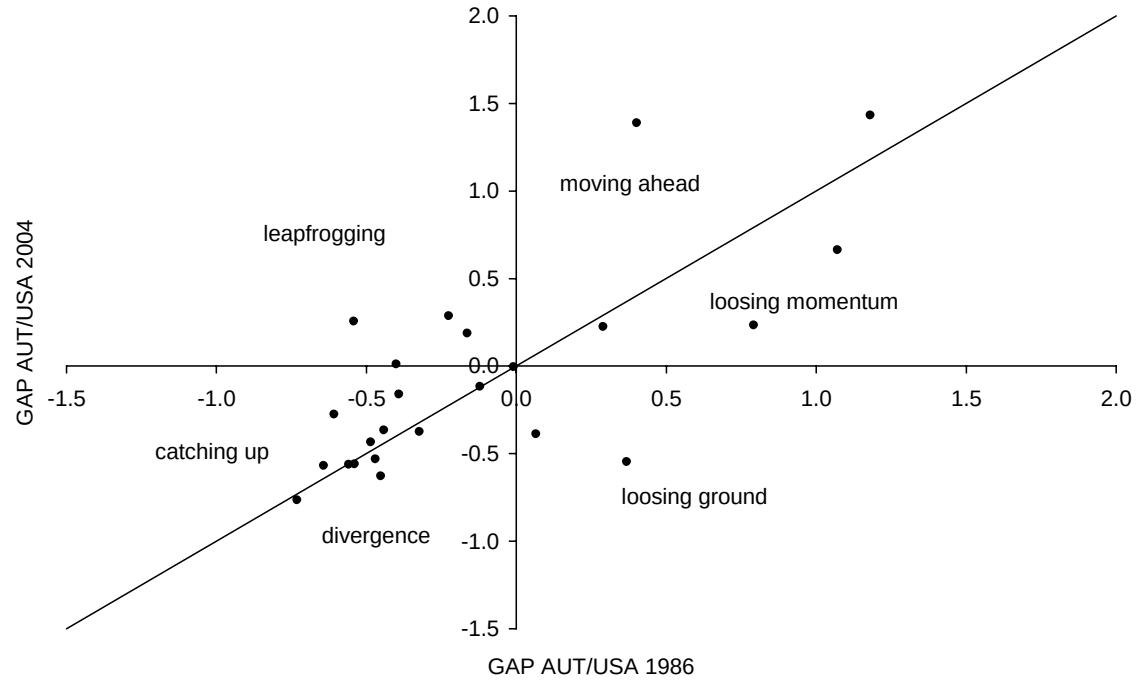
Although the US is definitely not the technological frontier in each observed industry as can be concluded from table 9, henceforth, the analysis takes the US as benchmark country for the MFP-level given the speedup in MFP growth since the mid 1990s in many US-industries. Moreover, this country is the common benchmark in the literature as it has been seen as productivity leader across the world for a long time.

The rankings in table 9 are less informative than the distance of these countries to the leader and the changes over time. Various possible definitions of frontiers and distance to the frontier can be deducted from theories on economic growth. This paper uses the more general notion that MFP-levels of leading countries can be seen as production frontiers or best practices. This distance to the frontier approximates the potential for technology transfer of the follower country. Empirically, the distance of a sector from the global technology frontier is estimated by the difference in MFP levels (Cameron et al. (2005), Griffith et al. (2004), Vandenbussche et al. (2006)).

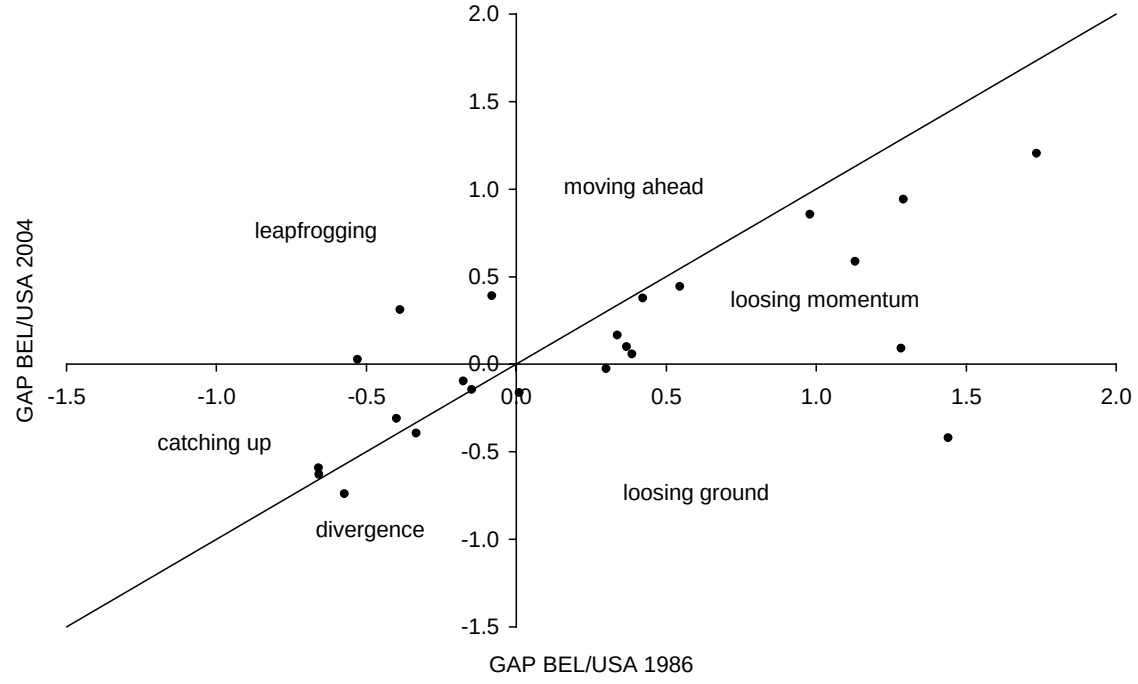
Graphs 4 to 6 present the MFP-results for each country across industries for two years: 1986 and 2004. Each point in these graphs presents an industry. If there is no gap in MFP-level for an industry the point is either on the Y-as in case of 1986 or on the X-as in case of 2004. Each graph consists of four quadrants with each of them having a different meaning in terms of catch up and convergence patterns. Discussing them clockwise, quadrant I implicates that there is a positive gap in favour of the respective country to the benchmark country in both years. Here, the industry realises a structural higher productivity level than its American counterpart over time. Quadrant II contains the results where in 1986 industry i in country j initially had a higher MFP-level than its American counterpart, but that relatively lower MFP growth rates over the period 1986-2004 compared to the US turned it into a gap in 2004. In case of quadrant III, the gap has been present in both years. Finally, quadrant IV represents the results where there was initially a gap in 1986, but the MFP-level of industry i in country j was higher in 2004 reflecting a successful catching up process, even ultimately leapfrogging its American counterpart in terms of MFP-level.

[5] To come up with comparable data for each of the three countries, the analysis is limited to the period 1986-2004 and to 25 industries.

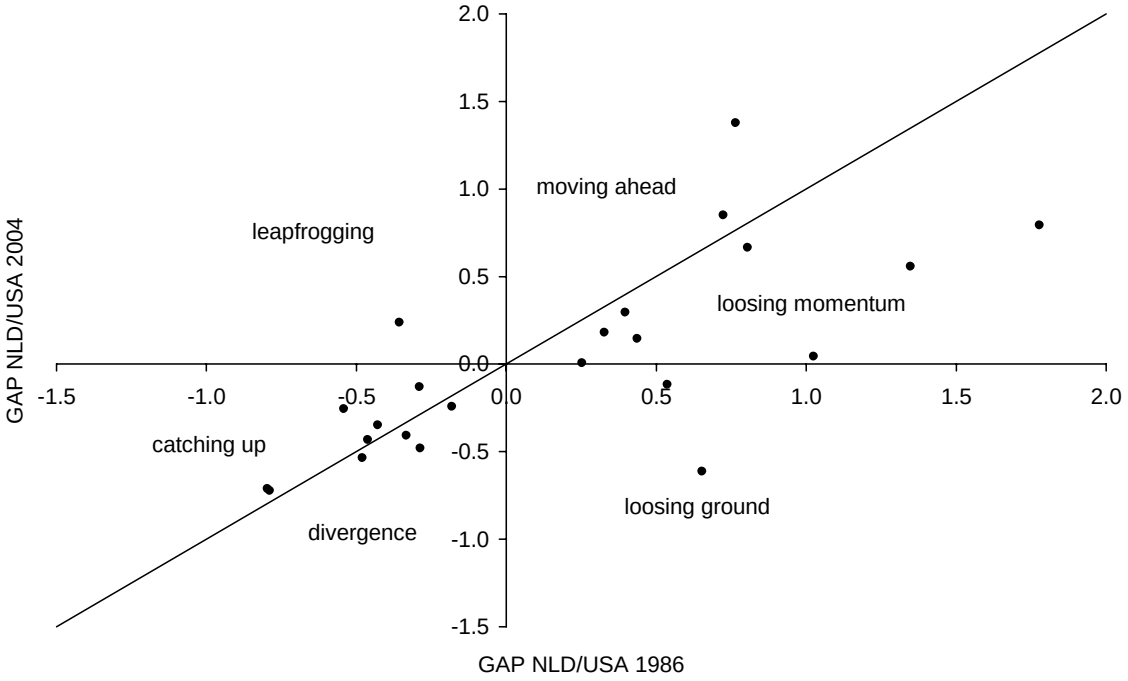
Graph 4: Comparison MFP-levels US and Austria per industry, 1986 and 2004



Graph 5: Comparison MFP-levels US and Belgium per industry, 1986 and 2004



Graph 6: Comparison MFP-levels US and the Netherlands per industry, 1986 and 2004



Source graph 4-6: Own calculations based on preliminary results Inklaar and Timmer (2008).

Two main conclusions can be drawn from the graphs. First, even compared to the three countries here, the US is definitely not the technology leader in each particular industry. Second, it can also be concluded that there is a lot of volatility across the three countries, across industries and over time. All kinds of patterns emerge like catching up, moving ahead and leapfrogging.

Table 10 : Overview of industries on the move

Quadrant	Ia Moving ahead	Ib Loosing momentum	II Loosing ground	IIIa Divergence	IIIb Catching up	IV Leapfrogging
Austria	2	3	2	6	7	5
Belgium	0	11	3	2	5	4
The Nether-lands	3	8	2	4	6	2

Source: Own calculations with EUKLEMS database.

Table 10 summarizes the results of those patterns in terms of number of industries.[6] There are a few industries in each of the three countries that remain to be more productive compared with the US, some of them even succeeded in moving further away. Except for Austria, there are more industries that are loosing moment or are falling further (i.e. loosing ground or further divergence) behind the MFP-level of American industries. Those industries are below the 45 degree line. For Belgium there are 16 industries beneath and 9 above the 45 degree line; for the Netherlands respectively 14 beneath and 11 above; for Austria respectively 11 beneath and 14 above the 45 degree line.

[6] SIC-code 23 (i.e. coke, refined petroleum products and nuclear fuel) is not visible in the graphs as the US MFP-level of this industry relatively deteriorated considerably.

Table 11: Importance of industries in % of value added

Country	Period	Ia Moving ahead	Ib Loosing momentum	II Loosing ground	IIIa Divergence	IIIb Catching up	IV Leapfrogging
Austria	1986	2.1	25.5	8.2	30.7	18.4	15.0
	2004	2.0	26.4	7.5	34.2	16.0	13.8
Belgium	1986	0.0	59.8	11.9	4.2	16.2	7.9
	2004	0.0	56.7	11.9	2.5	20.5	8.5
The Nether-lands	1986	57.7	10.3	6.5	7.8	15.7	1.9
	2004	55.7	9.5	3.5	6.4	21.6	3.4

Source: Own calculations with EUKLEMS database.

Although Austria has more industries improving their position compared to the US in terms of industries than Belgium and the Netherlands. In terms of value added, the story is different (see table 11). Here, the Netherlands is doing better. More precisely, in the Netherlands nearly 80 percent of total value added in 2004 was positioned in the items moving ahead, catching up or leapfrogging. Moreover, those Dutch industries became more important over time as their total share in the Dutch economy was 75 percent in 1986. For comparison, in Austria this share was not more than 32 percent in 2004 similar to the results for Belgium.

Apparently, there is neither for each industry nor for each country a straight story of what is going on beyond the aggregated level except for the ICT-production (SIC 30t33). The latter is related to the success of the American ICT-production (SIC 30t33). Although, productivity performance in EU ICT-manufacturing production should not be ignored, the US performance was exceptional in the second half on the 1990s. Nonetheless, its contribution to the EU-US differential is only minor.

It has been well documented that the EU-US labour productivity growth differential since the mid 1990s is huge in the market services (see e.g. Van Ark et al., 2007 and Inklaar et al., 2008). Our analysis confirms that finding with respect to the three countries, since relatively few market services industries are located in either quadrant I or quadrant IV. Therefore, the next subsection focuses on the productivity performance of the market services in more detail.

3.2. Focus on market services

3.2.1. Facts and figures

During recent decades, market services have increased their economic importance in most industrialised countries. They have played a growing role in terms of value added and job creation. The EUKLEMS database provides valuable data for measuring this evolution for a sub-sector, market services excluding Post and telecommunication, called 'market services' hereafter, which includes the sectors with NACE code G, H, I (without Post and telecommunication (60 to 63)), J, K (without Real estate activities (71 to 74)), O and P.[7]

[7] Post and telecommunication are removed from market services because these industries are aggregated with others to constitute the sub-sector 'ICT producer sector'. The development of this sub-sector is mainly influenced by its own factors, such as technological progress, which are not necessary present for other market services. Real estate activities are considered as non-market services given the difficulties in correctly measuring the output of this industry.

The increase in the relative importance of market services in total number of persons engaged in the three small European countries and in the US is illustrated by table 12. Although this increasing trend is common to all studied countries, it is more perceptible in the US and in the Netherlands. A comparable picture emerges from table 13 where the relative importance of market services is measured in terms of value added at constant prices for the whole economy. The Netherlands has again recorded an evolution closer to that of the US.

Table 12: Relative importance of market services in total number of persons engaged *(%)*

	1970	2004
Austria	24.9	42.4
Belgium	34.1	45.7
The Netherlands	39.3	51.6
US	40.2	51.9

Source: Own calculations with EUKLEMS database.

Table 13: Relative importance of market services in total real value added *(%)*

	1970	2004
Austria	32.8	39.2
Belgium	41.4	39.6
The Netherlands	39.5	43.0
US	28.3	41.7

Source: own calculations with EUKLEMS database.

However, market services have traditionally had less impressive performance in terms of productivity growth because the majority of them are much more labour-intensive than manufacturing sectors (Baumol, 1967). As illustrated by table 14, this characteristic better describes European services than American ones. During the most recent period, 1995-2004, labour productivity growth rates in market services decreased in the EU15 overall, Austria and Belgium but increased rapidly in the US and, at a slower pace, in the Netherlands.

Table 14 : Labour productivity growth in market services *(average annual growth rate, %)*

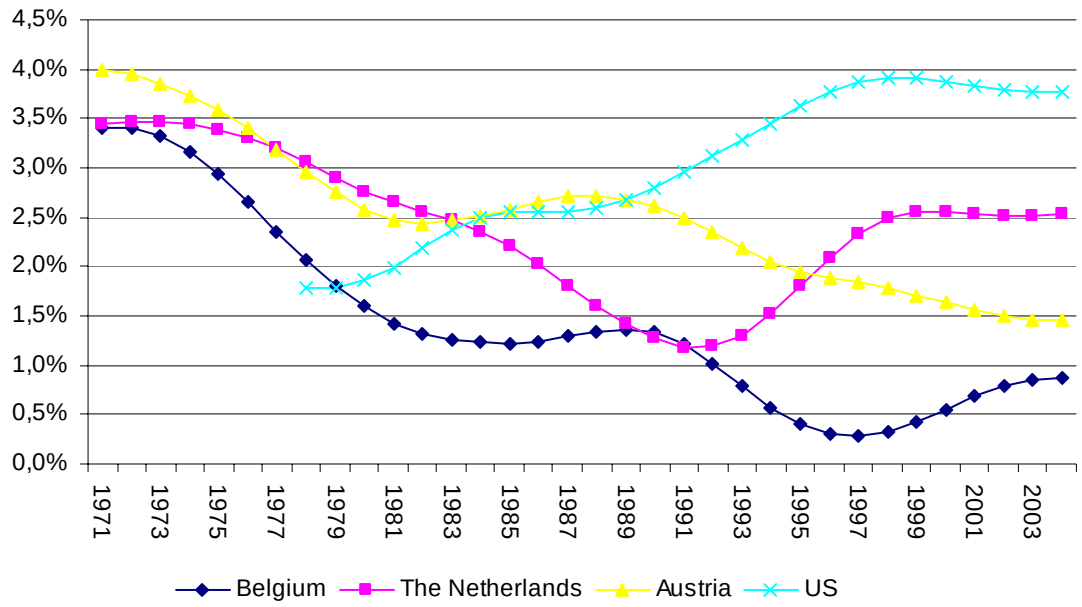
	US	EU15	Austria	Belgium	The Netherlands
1975-1985	n.a.	1.71	2.04	1.65	1.49
1985-1995	1.42	1.67	2.08	1.08	0.28
1995-2004	3.21	0.87	0.49	0.97	1.93

Source: Own calculations with EUKLEMS database.

Market services as above defined, include very different economic activities and it is useful to enter in a more detailed analysis to better understand the sources of these divergences in productivity growth rates. Three main market services industries are identified in the EUKLEMS database: Distribution, Finance and business services and Personal services. The breakdown of the data by industry reveals that the acceleration of labour productivity growth in the US and the Netherlands is due to all those three industries. However, during the most recent decade, both countries recorded a particularly high labour productivity growth in Distribution in comparison to Austria and Belgium, as illustrated by graph 7, which gives the trends in labour productivity growth obtained by the Hodrick-Prescot filtered series (with the lambda parameter set to 1).

The confirmation of the role played by Distribution in the labour productivity growth of market services is also given by the contribution of the three main industries to labour productivity growth in market services, estimated by weighting the labour productivity growth of each industry by its average share in total nominal gross value added of market services (see table 15). The results show that the contribution of Distribution to labour productivity growth in Dutch market services increased substantially during the most recent period. During this period, 71% of the labour productivity growth in the Dutch market services sector came from labour productivity growth in Distribution. This strong contribution of Distribution is mainly due to Wholesale and retail trade (50 to 52), and in particular to Wholesale trade and commission trade (51). By contrast, the contribution of Distribution to the labour productivity growth of market services decreased in Belgium and Austria over the most recent period. In Belgium, this lower contribution of Distribution was due to a strong deterioration of the contribution of the Transport and storage industry (60 to 63), which even became slightly negative. The improvement in the contribution of the Wholesale and retail trade during the most recent period did not fully compensate for the negative impact of the Transport and storage industry. In Austria, the lower contribution of Distribution was due to a lower contribution from the Trade industry and the Transport and storage industry.

Graph 7: Growth rate of labour productivity (HP filtered) – Distribution sector



Source: Own calculations with EUKLEMS database.

Table 15: Industry contribution to labour productivity growth of market services

(average annual growth rate, %)

Country	Period	Market services	Distribution services	Finance and business services	Personal services	Reallocation effect
Austria	1985-1995	2.08	1.28	0.56	0.10	0.14
	1995-2004	0.49	0.78	-0.69	0.00	0.40
Belgium	1985-1995	1.08	0.57	-0.04	0.27	0.28
	1995-2004	0.97	0.36	0.42	0.02	0.18
The Netherlands	1985-1995	0.28	0.45	-0.26	-0.05	0.14
	1995-2004	1.93	1.37	0.36	0.09	0.11
US	1985-1995	1.42	0.95	0.28	0.06	0.13
	1995-2004	3.21	1.61	1.34	0.20	0.06

Source: Own calculations with EUKLEMS database.

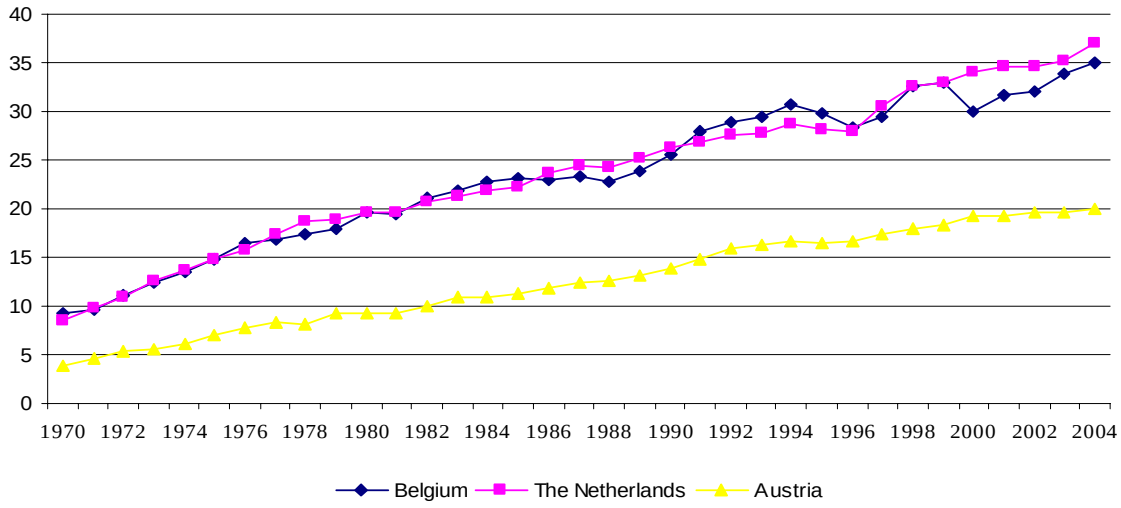
However, different productivity growth rates between countries could be linked to differences in levels of productivity. Productivity level comparisons have to be considered with caution as they are subject to more measurement uncertainty than comparisons of growth rates. Moreover, differences in aggregated productivity levels may reflect differences in industry mix. They also have to be interpreted in a broader context by taking into account differences in the intensity of labour utilisation (working hours per head of population).[8]

Traditionally, Belgium is known for its high level of observed productivity. It could be therefore easier for the Netherlands and Austria to record higher productivity growth rates than for Belgium (β convergence in the catching-up theory).[9] As illustrated by graph 8, on the levels of productivity in Distribution, Belgian productivity level based on PPP has always been close to the Dutch level, preventing the catching-up explanation applied to the current situation. Therefore, it could be inferred that specific evolutions in the Dutch Distribution sector at least partly explain the observed upsurge in productivity growth rates.

[8] Cette (2005) shows that by estimating returns to hours worked and the employment rate it is possible to calculate structural hourly productivity, i.e. the productivity level assuming the hours worked and the employment rate are constant. By comparing this structural hourly productivity levels for the main industrialised countries, i.e. productivity levels based on the assumption that hours worked and the employment rate are the same as in the US, he shows that only Norway maintains a productivity level above that of the US. Unfortunately, this exercise did not include Belgium and Austria. Dolman, Parham and Zheng (2007) calculated structural productivity levels after adjustments for difference in labour utilisation, assuming the long-run productivity elasticities to employment rates and hours worked per employed person reported in Berlorgey, Lecat and Maury (2006), for most of OECD countries for the year 2002. Austria, the Netherlands and Belgium exhibited a quasi-identical level of structural productivity that was slightly below that of the US and with a Belgian productivity level slightly below those of the two neighboring countries.

[9] Two useful measures of convergence are commonly referred to as sigma convergence (σ) and beta convergence (β). Sigma convergence refers to a decline in the dispersion of countries' productivity levels. Beta convergence refers to productivity growing faster in countries with initially lower productivity levels. The speed of convergence measures the rate at which these initial productivity gaps are closed.

Graph 8: Labour productivity level in the Distribution services



Source: Own calculations with EUKLEMS database.

3.2.2. Productivity growth decomposition in Distribution

Using the growth accounting decomposition framework, table 16 presents the decomposition for Distribution, estimated over the periods 1985-1994 and 1995-2004. It allows the common developments and divergences between the three small European countries and the US to be underlined.

Table 16: Labour productivity decomposition for Distribution *(average annual growth rate, %)*

Country	Period	Total	Labour composition	NICT Capital deepening	ICT Capital deepening	MFP
Austria	1985-1995	2.54	0.23	0.42	0.33	1.56
	1995-2004	1.72	0.15	0.10	0.60	0.87
Belgium	1986-1995	1.33	0.59	1.18	0.82	-1.26
	1995-2004	0.80	0.33	0.64	1.20	-1.37
The Netherlands	1985-1995	0.93	0.38	-0.02	0.32	0.25
	1995-2004	3.20	0.16	0.21	0.52	2.31
US	1985-1995	2.13	0.26	0.12	0.47	1.28
	1995-2004	4.30	0.32	0.32	0.90	2.85

Note: for Belgium 1986-1995 because the lack of data for the labour composition effect before 1986.
Source: Own calculations with EUKLEMS database.

The labour composition effect decreased in the three European countries, leading to the conclusion that the improvement in labour quality was lower during the second period, in contrast to that observed for the US. The ICT capital deepening contribution increased and became larger than NICT capital deepening in all countries, underlying the fact that ICT capital accumulation also occurred rapidly in the services sector. However, the spread of new technologies was relatively fast in the US. In Austria and Belgium, MFP contribution decreased sharply (Austria) or was constantly negative (Belgium). The US and the Netherlands, on the other hand, recorded a large increase in the MFP contribution during the most recent period.

Table 16 clearly illustrates that the divergences in labour productivity growth of Distribution observed between Belgium and the Netherlands over the most recent period, 1995-2004, was exclusively due to MFP evolution. In the Netherlands, MFP growth of Distribution accounted for 95% of the MFP growth of the market services sector over this most recent period. This good performance was mainly due to Wholesale trade, which recorded an increase in its MFP at an average annual rate of 3.9%, and to Sale, maintenance and repair of motor vehicles, with an average annual MFP growth rate of 3.0% over 1995-2004.

Table 17: MFP growth in Distribution – 1995-2004 *(average annual growth rate, %)*

	Belgium	The Netherlands	Austria
Distribution	-1.37	2.31	0.87
- Trade	-0.91	2.85	1.25
- Sale, maintenance and repair of motor vehicles	-2.03	2.99	0.06
- Wholesale trade	-1.20	3.92	1.66
- Retail trade	-0.01	0.76	1.14
- Transport and storage	-2.48	0.81	-0.14

Source: Own calculations with EUKLEMS database.

During the same period, MFP growth in the Belgian Distribution sector was negative, mainly influenced by the negative evolution of MFP in Transport and storage. In the trade sub-sector, Sale, maintenance and repair of motor vehicles and Wholesale trade recorded the worst evolutions. Austrian MFP performances are in the middle of the panel. Transport and storage recorded a decrease in MFP, while Trade made a positive contribution to the MFP growth of the Austrian Distribution sector, mainly due to a MFP increase in Wholesale and Retail trade.

3.3. Conclusions

Productivity levels of Austria, Belgium, and the Netherlands are high. However, both labour productivity growth rates and MFP growth rates in Austria, Belgium, and the Netherlands have been considerably lower than in the US since the mid 1990s. By now, the favourable position of the three countries compared to the US has almost been vanished. To some extent, these lower growth rates are owing to the disappearance of the catch up bonus diminishing the possibility to learn from the US. This is, however, not the whole story as even industries that were already lagging behind their American counterparts experienced slower growth rates. This is particularly the case for industries belonging to the market services.

The comparison of labour productivity growth in market services brings important divergences into light. While Austria and Belgium recorded a decrease in their productivity growth between 1995 and 2004, the Netherlands followed a pattern that was also observed in the US, and has recorded an increase in its growth rate since 1995. The decomposition between the main industries shows the prime importance of Distribution in explaining divergences in productivity performance. The decomposition of labour productivity growth in this sector allows the important role played by MFP in the Dutch upsurge in productivity growth to be underlined.

4. Determinants of productivity in market services

This section focuses on determinants of productivity in market services, in particular the Distribution sector. The latter is the most important sector in the divergences in labour productivity growth with the US as discussed in the previous section. This section is structured in two parts: the first part sketches the ultimate sources of productivity growth of productivity in market services, going beyond the growth accounting framework (section 4.1). The second part of this section is dedicated to a preliminary empirical study of the potential determinants of the MFP growth, which appears in the first part of the section, playing an important role in the divergences in productivity (section 4.2).

4.1. Analytical framework: potential determinants

There exists a vast amount of theoretical and empirical literature unravelling the reasons why firms (industries) differ in productivity within industries (sectors), across countries and over time. If anything, this paper does not aim to replicate these issues or strands of literature. Here, we particularly focus on the causes behind the patterns of convergence and divergence of MFP-levels related to determinants of the distance to the frontier theory.

This subsection provides a brief discussion of the main determinants of productivity growth to the technological frontier (see e.g. for a comprehensive overview of the literature Batrokova et al., 2008).[10] Agion and Howitt (2006) propose a theory, mainly based on the Schumpeterian creative destruction model, in which growth results from quality-improving innovations. This theory conditions the role of growth and therefore of MFP determinants, to the distance from the technological production frontier reached by the sector or the country, and/or to the country's level of financial development. The further the country is behind the technology frontier the faster it will grow given larger quality improvements allowed by innovation. Main determinants are investments in research and development (R&D), human capital (including education) and competition (including entry and exit). For instance Griffith et al. (2004) emphasize that R&D has two faces: stimulating innovation (innovative role), and facilitating the imitation of others' discoveries (imitative role). In that respect, R&D-spillovers and other spillovers of knowledge that may contribute to convergence across countries are taken into account. Also the market structure where firms operate on is relevant including the threat of entry to markets, both for the decision to adopt an existing technology and to develop new technologies through R&D efforts. Finally, physical distance to the frontier and openness to trade (or trade intensity) are put forward by literature as other determinants of productivity growth. Except for the last two determinants, the determinants are briefly discussed here.

Innovations and R&D

Innovations introduced in the production process or in the organisation (disembodied technological progress) will generate economic growth mainly by their effect on MFP growth (see Romer, 1990). Indeed, this type of innovation allows improvements to the efficiency with which both labour and capital inputs are used to produce output. The innovation capability of a country or a sector is frequently approximated by the more easily measurable notion of R&D expenditure. Indeed, innovation depends

[10] Currently, CPB is conducting a comprehensive research programme focussing on the determinants of productivity growth to the frontier. This programme elaborates on theoretical issues by exploring the economic literature. The review of Batrokova et al. (2008) is the starting point for two projects using empirics at the industry level and at the firm level with the objective to gain insight in the Dutch gap to the technology frontier.

largely on the level of R&D activities, even if R&D is not the only source of innovation, in particular in services activities, where innovation seems principally non-technological.

The relationship between MFP growth and R&D stock or R&D intensity has been the subject of a great number of economic studies. The majority of these studies found a strong and significant link between R&D and productivity growth. In his survey of the literature, Nadiri (1993) concludes that the elasticity of MFP to R&D stock is situated between 0.08 and 0.30 at the industry level.[11] Productivity growth is not only linked to the growth of domestic R&D stock, but also to the level of the stock. Indeed, according to Aghion and Howitt (1992), growth is generated by a random sequence of innovations produced by research activities that depend on the labour devoted to these activities. Consequently, the amount of R&D activities achieved has an influence on the probability of innovations, which in turn generate productivity growth.

R&D activities performed in a country, a sector or a firm, have an impact not only on the country/sector/firm's productivity but also on the productivity of other countries/sectors/firms. This existence of international and national R&D externalities, widely recognised in the literature, rests on the quasi-public good character of knowledge. These externalities, usually known under the term 'spillovers'[12], can be of two types: rent spillovers and knowledge spillovers (see Griliches, 1979). The first category reflects incomplete price adjustments for quality improvements in intermediate inputs, preventing the complete appropriation of the innovation rent by the innovator, due to imperfectly monopolistic pricing arising from competition. These kinds of spillovers are therefore embodied in economic transactions, such as the purchase of intermediate inputs or investment goods. The second category is due to transfers of ideas and knowledge from one industry to another. Poor patent protection, the inability to keep innovations secret, reverse engineering, technical meeting and mobility of (R&D) personnel are possible channels of knowledge spillovers.

The ability of a firm (or industry) to capture these spillovers depends on its own level of R&D activities. This idea is developed by Cohen and Levinthal (1989), who established the concept of the "two faces of R&D". R&D activities play two roles: on the one hand, R&D activities generate innovations, on the other hand R&D improves the ability of a firm to identify, assimilate and exploit outside knowledge. Cohen and Levinthal (1989) label this capability the learning or absorptive capacity of the firm. The absorptive capacity is largely a function of the firm's level of prior knowledge. Applied to a country perspective and the distance to the frontier, it works as follows. For a country that lies behind the technological frontier there are two main sources of productivity growth, both of which can be influenced by R&D: innovation (direct influence of R&D); technology transfer (indirect influence of R&D, depends on the distance to the frontier). This relationship between own R&D level and impact of R&D spillovers on productivity growth was established empirically in several studies (see Grünfeld, 2002 and Poldahl, 2006). Using a panel of industries across twelve OECD-countries, a leading edge paper of Griffith et al. (2004) ascertains that the imitation effect of R&D is most pronounced for countries lagging behind the frontier. The returns to R&D thus have been recurrently underestimated, when based on US data only.

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[11] The regression of the change in MFP on R&D intensity (relative to output) provides an estimate of the rate of return of R&D.

[12] For an econometric estimation of national and international R&D spillovers see van Pottelsberge and Guellec (2001).

Human capital

Similar to R&D, human capital (or human skills) may have a direct and an indirect effect on productivity growth and helping to close the gap with the frontier. Seen as just another input factor in the production process, human capital might help to speeding up technology absorption and stimulating innovation. Sianesi and Reenen (2003) provide a comprehensive overview of empirical studies on the effects of human capital on growth.

The direct effect of human capital on productivity growth is quite straightforward and refers to the skills and ability of employees. In fact, it is likely that higher skilled employees are more productive than low skilled employees. Then employing relatively more high skilled people will result in a higher (average) labour productivity levels and MFP-levels. The indirect effect of human capital is related to the absorption of knowledge and imitation. Generally, it is argued that higher human skills facilitate the imitation of frontier technology, as high skilled employees are better able to absorb external knowledge than low skilled employees (see e.g. Nelson and Phelps, 1966). As a result, countries that are further away from the frontier, the more important higher skill levels are in the catch up process with the frontier. In contrast, Acemoglu et al. (2002) propose a model in which higher education has a bigger effect on a country's ability to make leading-edge innovations whereas primary and secondary education are more likely to make a difference in terms of the country's ability to implement existing technologies.

Competition

Theoretical and empirical studies suggest that effect of competition and the threat of entry on productivity is ambiguous. Aghion et al. (2005) and Acemoglu et al. (2006) argue that competition favours growth in countries and industries close to the world technological frontier. In contrast, it hampers productivity growth in countries and industries further away from the frontier.

Theoretically, competition may increase productivity through two channels. First, competition may stimulate productivity directly by pushing firms to reduce the X-inefficiency to avoid bankruptcy. Second, competition may increase productivity through its positive effects on innovation. Firms may increase their innovative effort to escape from fiercer competitive pressures. However, the opposite effect is also possible as firms may reduce their innovative effort in the case of increased competitive pressures because their gain from innovation will then become too low (Schumpeter effect).

Aghion et al. (2005) suggest that the combination of both effect results in an inverted U-shaped relationship between the degree of competition and innovation. Vandenbussche et al. (2006) propose a distinction between innovation and imitation when studying the impact of competition. Growth-enhancing policies may change if countries move closer to the technological frontier. A stringent protection of intellectual property can be more important for productivity growth in countries close to the frontier that are more heavily engaged in innovation rather than imitation.

Similarly, Aghion et al. (2006) stress the importance of (the threat of) entry in this respect. Based on firm-level panel data of the UK over the period 1987-1993, the authors show that entry has a more positive effect on MFP growth (of incumbents) in industries that are close to the technological frontier than in those that are not. Exit can have a positive effect because it replaces less efficient firms by more efficient ones.

Convergence and divergence

Empirical studies show that countries (or its industries) do not converge automatically to that of the world technology frontier. Different convergence groups may exist and a country might end up in a convergence trap and stop converging to the frontier at all. Apart from the significant role of determinants of productivity growth, governmental policies might also be important in assuring the country's convergence to the frontier. Acemoglu et al. (2006) highlight these issues in case of competition. The authors establish that for countries close to the world technology frontier, a more competitive environment and a better selection on the labour market enhance growth. On the contrary, for countries far away from the technological frontier it might be better to limit competition.

4.2. Determinants of MFP evolution

From section 3.2, it emerges that the crucial point to understand is why MFP in Distribution (especially in the Wholesale trade) has increased in the Netherlands much faster than in the two other countries over the most recent period. In table 18, the MFP levels for the sectors constitutive of Distribution are presented for the three studies countries in 1997. Except for Transport and storage, Belgian and Dutch MFP levels are very close and very high leading to consider them as being on the technological frontier which is not the case of Austria, corresponding better to a technological follower in Distribution. The higher Dutch MFP growth rates support the idea that the Netherlands have been more successful to move up the technological frontier than Belgium. Moreover, Austria seems to encounter problems to implement a fruit bearing catching up process.

Table 18: Multifactor Productivity level relative to the US, 1997, US=1

	Austria	Belgium	The Netherlands
Motor vehicle trade, retail sales of fuel and motor repairs	0.88	1.71	1.28
Wholesale trade	0.75	1.16	1.19
Retail trade and repair of household goods	0.95	1.07	1.09
Transport and storage	0.74	0.70	1.40

Source: Inklaar et al., 2008.

This one year observation is confirmed by Inklaar and Timmer (2008) presenting the technological three leaders in market services sectors in 1980, 1995 and 2004. In 1980, Belgium was leader in Motor trade and in Wholesale Trade and second in Retail Trade but disappeared from the list in 2004 except for Motor trade. The Netherlands remains leader in Transport and storage in the three years of observation and entered in the top three in Motor trade and Wholesale trade in 2004. Austria never appeared in the list for Distribution sectors.

Having identified the relative position of the countries from the technology frontier, the analysis tries to identify the elements which might explain the observed divergences in MFP growth rates. The main factors explored in this subsection are: R&D and innovation efforts, ICT use, labour force qualifications and degree of competition in Distribution.

4.2.1. Difference in R&D and innovation

The idea is that R&D can generate innovation and, for sectors or countries far from the frontier, R&D can speed up technological transfer, which represents another source of MFP growth. Aghion and Ho-

witt (2006) and Griffith et al. (2004) show that the further the country is behind the global technology frontier, the faster it will grow due to potential of technological transfer and imitation of existing technologies, through R&D. However, in European Commission (2008), regressions do not find a significant effect of technological gap on MFP growth in the private services sector, with a panel of 28 industries for 9 EU countries plus the US over the period 1980-2004. The coefficients of the interactions between technological gap and R&D and between MFP growth at the frontier and R&D are also non significant.

For countries close to the technology frontier, like Belgium or the Netherlands, the main source of MFP growth is the introduction of new technologies rather than imitation of existing technologies. R&D being a source of innovation, different levels of R&D expenditure could partly explain why the Netherlands have been more successful to move up its frontier than Belgium. Table 19 shows that, over 1995-2004, the average intensity of R&D in Distribution was equivalent in Belgium and in Austria and largely higher in the Netherlands. A more detailed analysis of the period shows, however, that the gap between the three countries has been close since about 2000, due to a decreasing trend of R&D intensity in the Netherlands and an increasing trend in the two other countries. A similar evolution was observed for R&D intensity in the total economy, which can have influenced MFP growth of Distribution due to the existence of R&D spillovers. This recent evolution in the R&D expenditure in Austria and Belgium is encouraging for the productivity growth in the future.

Table 19: Indicators of main determinants of MFP growth – Distribution

Determinant	**Country**	**1985-1995**	**1995-2005**
R&D expenditure on VA (%)*			
	AU		0.27
	BE		0.26
	NLDS		0.35
ICT compensation on VA (%)			
	AU	2.21	2.84
	BE	5.81	7.09
	NLDS	2.68	3.78
Share of High-skilled labour compensation (in total labour compensation) (%)			
	AU	4.71	6.06
	BE**	11.25	13.95
	NLDS	13.67	18.75
Indicator of product market regulation***		**1998**	**2003**
Transport	AU	2.98	2.73
	BE	2.80	2.02
	NLDS	1.86	1.43
Retail	AU	4.07	3.16
	BE	3.67	4.52
	NLDS	1.90	1.63

* The Distribution sector is defined as G+I due to data availability.

** For Belgium, average on the period 1987-1995 for lack of available data.

*** Scale of the indicator is 0-6: from least to most restrictive of competition

4.2.2. Difference in ICT use?

ICT, like the other capital assets, contributes, to labour productivity growth through increased capital deepening. ICT also contributes to labour productivity growth through MFP growth. The existence of this channel, and its importance are however more controversial in the economic literature. Two types of possible impact of ICT use on MFP growth can be identified (see OECD, 2004). The first impact is linked to the potential of ICT as a "general purpose technology". The increasing use of ICT may enable new organizations of production and sales at the firm level and at the economy level (see Van Leeuwen and van der Wiel, 2003). It may also lead to greater efficiency in the creation of knowledge and enable firms to improve or create new product or services offered (see OECD, 2002). The second impact of ICT on MFP growth is based on the existence of positive externalities from the use of ICT. For example, the diffusion of ICT may help establish networks, which produce greater benefits the more customers or firms are connected to the network (see OECD, 2002). This existence of spillovers implies that social returns on ICT investments exceed their private returns.

The link between ICT use and MFP growth remains, however, difficult to prove empirically. Moreover, most existing studies have focused on manufacturing. Integration of ICT in the production process requires firms to be able to mobilise qualified human resources with adequate skills (see OECD, 2004). Furthermore, MFP gains would occur progressively and under the condition that the introduction of ICT is associated with additional investments in intangible assets, such as new organizational structures, better worker skills, new strategies (as the lean retailing system (see Abernathy et al., 1999) and new business processes (see OECD, 2000). Van Leeuwen and van der Wiel (2003) found, for a panel of firm-level data for Dutch market services, for the period 1994-1998 that ICT spillovers can be an important source of MFP growth in ICT-using industries. Van Ark and Inklaar (2005) found with a panel of 9 market services industries in 11 countries for the period 1980-2004, no support for significant MFP spillovers from ICT investment, neither in the US nor in European countries.

Table 19 shows that the use of ICT, measured as the share of ICT capital compensation in value added, was higher in Belgium than in the Netherlands and in Austria in Distribution, over the whole period. MFP growth in Distribution could also have been influenced by ICT use in total economy due to the existence of spillovers. ICT use in total economy was also higher in Belgium than in the two other countries, but the gap between the three countries was more reduced. All in all, ICT use does not provide per se a straightforward explanation of the differences in MFP growth in Distribution between the Netherlands and the two other countries studied.

4.2.3. Difference in labour qualifications or skills?

As discussed, it can be argued that high skilled human capital is more important for countries close to the frontier. For instance, Vandenbussche et al. (2004) examine the contribution of human capital to economy-wide technological improvements through innovation and imitation. Using a panel dataset for 19 OECD countries, they show that skilled labour has a higher growth-enhancing effect closer to the technological frontier under the assumption that innovation is a relatively more skill-intensive activity than imitation. The authors validate their model showing also that tertiary education is a factor of economic divergences among OECD countries

In European Commission (2008), regressions based on a distance to frontier model, show that human capital has a positive effect on MFP growth but that this effect is indirect, emanating from a stronger positive impact of MFP growth at the frontier. Moreover, this effect is also sector-specific

with human capital appearing to be most effective in determining the MFP performance of the private services sector.

These results imply that high education investment would be much more MFP growth-enhancing in the case of the Netherlands and Belgium, considered as being on the technological frontier than in the case of Austria reliant more on imitation to push its MFP. Differences emerged in the share of hours worked by high skilled labour compensation in Distribution with a clear advantage of the Netherlands in comparison to Belgium.

4.2.4. Differences in the intensity of competition?

As underlined by Aghion and Howitt (2006) more intense competition in "neck-and-neck" industries can lead to higher innovations rates and hence faster productivity growth. The main mechanism behind enhancing competition in this model consists in allowing entry of new competitors. Nicoletti and Scarpetta (2003) using OECD panel data demonstrated significant links between product market policies and productivity performance with entry liberalisation leading to productivity gains in all of the countries considered. Moreover, entry liberalisation in the services industries boosts annual MFP growth in the overall business sector despite of having no effect in the services sector itself. Later on Nicoletti and Scarpetta (2005) suggested that lower barriers to trade and less regulation seem to have increased the level and the rate of growth of productivity by stimulating business investment and promoting innovation and technological catch-up. On the dynamic side, Griffith et al. (2006) present results which suggest that product market reforms have led to increased competition which in turn have positively impacted the incentives to innovate. They found that intensifying competition tends to increase R&D investment but mainly through increased innovative activity by incumbents rather than new entrants. Inklaar et al. (2008) econometrically study whether regulatory barriers to entry hamper productivity growth in market services. They find no empirical evidences of the effect of the average level of barriers to entry in services on MFP growth in market services industries. However, considering barriers to entry in two individual industries, Transport and storage and Post and telecommunication services, they find that lower barriers are strongly related to higher MFP growth in Post and telecommunication even if such strong link is not clearly proved in Transport and storage.

Table 19 shows that for two main parts of Distribution, Transport and Retail trade, OECD regulatory indicators are at a much lower level in the Netherlands than in the two other countries. This lower level of regulatory barriers could have facilitated potential entry and increased threats of entry on incumbents. Unfortunately, there is only scare statistical information on the rate of entry available on an international comparative basis. In 2000, the rate of birth (number of real enterprise births of year n divided by the population of active enterprises of year n) as published by Eurostat in the structural indicators database was 7.04% in Belgium against 9.45% in the Netherlands (no information available for Austria).

4.3. Conclusions

In line with the Aghion-Howitt model, MFP levels lead to consider Distribution in Belgium and the Netherlands as being on the technological frontier while Distribution in Austria appeared to correspond more to a technological follower, meaning that the same determinants could have differentiated effects and questioning on the reasons explaining the success of the Netherlands in pushing up the frontier in comparison to Belgium.

Four main determinants of MFP growth are taken into consideration: R&D and innovation, ICT use, labour qualifications, and regulations. The comparison between the three countries provides the insights that the Dutch performance is better in terms of labour force qualification, R&D efforts, and regulatory environment. These better performances could have helped the country contrary to what is happening in Belgium, to successfully move up its frontier. The relative lower position of Austria in these indicators should not be viewed as alarming, this country could indeed potentially benefit from a catching up effect to improve its productivity growth.

This analysis is in line with the conclusions of theoretical models underlying the importance of institutions, and more generally of framework conditions, favouring either imitation or innovation depending on the proximity of the country from the technology frontier. At the end of the catching up process, the availability of high skilled workers, of financial instruments promoting risky innovative activities, entrepreneurship spirit and competition-enhancing policies is essential to maintain productivity growth.

5. Industrial specialisation and structural change

This section addresses industrial specialisation and structural change in the three countries, taking an EU aggregate and the US as benchmarks for additional comparison. We use a new sectoral taxonomy which categorises both manufacturing and service industries by their educational intensity and combine it with the OECD definition of high-tech manufacturing. We first review the theoretical literature on human capital and resources for explanations of sector specificity in educational intensity (section 5.1). After presenting the taxonomy (section 5.2), we summarise the major patterns and changes of specialisation in terms of sector types (section 5.3). Finally, we apply the growth accounting method to investigate the differences between industry types in terms of the various factor contributions to aggregate growth (section 5.4).

5.1. Sector specificity and educational intensity

Apart from the cultural values of education to the individual and society at large, the economic interpretation of education emphasizes its nature as a special input to production. This 'human capital revolution' (see Freeman, 1986) was triggered by Schultz (1960, 1961), who proposed that education is an investment in people that generates a distinct class of productive assets. It is labelled human capital, first, because it distinctly becomes part of the person receiving it, and second, because it requires the devotion of substantial resources with the aim of improving a person's productive capabilities and hence the individual prospects for future earnings (see Becker, 1964/75).

The literature reveals at least three causal links, by which schooling relates to future earnings: first, through the acquisition of cognitive and social skills (human capital theory); second, by sorting high- and low-productivity personnel into appropriate jobs (signalling and screening); and third, by increasing a society's capacity for innovation and the diffusion of new ideas (positive spillovers). Taken together, the three mechanisms support the conclusion that educational attainment is a valid measure of the productive capabilities available in the human resource base of a firm, sector or country.

The above considerations explain the supply of educated labour. As it represents capital that is embodied in humans, its individual nature does not easily relate to a sectoral analysis. Consequently, the sector specificity of educational intensity, which motivates the construction of an industry taxonomy in the first place, must be explained by determinants of the demand for labour skills.

Again, the theoretical literature provides various explanations. Assuming that factor and product markets are perfectly competitive, the most straightforward explanation of variations in the demand for educated personnel are intrinsic differences in the technology of production, which determine the marginal product, and together with input prices the factor shares of distinct skill classes. For a given level of output, the respective ratio of wages to labour productivity is therefore the immediate criterion in selecting skill standards for heterogeneous types of labour Lazear (1998). In short, from the micro-perspective of a human resource manager, the required skill standards largely depend on the characteristics of the technology and labour markets. In principle, both are exogenous to the firm, once it has chosen its geographic location and product portfolio. We should therefore expect that these determinants correlate with sector-specific contexts, as defined, for example, in standard industry classifications.

5.2. The taxonomy of educational intensity

Sectoral taxonomies can be a convenient means to condition the indicators on growth and productivity and thereby help to identify more general tendencies without abandoning the wealth of industry detail available in the EU KLEMS data. In this section, we therefore apply a sectoral taxonomy, which classifies forty-nine manufacturing and service industries according to their educational workforce composition. The classification is documented in Peneder (2007). It emanates from statistical cluster techniques applied to data for the US, Germany, France, the UK and Austria. For that purpose, an industry's workforce was segregated by the individual's highest level of educational attainment, for which, depending on the availability of data, the shares in total employment, wages or hours worked were calculated. The shares of all but one of these educational categories were then entered in the clustering algorithm. Since each person is a member of only one of the various educational categories, the latter effectively span an orthonormal space for each measure of workforce composition. The annual data were pooled to comprise two consecutive years (mostly 1999/2000).

To summarise briefly, the taxonomy separates the three following mutually exclusive classes of industries...

- ... with *low educational intensity*: agriculture, food, textiles and clothing, wood and products of wood, mineral products, basic metals and metal products, construction, sale & repair of motor vehicles, or hotels and catering.
- ... *intermediate educational intensity*: mining, pulp and paper (products), printing and publishing, oil-refining, chemicals, rubber and plastics, mechanical engineering and apparatus, motor vehicles and other transport vehicles, miscellaneous manufacturing, electricity, gas and water supply, retail and wholesale trade, transport, communications, real estate, renting of machinery, public administration and other services.
- ... *high educational intensity*: financial intermediation (NACE 65), computer and related activities, research and development, other business services, and education.

In the tables 21 to 23 we further separate a subset of high-tech manufacturing industries as defined by the OECD, which comprises of chemicals, electrical and optical equipment, as well as other transport equipment. The OECD technology classification covers only manufacturing sectors and is defined by their R&D intensity. All sectors identified by the OECD as high-tech happen to belong to the same category of intermediate educational intensity in the above taxonomy. The two classifications thus demonstrate that technology and education are related but nevertheless independent components of production. While the former indicates knowledge that is largely embodied in humans, the latter refers to the complexity of operations and tends to depend more on technological artefacts (codifiable blueprints).

5.3. Industrial specialisation by industry type

Investigating the patterns of specialisation for the distinct industry types with respect to gross output, intermediate inputs, value added and employment shares, we focus on the years 1985, 1995 and 2004 and add an aggregate of ten European core countries (EU10) as well as the US as benchmarks (see table 20). We find a few common characteristics as well as marked differences between the selected countries.

Table 20: Industrial specialisation by industry type (*SHARES IN %*)

	Austria			Belgium			Netherlands			EU 10[1)]			US		
	1985	1995	2004	1985	1995	2004	1985	1995	2004	1985	1995	2004	1985	1995	2004
HIGH SKILL Industries															
Gross Output	7,1	9,7	11,6	10,1	13,5	15,9	8,7	12,5	14,7	10,3	12,3	14,2	9,4	12,5	15,5
Intermediates	3,5	5,9	7,3	6,6	10,3	12,1	6,2	9,1	11,0	6,4	7,9	9,4	5,8	8,6	12,8
Value Added	10,5	13,1	15,9	14,5	17,5	21,3	11,6	16,5	19,1	14,3	16,7	19,4	12,6	16,0	17,9
Employment	10,3	11,6	17,3	17,0	22,3	26,8	18,1	22,6	26,2	13,7	18,2	22,6	21,0	25,6	28,4
HIGH-TECH, MEDIUM SKILL Industries															
Gross Output	5,8	5,3	5,1	7,5	7,1	7,3	8,9	7,8	6,9	7,4	6,8	6,7	7,1	7,4	5,7
Intermediates	7,3	6,7	6,5	8,4	8,0	9,0	11,7	10,2	9,7	9,3	8,8	8,7	9,3	9,6	7,4
Value Added	4,3	4,0	3,7	6,4	5,9	5,0	5,6	5,0	3,6	5,5	4,7	4,5	5,1	5,5	4,3
Employment	3,4	3,1	2,6	4,6	3,9	3,3	4,4	3,1	2,4	4,7	3,8	3,2	4,2	3,2	2,5
MEDIUM SKILL Industries															
Gross Output	49,1	48,6	50,9	52,0	49,3	49,0	49,6	47,3	49,8	50,7	47,2	48,4	53,5	50,7	50,2
Intermediates	47,3	48,2	54,1	52,6	50,0	50,2	44,0	44,7	48,4	51,3	48,5	51,5	54,1	51,0	51,6
Value Added	50,7	48,9	47,8	51,1	48,5	47,4	56,3	50,3	51,4	50,0	45,9	45,0	53,0	50,5	49,0
Employment	40,8	42,7	41,8	53,1	49,1	47,6	51,1	48,8	47,6	48,5	47,6	45,3	47,2	44,1	41,6
LOW SKILL Industries															
Gross Output	38,1	36,5	32,3	30,4	30,2	27,7	32,8	32,4	28,6	31,6	33,7	30,7	30,0	29,3	28,5
Intermediates	41,9	39,2	32,0	32,4	31,8	28,7	38,1	36,1	30,8	33,0	34,8	30,4	30,8	30,8	28,2
Value Added	34,5	34,0	32,6	27,9	28,1	26,3	26,5	28,2	25,9	30,1	32,7	31,0	29,3	28,0	28,9
Employment	45,4	42,6	38,2	25,3	24,8	22,2	26,4	25,5	23,7	33,1	30,4	28,9	27,6	27,0	27,5

1) The EU10 consists of Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Spain and the United Kingdom.

To begin with the commonalities, the data show that each country has uniformly increased its share of industries with 'high educational intensity' for each of the measures applied and with respect to both periods of comparison. Interestingly, the same cannot be said about the subset of 'high-tech' industries. Apart from only very few exceptions (i.e. intermediate inputs and gross output in Belgium) the shares have declined in any of the countries and for each of the measures used. The data thus demonstrate a pronounced and robust structural change in favour of education intensive sectors but not towards high-tech industries.

As a second common characteristic, we find that for the industries with high educational intensity the labour input shares are generally larger than for any of the other measures, while its share of intermediate inputs is consistently and by far the lowest among the chosen indicators. In between, the value added shares are always above those for gross output. In contrast, we find precisely the opposite patterns for the group of high-tech industries as defined by the OECD. For each country and each of the years displayed in table 20 the shares are highest for intermediate inputs and lowest for labour inputs, with gross output shares consequently being higher than value added shares. Again, the data thus reveal a sharp contrast between high-skill vs. high-tech industries, both representing different kinds of knowledge-intensive production. While the former, display generally high labour intensities in combination with a comparatively low use of intermediate inputs, precisely the opposite applies to the latter.

Turning to the major differences in the specialisation patterns between the three countries, no matter which measure we use, Austria stands out with by far the lowest shares in both high-skill and high-tech sectors on the one hand, and the highest share in low-skill industries on the other. While the former are also below the average of the EU, the latter are above this benchmark. The Austrian structural deficits, exhibited by its low shares of knowledge-intensive industries, are well documented and known to be persistent. One obvious explanation for this paradox of a nevertheless good macroeconomic performance (in terms of per capita income) and the seemingly unfavourable sectoral composition of production, is that many Austrian producers occupy high-quality niches within rather traditional types of industries (see Peneder 2004).

Conversely, the patterns of specialisation in Belgium and the Netherlands are relatively similar, with the major differences being the somewhat higher share of Belgium in terms of both high-skill and high-tech sectors, while the Netherlands is somewhat more specialised in low-skilled industries. However, the latter observation is not entirely conclusive, as the Netherlands exhibit higher shares of low-skill industries in terms of gross output, intermediates and labour inputs, but not in value added. With respect to the latter, a relatively higher proportion originates from the non high-tech industries with an intermediate educational intensity. In both countries, the importance of low-skill industries is below that of the EU aggregate and the US, especially so in terms of value added and labour input shares.

Compared to the US, we find in the EU10 a slightly higher degree of specialisation for high-tech industries, a higher value added share but lower labour input share in high-skill sectors. Also for the group of non high-tech industries with an intermediate educational intensity, we find no discernable general tendency, as its share is above in some and below the US in other measures. Finally, for the group of industries with a low educational intensity, the EU generally displays higher shares than the US.

Table 21 - Growth and growth contributions by type of industries, 1985-1994

	Share of industries … with educational intensity				Total	Annual growth
	high	*intermediate*		*low*		
		high-tech	*other*			
Gross output growth						
Austria	11,8	7,4	57,5	23,2	100,0	2,84
Belgium	16,6	8,9	36,8	37,8	100,0	2,13
Netherlands	17,5	7,7	44,4	30,5	100,0	2,27
EU 10[1])	16,3	10,0	42,5	31,2	100,0	2,10
US	15,8	11,5	45,7	26,9	100,0	2,53
Intermediates growth						
Austria	12,3	7,6	51,4	28,7	100,0	3,44
Belgium	15,0	10,3	33,7	41,0	100,0	2,13
Netherlands	9,3	12,6	45,3	32,7	100,0	1,84
EU 10[1])	14,4	11,9	42,5	31,3	100,0	2,34
US	12,9	10,3	46,1	30,7	100,0	2,52
Value Added growth						
Austria	11,5	6,7	62,4	19,4	100,0	2,59
Belgium	18,6	7,1	40,6	33,7	100,0	2,13
Netherlands	21,1	4,1	45,4	29,4	100,0	2,48
EU 10[1])	19,9	8,1	42,4	29,6	100,0	2,17
US	17,6	12,2	46,1	24,1	100,0	2,69
Labour service growth contributions						
Austria	42,4	-4,4	60,1	1,8	100,0	0,38
Belgium	93,4	-6,5	-3,9	16,9	100,0	0,50
Netherlands	40,2	-2,5	47,7	14,7	100,0	0,97
EU 10[1])	122,8	-18,7	17,3	-21,5	100,0	0,28
US	63,2	-6,6	24,7	18,7	100,0	0,61
Non-ICT-capital services growth contributions						
Austria	10,1	4,8	38,2	47,0	100,0	0,66
Belgium	0,2	16,6	39,0	44,1	100,0	0,84
Netherlands	7,3	5,1	48,8	38,8	100,0	0,67
EU 10[1])	14,9	5,8	37,7	41,5	100,0	0,74
US	10,7	3,5	34,2	51,6	100,0	0,84
ICT-capital services growth contributions						
Austria	17,4	2,1	74,4	6,1	100,0	0,30
Belgium	1,0	10,2	65,6	23,1	100,0	0,49
Netherlands	11,8	6,0	73,9	8,4	100,0	0,41
EU 10[1])	16,7	5,0	61,1	17,3	100,0	0,37
US	19,3	6,8	64,1	9,8	100,0	0,59
MFP growth contributions						
Austria	0,5	13,1	74,0	12,4	100,0	1,11
Belgium	-61,3	-28,0	42,3	147,1	100,0	0,10
Netherlands	6,6	18,2	-8,5	83,7	100,0	0,32
EU 10[1])	-12,3	22,3	46,2	43,8	100,0	0,72
US	-25,0	53,7	69,1	2,3	100,0	0,52

1) The EU-15ex (accounting) consists of Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Spain and the United Kingdom.

5.4. Growth accounting by industry type

Pronounced structural differences also become apparent, when we next turn to the question, to what extent each industry type contributed to the aggregate performance in terms of growth and productivity.

Table 21 and 22 report the shares and the annual growth rates for the period 1985 to 1994 and 1995 to 2004, respectively. The data reveal some general differences between industry types that appear to be rather common among countries. For example, one striking observation is the particularly high share in the total MFP contribution to aggregate growth of the group of high-tech manufacturing industries. For instance, in the EU10 during the period 1995 to 2004, high-tech sectors accounted only for 9% of the total economy growth in gross output and intermediate inputs and a little less than 7% of total value added growth (see table 22). These contributions are largely consistent with its small overall size, even though already above its shares in total gross output or value added. However, in remarkable contrast to its small overall size, the high-tech sectors are the source of half of the entire MFP contribution to aggregate growth in the EU10. Also in the US its share in the total MFP contribution is 34%, in the Netherlands 21% and in Austria 17% during the period 1995-2004. Again all the other measures exhibit comparatively low shares which are largely congruent with the small size of the sectors (albeit indicating above average dynamics). The patterns are also similar for the period before 1995, with the one difference that then the share in the generally higher aggregate MFP contribution had been smaller in the EU than in the US (see table 21). The only outlier to this rather common observation is Belgium. But even though in the latter period its aggregate MFP contribution is negative, the high-skill sectors as such provided a small but positive contribution.

Again, the data reveal high-tech and high-skill industries to be quite different, as we observe a consistent negative contribution of high-skill industries to the MFP part of aggregate growth. In the latter period between 1995 and 2004 we find a negative sign for each of the countries. However, in the years from 1985 to 1994 this applies only to Belgium, the EU10 as well as the US, whereas Austria and the Netherlands exhibit a positive MFP contribution from high-skill industries.

More generally, Belgium shows the highest share of high-skill industries in the contributions to aggregate growth of gross output and value added for the period after 1995, whereas in the period before 1995 this portion was largest in the Netherlands. Among the three countries, in both periods Belgium also comes first in terms of the contribution to the growth of gross output and value added from the high-tech sectors, even though all the European countries stay below the

Table 22 - Growth and growth contributions by type of industries, 1995-2004

	Share of industries with . . . educational intensity				Total	Annual growth
	high	*intermediate*		*low*		
		high-tech	*other*			
Gross output growth						
Austria	16,1	6,3	61,9	15,7	100,0	2,79
Belgium	22,8	15,7	44,0	17,5	100,0	2,83
Netherlands	18,8	7,9	57,0	16,2	100,0	2,66
EU 10[1])	16,1	8,9	53,2	21,8	100,0	2,23
US	21,1	12,2	47,6	19,1	100,0	3,17
Intermediates growth						
Austria	9,0	6,9	71,1	13,1	100,0	3,64
Belgium	17,4	17,4	47,7	17,6	100,0	3,70
Netherlands	16,0	10,0	56,2	17,9	100,0	2,94
EU 10[1])	14,3	9,1	57,5	19,1	100,0	3,26
US	23,3	8,8	50,3	17,6	100,0	3,46
Value Added growth						
Austria	26,1	5,2	48,6	20,1	100,0	2,14
Belgium	34,7	10,4	37,6	17,2	100,0	1,89
Netherlands	22,3	5,5	58,3	14,0	100,0	2,39
EU 10[1])	22,8	6,7	47,3	23,1	100,0	1,88
US	18,6	15,4	45,3	20,7	100,0	3,02
Labour service growth contributions						
Austria	140,0	-14,9	17,3	-42,4	100,0	0,33
Belgium	80,5	-2,8	24,8	-2,5	100,0	0,66
Netherlands	51,6	-2,7	33,1	18,0	100,0	0,74
EU 10[1])	77,7	-6,0	14,2	14,1	100,0	0,48
US	80,5	-16,6	-2,7	38,7	100,0	0,33
Non-ICT-capital services growth contributions						
Austria	20,6	2,0	17,0	60,4	100,0	0,45
Belgium	3,5	14,3	29,2	53,1	100,0	0,63
Netherlands	19,2	2,3	24,8	53,7	100,0	0,48
EU 10[1])	21,9	2,9	27,3	47,9	100,0	0,66
US	33,0	8,1	47,0	11,9	100,0	0,39
ICT-capital services growth contributions						
Austria	27,1	3,1	61,9	7,9	100,0	0,48
Belgium	3,5	8,0	54,9	33,6	100,0	0,69
Netherlands	23,5	3,0	65,2	8,4	100,0	0,53
EU 10[1])	30,3	4,5	47,0	18,2	100,0	0,48
US	20,8	5,2	52,3	21,7	100,0	0,99
MFP growth contributions						
Austria	-19,9	17,3	70,5	32,1	100,0	0,76
Belgium	-23,3	-26,6	39,3	110,6	100,0	-0,22
Netherlands	-16,8	20,6	117,4	-21,2	100,0	0,54
EU 10[1])	-09,7	50,0	180,6	-20,8	100,0	0,22
US	-5,0	34,0	53,1	18,0	100,0	1,16

1) The EU-15ex (accounting) consists of Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Spain and the United Kingdom

US benchmark with respect to the latter. Conversely, in both Austria and the Netherlands aggregate growth of gross output and value added relied more heavily on the other sectors with intermediate educational intensity. In all the three countries the contributions from low-skill industries are below the benchmarks of the EU10 and the US in the more recent period. In the earlier period, only Belgium exhibits a contribution of low-skill industries above these benchmarks.

With respect to the growth of intermediate inputs, Austria is the outlying observation where this contribution is largely concentrated in the group of other industries with intermediate educational intensity. In the other countries we observe the general patterns of a rather moderate contribution from high-skill sectors, compensated by the high-tech industries, which exhibit a relatively stronger contribution to the growth of intermediate inputs.

The numbers on labour services are mainly characterised by the consistent negative contributions from the high-tech sectors in each of the countries and for both time periods. We also find negative contributions occasionally for the group of industries with a low educational intensity. In contrast, for the sectors identified with a high educational intensity the share in the growth contribution from labour services is consistently higher than that in value added growth. This finding also reflects differences between sector types in the relative prices for heterogeneous labour, which tend to increase faster for groups with higher qualifications. Finally turning to capital services, we observe that the contributions from Non-ICT capital inputs are concentrated mainly in the group of low-skill industries, whereas the growth contribution from ICT capital is particularly strong among the other industries with an intermediate educational profile. This observation applies to both periods.

5.5. Summary and conclusions

This section analysed differences in the patterns of specialisation and the decomposition of growth contributions applying a new sectoral taxonomy, which distinguishes industries by their degree of educational intensity, and combined it with the OECD classification of high-tech sectors. While the data displayed in the tables provide a wealth of detailed information about the country differences, the most striking results refer to rather general characteristics of the various sector types:

- First, the share of industries with a particularly high educational intensity in total gross output, value added, or employment has been consistently growing in each of the countries, both between 1985 and 1994 as well as between 1995 and 2004. While this might have been expected by many, it is more surprising that the same tendency cannot be detected with respect to the sectors classified as high-tech. In short, the data convincingly demonstrate a powerful tendency of structural change towards high-skill but not towards high-tech sectors.
- Second, despite their above-average growth dynamics, the sectors characterised by a particularly high-educational intensity appear to contribute little or even negatively to aggregate MFP growth. Given the partly intangible nature of many of their services and the according difficulties in precise measurement, the finding may indicate statistical problems in defining output; in particular with respect to the discrimination between prices changes and the quality component.
- Third, high-tech industries account for a huge portion of the MFP contribution to aggregate growth. This MFP contribution by far surpasses its relative modest shares in gross output, value added, or employment. Since the OECD identifies high-tech industries by their high-above average expenditures on R&D, this finding lends support to the growing demand for

supplemental innovation accounts within the current systems of National Accounts (see Advisory Committee on Measuring Innovation, 2008).

The empirical findings thus confirm the importance of a proper distinction between high-skill versus high-tech sectors. Despite apparent complementarities between education (or skills, more generally) and technology, both sector types represent different forms of knowledge intensive production. While the former are all service industries, characterised by a high degree of knowledge embodied in humans, the latter are all manufacturing industries and operations tend to depend more on codified knowledge in the form of technological artefacts.

6. Conclusions

This paper describes and analyses the productivity performance of three small European countries: Austria, Belgium and the Netherlands. It uses the EUKLEMS database for describing productivity developments for those countries in an international perspective. Moreover, it uses this database as stepping stone for a preliminary in-depth analysis of important sources of productivity. This paper particularly explores three specific topics for the three countries considered: i) catching up or falling behind?, ii) determinants of productivity in market services, iii) industrial specialisation and structural change. This exploration shows that there are both similar trends as well as diverging trends going on in the three countries.

Productivity levels of Austria, Belgium, and the Netherlands are high. Up to the early 2000s, labour productivity per hour worked in Belgium and the Netherlands was even higher than in the US, while Austria was close to that level. With regard to MFP, the picture is more or less the same. However, both labour productivity growth rates and MFP growth rates in Austria, Belgium, and the Netherlands have been considerably lower than in the US since the mid 1990s. By now, the favourable position of the three countries compared to the US has almost been vanished. Belgium's lead in MFP-levels has been substantially reduced, while Austria is falling further behind. The MFP-level of the Netherlands is still favourable, but has become less outstanding. To some extent, these lower growth rates are owing to the disappearance of the catch up bonus diminishing the possibility to learn from the US. This is, however, not the whole story as even some industries that were already lagging behind their American counterparts experienced slower growth rates. This is particularly the case for industries belonging to the market services. The comparison of labour productivity growth in market services brings important divergences to light. While Austria and Belgium recorded a decrease in their productivity growth between 1995 and 2004, the Netherlands followed a pattern that was also observed in the US, and has recorded an increase in its growth rate since 1995. The decomposition of labour productivity growth allows the important role played by MFP in the Dutch upsurge in productivity growth to be underlined. The decomposition between the main industries shows the prime importance of the Distribution sector in the Dutch performance.

The second specific topic addresses the determinants of productivity in market services in more detail. Four main determinants of MFP growth are taken into consideration: R&D and innovation, ICT use, labour qualifications, and regulations. In line with the Aghion-Howitt model, MFP levels lead to consider Distribution in Belgium and the Netherlands as being on the technological frontier while Distribution in Austria appeared to correspond more to a technological follower, meaning that the same determinants could have differentiated effects and questioning on the reasons explaining the success of the Netherlands in pushing up the frontier in comparison to Belgium.

The comparison between the three countries provides the insights that the Dutch performance is better in terms of labour force qualification, R&D efforts, and regulatory environment. These better performances could have helped the country contrary to what is happening in Belgium, to successfully move up its frontier. The relative lower position of Austria in these indicators should not be viewed as alarming, this country could indeed potentially benefit from a catching up effect to improve its productivity growth.

The third specific topic focuses on differences in the patterns of specialisation confirms the importance of a proper distinction between high-skill versus high-tech sectors. Despite apparent complementarities between education (or skills, more generally) and technology, both sector types represent different forms of knowledge intensive production. While the former are all service industries,

characterised by a high degree of knowledge embodied in humans, the latter are all manufacturing industries and operations tend to depend more on codified knowledge in the form of technological artefacts.

All in all, the three special topics provide preliminary inputs for a better understanding why divergent developments have recently emerged between European countries in terms of labour productivity. The findings underline the importance of labour qualifications, R&D efforts and competition in improving productivity growth. Those analyses have to be extended by more detailed studies at the industry level and at the firm level to gain a better understanding of the various channels through which these factors influence the increase in productivity. This is a necessary step for providing efficient economic policy recommendations.

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8. Annex

8.1. Description of the sectors

NACE Code A31	Description	NACE Code A60
AA	Agriculture, hunting and forestry	01-02
BB	Fishing	05
CA	Mining and quarrying of energy producing materials	10-12
CB	Mining and quarrying except energy producing materials	13-14
DA	Food products, beverages and tobacco	15-16
DB	Textiles and textile products	17-18
DC	Leather and leather products	19
DD	Wood and wood products	20
DE	Pulp, paper and paper products; publishing and printing	21-22
DF	Coke, refined petroleum products and nuclear fuel	23
DG	Chemicals, chemical products and man-made fibres	24
DH	Rubber and plastic products	25
DI	Other non metallic mineral products	26
DJ	Basic metals and fabricated metal products	27-28
DK	Machinery and equipment n.e.c.	29
DL	Electrical and optical equipment	30-33
DM	Transport equipment	34-35
DN	Manufacturing n.e.c.	36
EE	Electricity, gas and water supply	40-41
FF	Construction	45
GG	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	50-52
HH	Hotel and restaurant	55
II	Transport, storage and communication	60-64
JJ	Financial intermediation	65-67
KK	Real estate, renting and business activities	70-74
LL	Public administration and defence, compulsory social security	75
MM	Education	80
NN	Health and social work	85
OO	Other community, social and personal service activities	90-93
PP	Private households with employed persons	95
QQ	Èxtra-territorial organisations and bodies	99

8.2. Construction of the indicators of regulation

The indicators of regulation used in this paper come from the *OECD International Regulation Database*. These data have been collected from a wide variety of sources, including publications of the OECD and a range of other institutions and the *OECD Regulatory Indicators Questionnaire*.

The regulatory data are converted into sectoral indicators of product market regulation by using a set of weights for the different themes. In each theme, several questions are taken into account, with a numerical value being assigned to each of the possible replies.

The weights used for the construction of the indicator of retail distribution are as follows: retail distribution = 0.20*registration in commercial register + 0.16*licenses or permits needed to engage in commercial activity + 0.16*specific regulation of large outlets + 0.17*protection of existing firms + 0.10*regulation of shop opening hours + 0.20*price controls.

For the transport sector, the indicator used in this working paper is an unweighted average of the indicators observed in three industries: air passenger transport, rail transport and road freight. The weights used for the rail transport are: 0.25*entry regulation + 0.25*public ownership + 0.25*market structure + 0.25*vertical separation. The weights used for the passenger air transport are: 0.5*entry regulation + 0.5*public ownership. The weight used for the road freight are: 0.5*entry regulation + 0.5*price controls.

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