EU SMEs in 2012: at the crossroads

Annual report on small and medium-sized enterprises in the EU, 2011/12

Client: European Commission

Rotterdam, September 2012

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ECORYS

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Preface

This report was prepared by Ecorys together with Cambridge Econometrics with financial support from the European Communities, under the Competitiveness and Innovation Programme 2007-2013. Prof. Dr. Joep Konings from the K.U. Leuven (Belgium) provided scientific support to the study team. Corine Besseling assisted with the business demographics statistics and the Stata computations. Dr Geert Steurs from IDEA Consult contributed to Chapter 4.

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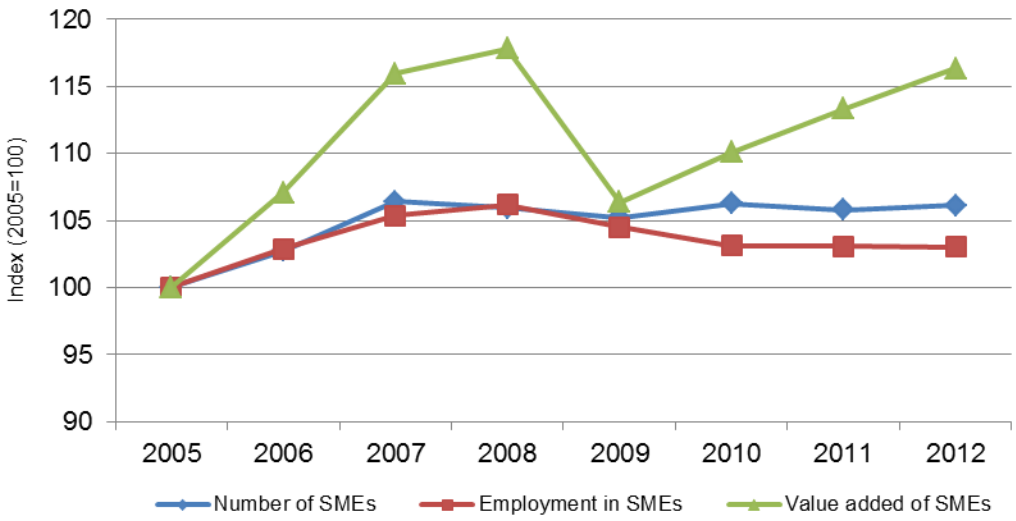
Summary

The European Union faced challenging economic conditions in 2011/12, with an intensifying sovereign debt crisis in the euro zone, the spectre of double-dip recession for several countries and weakening growth in even the better performing nations. Throughout the downturn, however, SMEs have retained their position as the backbone of the European economy, with some 20.7 million firms accounting for more than 98 per cent of all enterprises, of which the lion's share (92.2 per cent) are firms with fewer than ten employees. For 2012 it is estimated that SMEs accounted for 67 per cent of total employment and 58 per cent of gross value added (GVA)[1] . These figures point to a virtual stand still as compared to the preceding year, 2011. With more than 87 million person employed the EUs SMEs continue to be the backbone of the EU economy. However, the difficult economic environment continues to pose severe challenges to them. This is also reflected in the key findings of the report:

1. With the EU economy threatening to dip into recession again, SMEs in the EU as a whole continue to struggle to recover to pre-crisis levels of value added and employment.

Number of SMEs, employment in SMEs and value added of SMEs (2005=100)



Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Note: *2011 and 2012 figures are estimates.*

2. Yet, SME performance varies considerably among Member States. SMEs in Austria and Germany[2] have exceeded their 2008 levels of gross value added (GVA) and employment in 2011. SMEs in Belgium, Finland, France and Luxembourg have, on average, experienced an anaemic performance since 2008. In the other 20 Member States, SMEs have been so far unable to bounce back to their pre-crisis levels of either GVA or employment.

[1] Gross Value Added (GVA) includes depreciation, rewards to labour, capital and entrepreneurial risk. GVA remains when the intermediate costs are deducted from the sales or turnover.

[2] The same may be true for Malta, on the basis of its overall macroeconomic performance, but the data for the performance of SMEs in Malta is very limited and so the estimates presented in this report should be treated with caution.

3. A number of factors explain why in very few countries SMEs have recovered well. First, it appears to help if an economy, such as the Germany's, is strong in high-tech and medium high-tech manufacturing and knowledge-intensive services. Second, sectoral labour productivity levels are higher when the sector shows higher investment rates, higher export rates, and when the sector belongs to high-tech and medium high-tech manufacturing and knowledge-intensive services (see Table 3.6). Again, Austria and Germany have generally met these conditions (see Tables 3.7a and 3.7b). Third, the real value added growth in these best performing Member States is a result of both employment growth -boosting aggregate demand- and real productivity growth, with the contribution of the former being clearly the dominant one.
4. As regards the industrial picture, most sectors experienced a recovery in GVA growth for SMEs in the EU combined with declining or flat SME employment (overall remaining at much lower than the pre-crisis levels of 2008). The sole exceptions were trade, transportation and services. SMEs operating in the mining & quarrying performed least well.
5. Notwithstanding some positive effects on labour productivity, the main result of these trends is a 'jobless growth' for the EU's SMEs.

However, taking a closer picture as regards the dynamics of the SME sector in the individual Member States reveals also some encouraging trends. For instance, despite the fragile economic environment, the latest estimates suggest that the SME sector in an increasing number of countries has started to come around, at least for now. While there are still a number of countries where the situation also for SMEs has worsened, overall this may offer a glimpse of hope for the eventual beginning of a recovery. Hence, whereas in 2009 SMEs in 22 Member States experienced negative real GVA and employment growth, the situation in 2011 was more positive, with only 3 Member States in such a bad position and 13 countries exhibiting positive real GVA and employment growth (see Table A6 in Annex 1). In 2012, only two Member States were expected to have negative growth rates for both indicators (Greece, Portugal).[3]

Against the backdrop of the ongoing crisis, it is imperative that all options for stimulating growths in the EUs SME sector are fully explored. Firms active in the so-called "hi-tech" and knowledge-intensive industry have often been found to show a particular strong performance in terms of productivity and employment as well as GVA growth. Therefore, the report this year focuses on these sectors and their potential for stimulating growth. There are almost 46,000 SMEs in high-tech manufacturing (HTM) and more than 4,3 million SMEs offering knowledge-intensive services (KIS)[4] in the EU. These include SMEs producing pharmaceutical products, electronics or legal and accounting services as well as scientific R&D and creative industries. Together they represent more than a fifth (21,1%) of all of the EUs SMEs. While Germany contains the largest number of SMEs in high-tech manufacturing, while Italy, the UK and France are home to the largest number of knowledge-intensive services.

The above-average productivity growth in the high- tech manufacturing (HTM) and knowledge-intensive services (KIS) sectors is an additional source of growth for SMEs in Europe. When KIS

[3] It should be noted that all figures for 2011 and 2012 are estimates which have been calculated on the basis of a number of macro-economic variables. These estimates were revised a number of times during the drafting process due to changes and updates of the input variables. However, the current dynamic of the economic situation in many Member States is as such that even after the latest round of updating of the variables still in the first half of 2012, the situation might have gone further changes which might not be reflected in our latest estimates.

[4] The Eurostat definitions for high-tech and low-tech manufacturing sectors and high- and less knowledge-intensive services can be found in Annex 1, Tables A3 and A4.

SMEs are compared with the average for all EU SMEs, they performed better in 2011 in terms of both GVA and employment. The same applies for SMEs involved in high-tech manufacturing.

Furthermore, productivity growth of SMEs over the period 2009-2012 was greater in high KIS than in LKIS and was also higher in high-tech- than in low-tech manufacturing. Employment growth of SMEs in the same period was higher in HKIS than in LKIS. The evidence collected – in Figures 3.4b and 3.4c - for both productivity growth and employment growth shows that SMEs in HKIS are especially important drivers of competitiveness.

Member States that are relatively more knowledge-intensive have experienced faster GVA growth in their SMEs. A positive and statistically significant correlation exists between the shares of KIS SME employment in total SME employment and real GVA growth of all SMEs for the 27 Member States in 2008-2011. The same positive and statistically significant correlation applies between Member States' shares of SME employment in high-tech and medium-high-tech manufacturing and real GVA growth of their SMEs.

In addition, the dynamics in business demographics are also more favourable for KIS SMEs than for their LKIS counterparts, with a greater level of enterprise creation and probability of survival. As a result, their contribution to overall employment and GVA is further strengthened. Furthermore, knowledge-intensive services facilitate innovation both in service and manufacturing sectors and thus further enhance competitiveness.

The performance of these hi-tech industries comes also with risks. As many of the good and services produced by them are more export-oriented, they are more vulnerable to sudden external shocks in the global economy such as the one triggered by the outbreak of the financial crisis in 2008. Hence, employment growth in high-tech manufacturing and KIS SMEs was temporarily below that of the low-tech manufacturing and LKIS SMEs around 2010 although they also quickly bounced back. All things accounted for, the findings compiled for this report clearly underline the importance of bolstering hi-and medium-tech manufacturing as well as KIS industries.

On the basis of the established importance of high-tech and knowledge-intensive sectors, the obvious question is about adequate policy instruments. Given the limitations in scope of the report, it could not undertake to fully investigate all relevant policy instruments in this regard. Therefore, it deliberately focused on one policy area which has received a substantial amount of attention recently, i.e. the role of universities in stimulating more innovative start-ups by bridging the gap between public sector research and the business world. There is a detailed review of methods by which research-based spin-offs can be nurtured, including revision of researcher's status, introducing intellectual property rules, presenting annual awards, focusing on campus entrepreneurs, improving access to finance for student entrepreneurs, support and certification mechanisms for business incubators and result-oriented knowledge transfer offices.

Evaluations of incubator models have shown mixed results. Among the recommendations are new best practice frameworks for incubators and benchmarking incubation models, oriented to spin-offs in high-tech and medium high-tech manufacturing and/or knowledge-intensive services, needed in the EU.

1 Introduction

The overall economic situation in Europe in 2011 and the first half of 2012 has been full of uncertainties amid intensifying sovereign debt crisis in the euro zone.

The European Economic Forecast in Spring 2012 showed low levels of business and consumer sentiment, high unemployment limiting private consumption and declining export growth since 2010, which has led to a levelling off in GDP growth during 2011 and 2012. The 2012 Annual Growth Survey emphasised the implementation of agreed priorities, particularly the commitments in the Small Business Act to facilitate the creation of new businesses and a smart and lighter regulatory regime for micro and small enterprises. This should support a real internal market for services facilitating the take up of key enabling technologies and contributing to the growth potential of the European Union[5].

Although EU total employment hardly grew in 2011 (+0.2 per cent), its growth is estimated to fall back to minus 0.2 per cent in 2012. The US and Japan also recorded disappointing growth and employment in 2011 (see Table 1.1).

Table 1.1 Macroeconomic indicators for the EU-27, euro zone, US and Japan (Annual Growth Rates, %)

	2008	2009	2010	2011	2012	2013
Exports (goods and service)						
EU-27	1.5	-12.0	10.9	6.3	2.4	4.8
Euro zone	1.0	-12.7	11.2	6.2	2.1	4.6
USA	6.1	-9.4	11.3	6.7	4.9	6.6
Japan	1.4	-24.2	24.2	0.1	2.4	4.8
Real GDP Growth						
EU-27	0.3	-4.3	2.0	1.5	0.0	1.3
Euro zone	0.4	-4.3	1.9	1.5	-0.3	1.0
USA	-0.4	-3.5	3.0	1.7	2.0	2.1
Japan	-1.0	-5.5	4.4	-0.7	1.9	1.7
Employment						
EU-27	0.9	-1.9	-0.5	0.2	-0.2	0.2
Euro zone	0.7	-2.0	-0.6	0.1	-0.5	0.0
USA	-0.7	-5.0	-0.6	0.6	1.8	0.8
Japan	-0.3	-1.5	-0.4	-0.2	0.1	0.1

Source: European Economic Forecast, Spring 2012[6]

As emphasised in the 2012 Annual Growth Survey, improving growth and competitiveness through structural reforms only delivers results gradually over time. However, creating a perception of improved growth can have a positive short-term effect by restoring confidence and help all Member States, particularly those under market pressure. Insights into the key drivers of growth and competitiveness, such as the role of high-tech manufacturing and knowledge-intensive service

[5]COM (2011) 815 final, Annual Growth Survey 2012
[6]http://ec.europa.eu/economy_finance/publications/european_economy/2012/pdf/ee-2012-1_en.pdf

sectors, can help to prioritise and focus policy actions that are compatible with the overall Europe 2020 strategy targets.

Policies to enhance growth, jobs and competitiveness are key to the success of the Europe 2020 strategy. The dynamic role of SMEs - as the backbone of the European economy - seems to have played a crucial role in the recovery from the global crisis since 2008, as documented in last year's Annual Report on EU SMEs. Europe faces an important challenge to boost competitiveness through productivity growth, hence the seven flagship initiatives, in which innovation, new skills and sustainability are important components. SMEs have been considered one of the 'driving forces' of modern economies due to their contributions in terms of technological upgrading, product and process innovations, employment generation, export promotion, etc. The ability of SMEs to innovate is important because it improves not only their own competitiveness, but also through linkages and knowledge spill-overs with other firms the entire industry and macro economy. Given that Europe is increasingly a knowledge driven economy, it is therefore crucial to better understand the role of SMEs in this knowledge economy and how knowledge intensity, R&D and innovation can have an impact on productivity growth, especially in SMEs.

Against this background, this report presents the performance of SMEs in the EU using core indicators (number of enterprises, employment and value added) in chapter 2. It explores developments in these indicators by firm size class and by industry, and also present a comparison with the US and Japan. Growth appears to be unevenly distributed across sectors, and productivity growth is mainly observed in the high-tech and medium-tech manufacturing and knowledge-intensive service sectors.

Particular attention is devoted in chapter 3 to high-tech manufacturing and knowledge-intensive sectors. The performance of these sectors at Member State level shows that countries with relatively strong knowledge-intensive service sectors (evaluated in terms of employment shares) show higher growth in value added. Knowledge and technology driven SMEs can thus be seen as the growth engine for the EU economy, and thus raises the question of how these companies can be supported and nurtured.

Last but not least, in chapter 4, a brief compendium of public policies and support actions to create knowledge and technology intensive SMEs, with a particular focus on university spin-offs is presented.

This report on EU SMEs is based on data extracted from the Eurostat Structural Business Statistics that were available for the period 2005-2009. The data covers the non-financial enterprises, i.e., NACE Rev. 2 sectors B-J, L, M, N. Where this database had no data at the Member State level, the respective National Statistics Office (NSO) was requested to provide the missing data. This is the case of Malta, although a further procedure was still required to make estimates for missing data at sectoral level. These data were now-casted to 2010/2011 and forecasted for the years 2012 and 2013. The official definition by the European Commission for the different size classes in the SME group takes into account the annual balance sheet total, the amount of annual turnover and the number of persons employed in the enterprise. For practical reasons this report zooms in on the employment thresholds for SMEs only.

2 How well are EU SMEs doing in the current crisis?

2.1 SMEs in the EU economy in 2012

Small and Medium-sized Enterprises (SMEs) form the backbone of the EU economy – accounting for 99.8 per cent of non-financial enterprises in 2012, which equates to 20.7 million businesses. The overwhelming majority (92.2 per cent) are micro-enterprises, defined as those with fewer than ten employees. Some 6.5 per cent of SMEs in the EU are classified as small enterprises (employing between 10 and 49 people) and 1.1 per cent are medium-sized (50-249 employees). Large businesses, with more than 250 employees, account for just 0.2 of enterprises in the EU's non-financial sector.

In employment terms, SMEs provided an estimated 67.4 per cent of jobs in the non-financial business economy in 2012, almost identical to 2011 (67,4 per cent) but up from 66.9 per cent in 2010, although SMEs provided a slightly smaller share of GVA in the EU in 2011 and 2012 (58.1 per cent).

Table 2.1 Number of enterprises, employment and gross value added in EU-27, by size-class, 2012 (estimates)

	Micro	Small	Medium	SMEs	Large	Total
Number of enterprises						
Number	19,143,521	1,357,533	226,573	20,727,627	43,654	20,771,281
%	92.2	6,5	1,1	99.8	0,2	100
Employment						
Number	38395819	26771287	22310205	87477311	42318854	129796165
%	29,6	20,6	17,2	67,4	32,6	100
Gross value added						
EUR Millions	1307360,7	1143935,7	1136243,5	3587540	2591731,5	6179271,4
%	21,2	18,5	18,4	58,1	41,9	100

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

On average, SMEs across the EU employed 4.22 people in 2012, following 4,23 in 2011 and continuing a steady decline in size from 4.34 employees in 2005. This small increase is because average growth of SME enterprises was lower than the average growth in SME employment. The same pattern was also evident in large enterprises, with a slight increase in average firm size, from 968 persons employed in 2010 to 973 in 2011. Small changes in the average size of firms can imply large employment effects, given the sheer number of SMEs and their importance to the EU economy.

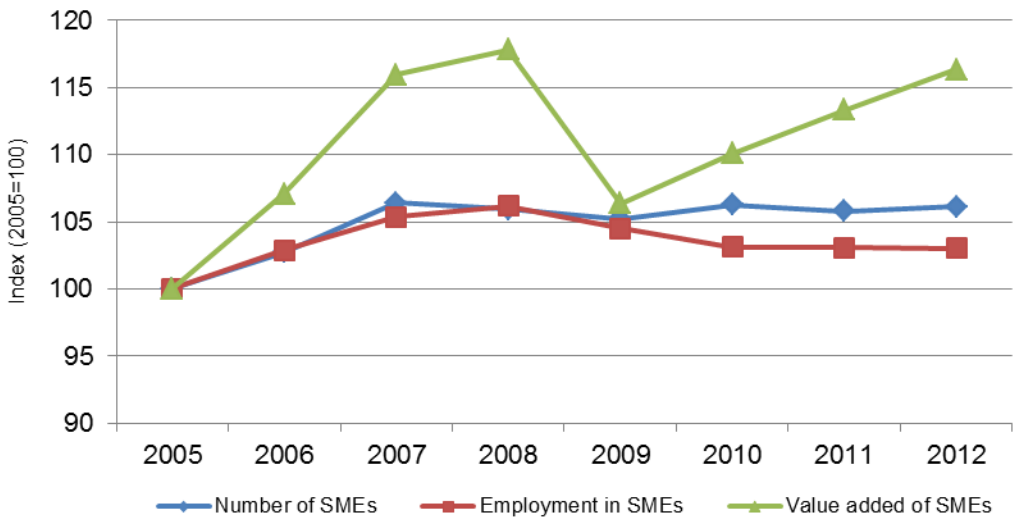
The performance of SMEs across the EU is measured with the help of three main indicators: the number of enterprises, their output via their gross value added (GVA) and the number of employees on their payroll. These three indicators reveal a mixed picture. Clearly SMEs were hit hard by the economic and financial crisis up until 2009, with year-on-year deteriorations across all three indicators, although large enterprises fared even less well. In 2010, the decline in the number of SMEs was largely halted, and there was a strong recovery in GVA across all size categories. Employment, however, declined across the board for the second successive year. The estimates

for the trends leading up to the end of this year point to a rather shaky and fragile development for the EU overall: while estimates for 2011 broadly point to a stalled recovery with an expected reduction in the number of enterprises overall (with small firms the least affected), for 2012, the number of enterprises and GVA overall is expected to increase again while employment in the micro and medium firms is to decline (it is expected to increase in small and large enterprises).

Box 1: The SME size-class definitions

Three classes of SME are distinguished: micro enterprises, small- and medium scale enterprises. Micro enterprises are enterprises that employ up to 9 people. Small enterprises employ between 10 and 49 people. Medium enterprises employ between 50 and 249 people. Large enterprises are thus defined as having 250 or more employees.

Figure 2.1 Number of SMEs, employment in SMEs and value added of SMEs (2005=100)

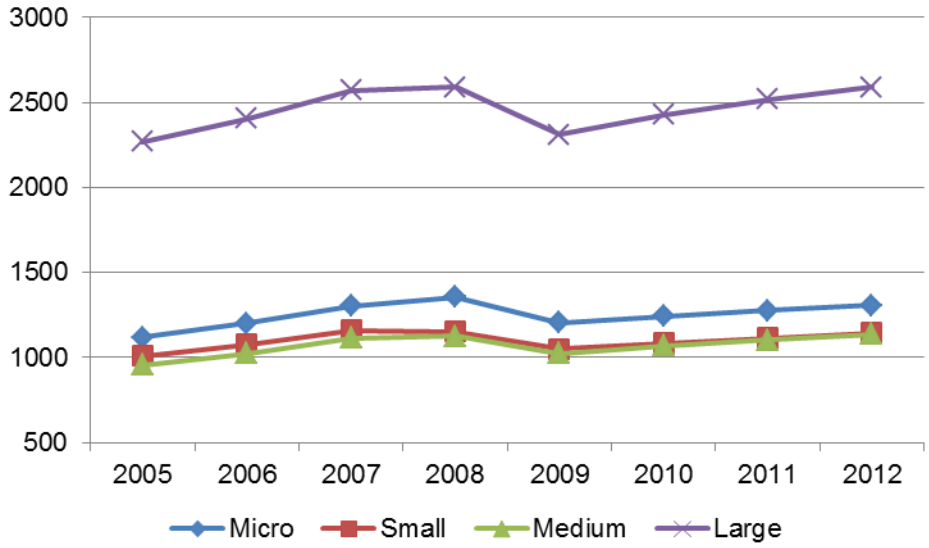


Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Note: *2011 and 2012 figures are estimates.*

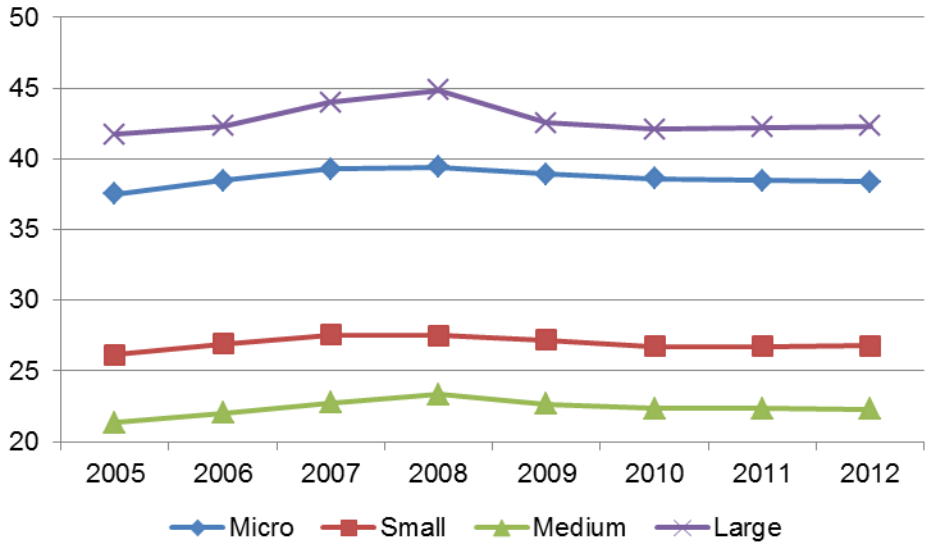
Figures 2.2-2.4 illustrate the developments of the three core SME indicators by size class over the period 2005-2012 in absolute terms. GVA clearly increased from 2009 for all sizes of SMEs classes, revealing a recovery from the recession of 2008-2009. This is not the case for employment. For this indicator only the large firms have enjoyed small increases after the crisis years, while the remaining size classes show a picture of stagnation.

Figure 2.2 GVA by size class, EU-27, 2005-2012 (in billion Euro)



Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

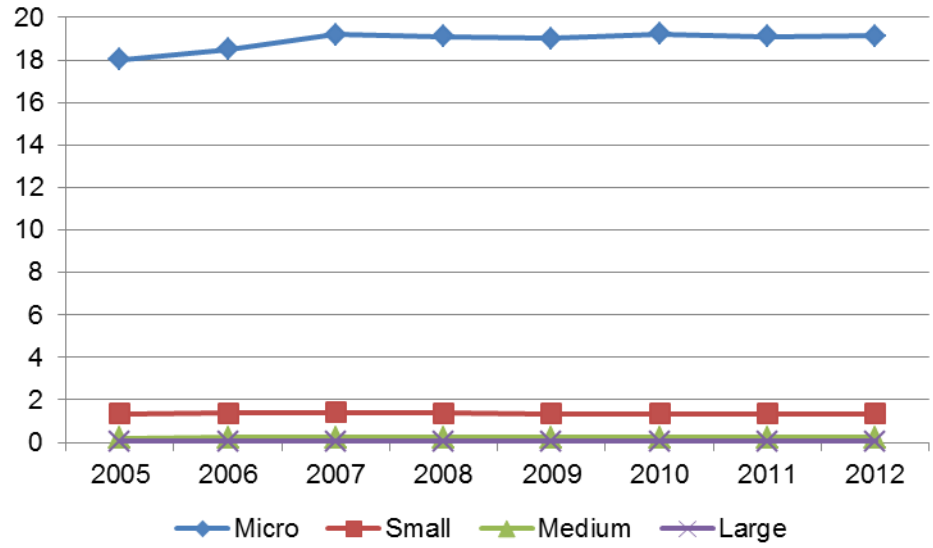
Figure 2.3 Employment by size class, EU-27, 2005-2012 (in million persons)



Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

With respect to the number of enterprises by size class, only micro enterprises showed an increase over the 2005-2012 period (see Figure 2.5).

Figure 2.4 Number of enterprises by size class, EU-27, 2005-2012 (in million)



Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

2.2 Variations in SME performance across Member States

The performance of SMEs across Member States can be assessed according to three criteria. The first is whether countries recovered in 2011; have they reached, or exceeded their pre-crisis (2008) level of SME real value added and employment? The second criterion complements the assessment by showing how fast the recovery has taken place by reviewing annual growth rates of real value added and employment of SMEs of Member States for the years since 2009. The third criterion points to a divergent performance of Member States in terms of growth of their SME value added and employment.

Taking real value added and employment levels among SMEs, only Austria, Germany and probably also Malta[7] recovered and improved on their position in 2008 (see Figure 2.5).

[7] The estimate for Malta is on the basis of its overall macroeconomic performance. Data for the performance of SMEs in Malta is very limited and so the estimates presented in this report should be treated with caution.

Figure 2.5 Real value added and employment in the SME sector in 2011, EU 27 Member States, Index (2008=100)

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

For the assessment of the performance of Member States on the basis of their annual growth rates in SME real value added and employment (criterion two), countries were divided into the following four groups:

- P-P countries, with positive growth in both real value added and employment;
- P-N countries, with positive real value added growth but a negative employment growth;
- N-P countries, with negative real value added growth but positive employment growth;
- N-N countries, with negative real value added and employment growth.

There is a clear overall improvement in 2012 compared with 2009. See Table 2.5[8]. In 2009 only Germany belonged to the P-P group and the majority (22) of Member States were in the N-N group. In between, i.e. in 2011, the P-P group contained 13 countries, while only three (Czech Republic, Greece and Ireland) in the N-N group. In 2012, 18 countries are expected to belong to the P-P group and only two Member States were expected to be still in the N-N group (Greece, Portugal). For the current year, however, sudden changes in the economic climate, especially in the countries worst affected by the current crisis, could imply further changes in this categorization.

Table 2.2 Categorization of Member States according to their real VA growth and employment growth in 2009 and 2012 (P-P, P-N, N-P, N-N) (estimates from 2010 onwards)

	2009	2012
P-P	Germany	Austria, Belgium, Bulgaria, Cyprus, Denmark, Estonia, Germany, Hungary, Ireland, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Romania, Slovakia, Spain, United Kingdom
P-N	Belgium, Netherlands	Czech Republic, Finland, France, Italy, Poland, Slovenia, Sweden
N-P	Bulgaria, United Kingdom	-

N-N	Austria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden	Greece, Portugal

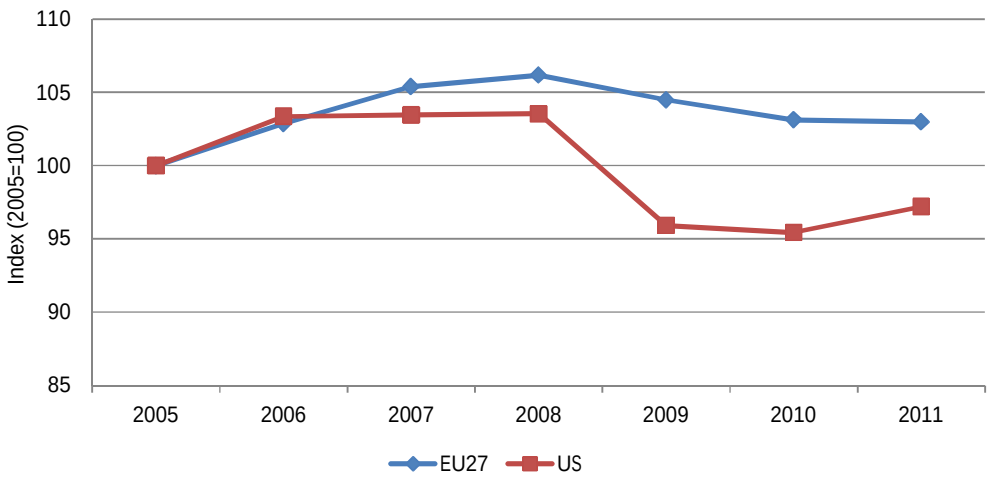
The performance of Member States in terms of SME value added and employment growth varies considerably. Austria, Belgium, France, Germany, Luxembourg and Malta[9] performed above the EU27 average for both SME employment and SME value added (see annex figures A1-A5). The Czech Republic, Estonia, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia and Spain all performed below the EU27 average for the two indicators.

Interestingly, when analysing SME performance in the EU15 (former Member States) and EU12 (new Member States) groups, growth rates in the SME performance indicators (number of enterprises, employment, value added) of the EU12 outperformed those of the EU15 before the crisis. However, their fall was also much bigger in 2009 than that of the EU15. Both groups of Member States follow a similar growth pattern from 2010 onwards.

2.3 EU SME performance compared with the US and Japan

In the US the number of SMEs and employment in them both fell sharply in 2008 and 2009, more so than their counterparts in the EU (see Figure 2.6 and 2.7). SMEs in the US appear to have recovered more robustly, however, in line with a pick-up in business sentiment and economic growth in 2010, and to a lesser extent in 2011.

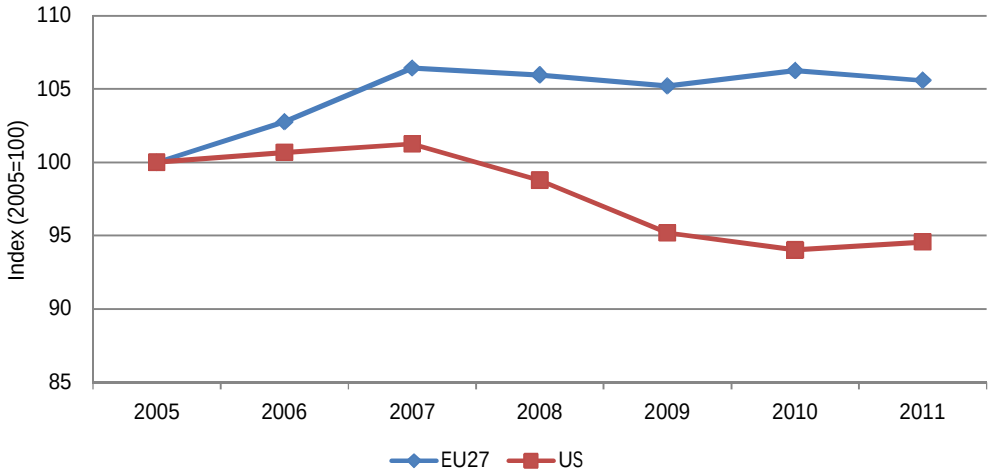
Figure 2.6 Employment in SMEs, 2005-2011



Sources: United States Bureau of Labour Statistics/ United States Census Bureau / Bureau of Economic Analyses / Cambridge Econometrics.

[9] Again, in the case of Malta it should be noted that for this time period there was no Eurostat but only national data available.

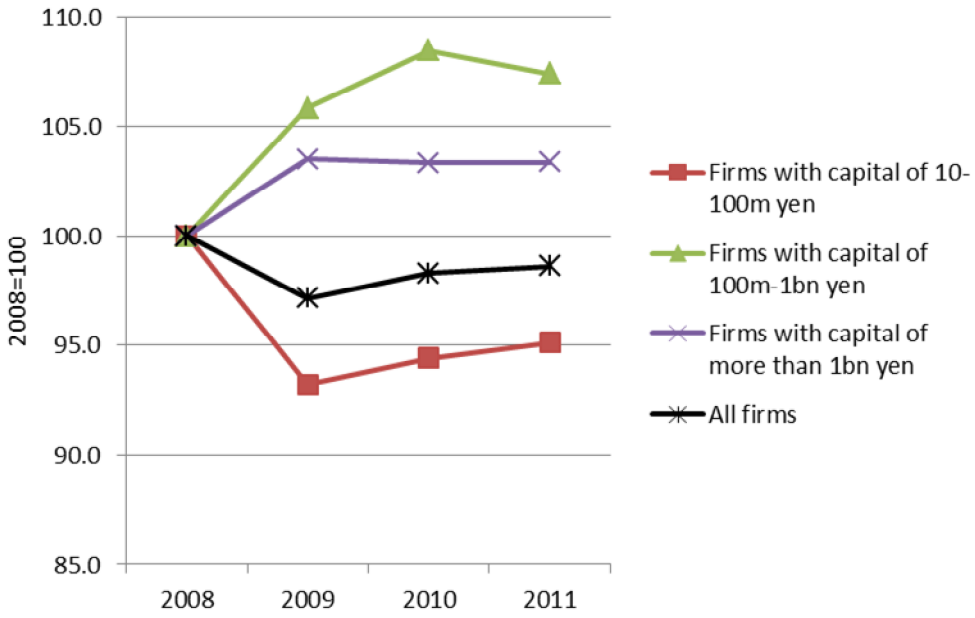
Figure 2.7 Number of SMEs, 2005-2011



Sources: United States Bureau of Labour Statistics/ United States Census Bureau / Bureau of Economic Analyses / Cambridge Econometrics.

Comparable data for Japan are limited, but they suggest the country's SMEs also performed better than their European counterparts during the immediate recovery from the global recession. Figures from the Ministry of Finance show the decline in employment was concentrated among small firms; firms in the two larger size-bands saw an increase in employment in 2009. The results for 2011 suggest a modest improvement among small firms while employment at larger firms was flat or falling (see Figure 2.8). However, this source is limited to corporations and so excludes the smallest firms, and it classifies the size of corporation by its capital rather than size of workforce[10].

Figure 2.8 Employment changes by size of corporation in Japan (all industries except finance and insurance)



Source: Ministry of Finance, Japan, Financial Statements Statistics of Corporations by Industry, Quarterly (http://www.mof.go.jp/english/pri/reference/ssc/historical.htm).

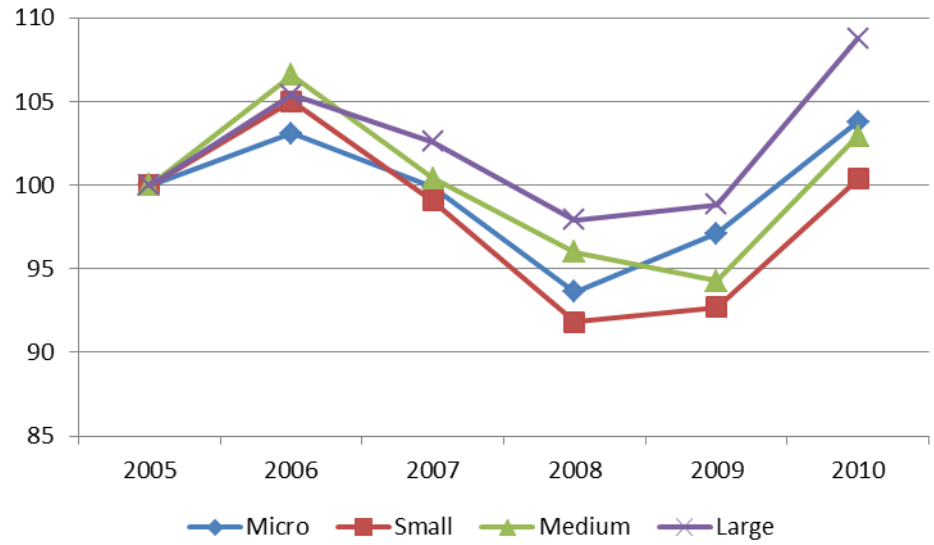
[10] The average number of employees for each sizeband in 2011 was as follows: firms with capital of 10-100m yen: 21 employees; firms with capital of 100m-1bn yen:214 employees; firms with capital of more than 1bn yen: 1,358 employees.

Comparison with Japan over the past year is of course distorted by the effects of the March 2011 earthquake and tsunami, both through direct damage to firms and through the impact on transport and energy infrastructure, and supply chains. The latest evidence[11] indicates that SMEs in Japan saw some improvement in business conditions as the immediate impact of the earthquake and tsunami passed, but more recently (early 2012) there was a flattening off as firms felt the impact of a stronger yen.

In the US, the number of enterprises and employment declined for all SME size-classes during the period 2008-2010. However, the gross value added of SMEs, declining since 2006, showed signs of recovery in 2009, particularly within manufacturing, ICT and professional services. Growth became more evident among SMEs in 2010 as all sectors of the economy saw output increase, with the exception of the construction sector. However, the overall performance of the SME sector during this period of recession and initial recovery is matched by larger companies (as shown in Figure 2.9).

The recovery in gross value-added came later in the EU27 than the US, with year-on-year growth not occurring until 2010. In contrast to the US, the initial recovery in the EU 27 was stronger among larger companies, in line with the strength of employment growth by company size.

Figure 2.9 Gross value added by size-class, USA, 2005-2010 (2005=100)[12]



Sources: United States Bureau of Labour Statistics/ United States Census Bureau / Bureau of Economic Analyses / Cambridge Econometrics.

[11] Japan Small and Medium Enterprise Agency (2012) *Key Points of the 2012 White Paper on Small and Medium Enterprises in Japan*, www.chusho.meti.go.jp/pamflet/hakusyo/H24/download/0523h24-Eng.pdf.

[12] The US Small Business Administration uses different size bands than European statistical offices to classify SMEs. In this case, micro firms are enterprises with 0-9 employees, small firms have 10-99 employees and medium-sized firms are enterprises with 100-299 employees.

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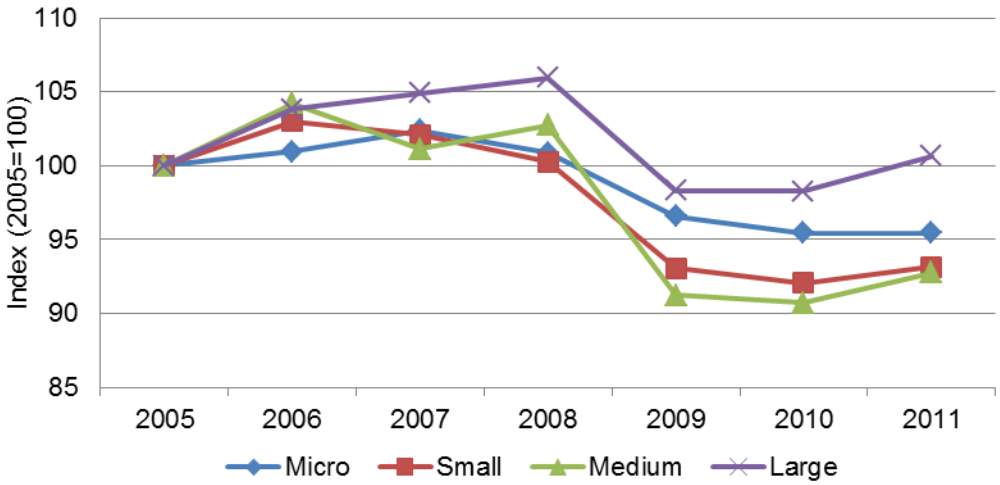
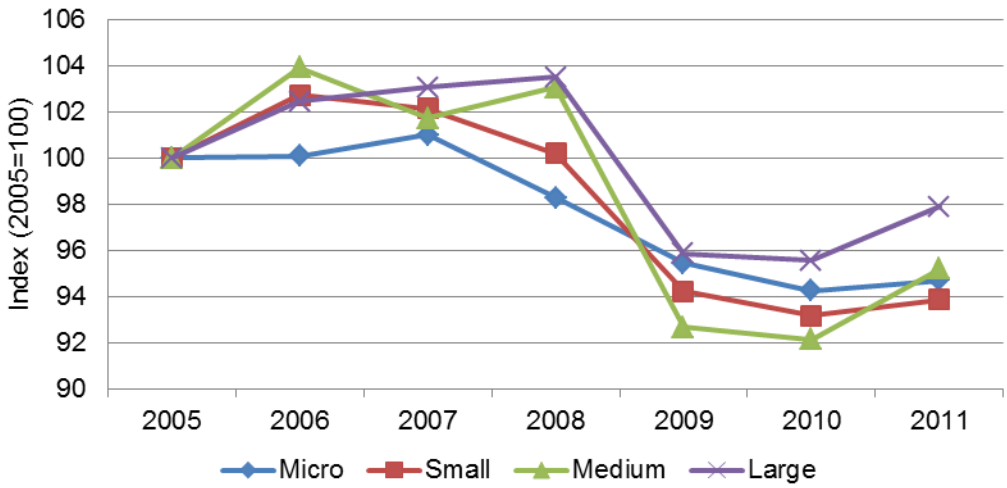
Figure 2.10 Employment by size-class, USA, 2005-2011 (2005=100)



Sources: United States Bureau of Labour Statistics/ United States Census Bureau / Bureau of Economic Analyses / Cambridge Econometrics.

Figure 2.11 Number of Enterprises by size-class, USA, 2005-2011 (2005=100)



Sources: United States Bureau of Labour Statistics/ United States Census Bureau / Bureau of Economic Analyses / Cambridge Econometrics.

2.4 Industrial sector analysis

Manufacturing and construction showed the strongest oscillations in their economic development since the onset of the crisis in 2008. As for the most recent years, 2011 and 2012, it is more difficult top discern clear patterns. European SMEs in the utilities[13] sector experienced the largest growth in

[13] Utilities include the following sectors in NACE Rev. 2: Electricity, gas, steam and air conditioning supply (Sector D), water supply, sewerage, waste management and remediation activities (Sector E)

terms of the absolute number of enterprises in 2011, while the most significant decline in this indicator occurred in SMEs engaged in manufacturing. For 2012, SMEs in transport and storage, and services sectors are expected to have the best performance in terms of employment and GVA in 2012. SME employment grew in the services- and trade sector but contracted most in the mining- and construction sectors. In terms of GVA, SMEs in the manufacturing and the trade sector increased relatively more than in the other sectors; only in mining & quarrying there was a drop in 2011. When all three performance indicators are taken into account, the SMEs in the trade- and services sector were estimated to exhibit the best performance in 2011 (see Table 2.6).

Table 2.3 Percentage growth of number of enterprises, employment and gross value added in EU-27 by size-class and sector of industry 2011 and 2008-2011 (estimates 2010-2011)

		Enterprises		Employment		Value Added	
		SMEs	Large	SMEs	Large	SMEs	Large
2011 (estimates)							
B-J, L, M, N	**Total non-financial business economy by NACE Rev. 2 section**	**-0.5**	**-0.1**	**0.0**	**0.4**	**2.9**	**3.6**
B	Mining & Quarrying	-0.6	1.3	-2.2	-2.5	-0.5	-1.4
C	Manufacturing	-0.9	-0.1	-0.6	0.0	3.8	5.8
UT	Utilities	0.3	-0.1	-1.1	-1.2	2.3	2.0
F	Construction	0.1	1.7	-1.7	-1.0	1.5	1.7
G	Wholesale and retail trade	-0.4	-1.4	0.3	0.0	3.4	2.9
H	Transportation and storage	-0.4	-0.8	0.1	0.4	2.6	3.4
SE	Services	-0.6	0.6	0.7	1.4	2.8	2.8
2008-2011 (estimates 2009-2011)							
B-J, L, M, N	**Total non-financial business economy by NACE Rev. 2 section**	**-0.2**	**-2.5**	**-2.9**	**-5.8**	**-3.8**	**-2.9**
B	Mining & Quarrying	2.2	-1.3	-9.8	-9.4	-14.2	-31.6
C	Manufacturing	-6.0	-8.3	-10.6	-10.4	-7.7	-5.6
UT	Utilities	5.8	2.4	0.1	-3.8	13.0	10.0
F	Construction	-1.9	-9.6	-11.0	-13.6	-15.9	-8.9
G	Wholesale and retail trade	2.5	0.9	1.8	-2.2	3.9	4.7
H	Transportation and storage	-4.5	-1.0	-5.0	-5.3	-5.7	-1.2
SE	Services	0.6	4.3	2.5	-2.8	-2.0	-3.8

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Note: Note: Overview of selected sectors and their codes at one-digit level under NACE Rev.2 codes

UT (Utilities):

- Sector: D: Electricity, gas, steam and air conditioning supply
- Sector: E: Water supply; sewerage, waste management and remediation activities

Sector: F: Construction

Sector: G: Wholesale and retail trade; repair of motor vehicles and motorcycles

Sector: H: Transportation and storage

Services:

- Sector: I: Accommodation/food services
- Sector: J: Information and communication
- Sector: L: Real estate activities
- Sector: M: Professional, scientific and technical activities
- Sector: N: Administrative and support services

The differences in the productivity of SMEs across sectors is interesting; there is evidence that a rise in productivity directly and positively affects the level of overall growth if there is also a rise in employment[14].

[14] See Uppenberg (2011). P.22

Uppenberg (2011) shows that the value added growth of a sector can be decomposed by employment growth and productivity growth. This decomposition is applied here to the SME segments in aggregated sectors of industry for the period 2007-2012. By sector the annual GVA growth is calculated and broken down into growth of productivity and growth of employment for the SME size-class.

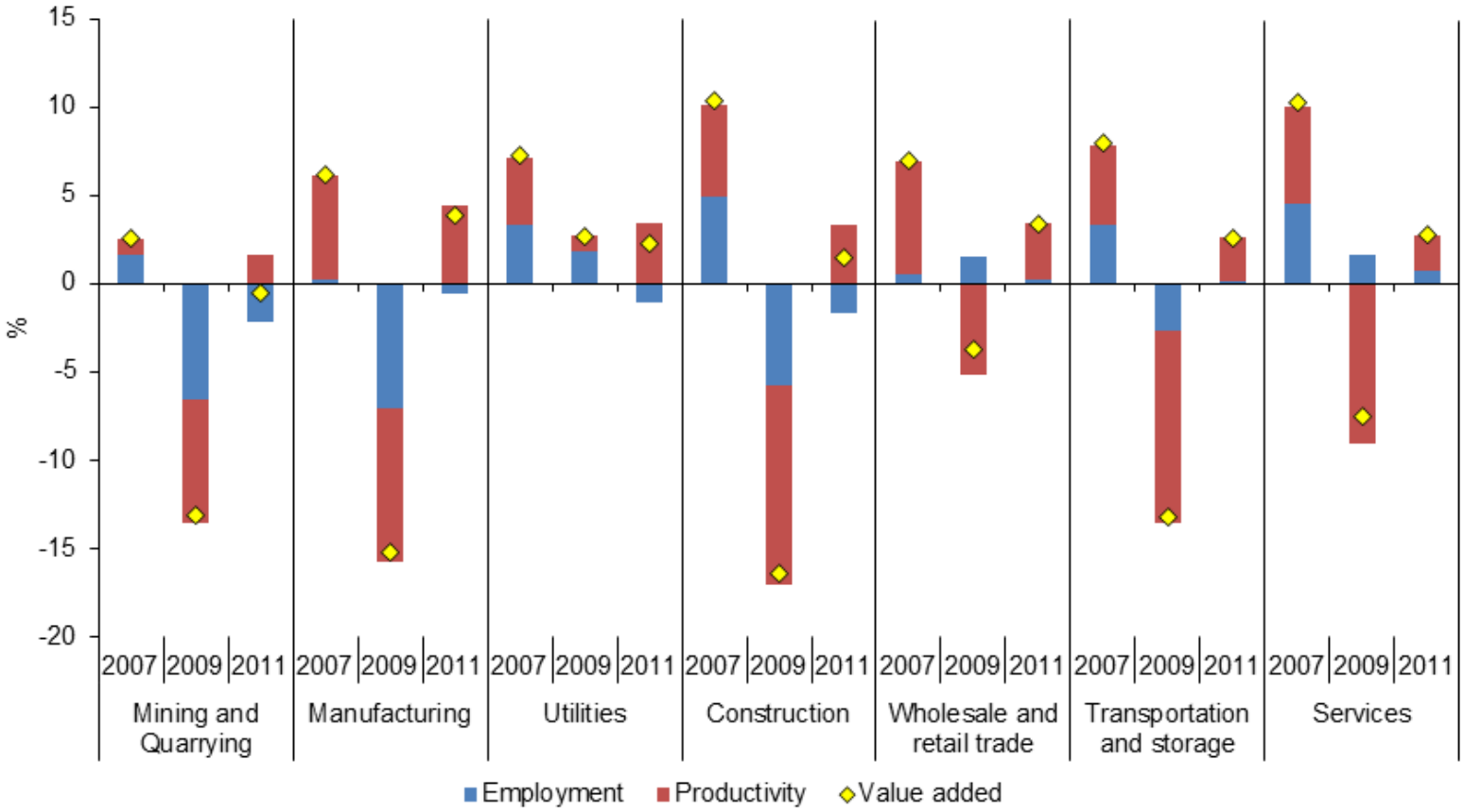
Figure 2.12 shows for all sectors in 2011 the breakdown of growth of GVA into growth of productivity and growth of employment. For all sectors there is productivity growth in 2011 indicated by the blue columns with positive annual growth percentages. There is negative employment growth for the mining, manufacturing, utilities and construction sectors in 2011. Hence the GVA growth diamond is located somewhere in the middle of the red and blue columns for these sectors and not on the top as for the trade, transportation and services sectors. The reason that the latter sectors have the GVA growth diamond on the top of the column in 2011 is because they have both positive employment- and productivity growth. The SMEs in the former sectors, with growth in productivity but employment decline, can be characterised as SMEs engaged in sectors that are restructuring; the SMEs in the latter sectors, with high growth in both productivity and employment, are SMEs active in dynamic sectors.

The recession of 2009 can be clearly seen in Figure 2.12 For all sectors – except for utilities –, negative growth of productivity and employment is shown, resulting in the GVA growth diamond located at – or nearly at – the bottom of the blue and red columns in that year. SMEs involved in sectors that over the medium term have negative or low growth in both employment and productivity do their business in relatively less dynamic sectors.

The overall GVA of EU SMEs has been growing in 2010 and 2011[15], but not for all sectors, e.g. mining & quarrying and construction. The growth, or lack of it, is based on their productivity growth. The decomposition is especially interesting for the last two years, 2010 and 2011, when there was a recovery in terms of value added in most sectors. Interestingly, while value added was growing in most sectors, employment was not. The best performing countries in terms of SME value added and employment (e.g. Austria and Germany), experienced mainly employment growth and to a lower extent real productivity growth (see Figure 2.13). Other countries that experienced a positive GVA growth during this period, such as Belgium, the Netherlands or Sweden, achieved this mainly via a steady increase in labour productive overcompensating the parallel loss in absolute employment. On the negative side, the picture is equally mixed. There is a group of countries, including a number of countries undertaking severe anti-crisis reform programs such as Ireland, Slovakia, Estonia and Portugal where a massive fall in SME employment was partially mitigated by a considerable increase in labour productivity hinting at an increase in competitiveness. There are, however, many countries where a loss in employment was accompanied by a simultaneous drop in productivity, the most obvious example of which was Romania. It also includes some other Member States that were implement austerity measures such as, for example, Greece, Spain or Latvia.

[15] For the sake of presentation, Figure 2.12 shows only the percentages for value added, productivity and employment for the years 2007, 2009 and 2011. The data for 2007 are from Eurostat Structural Business Statistics.

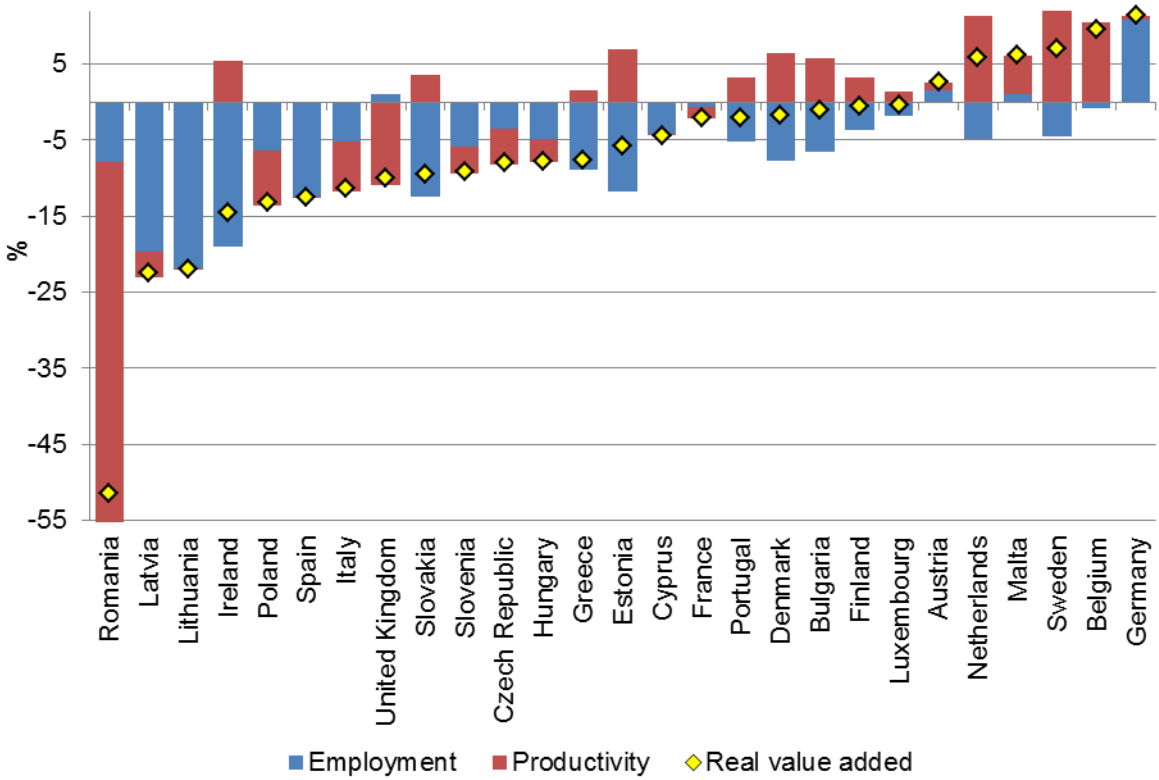
Figure 2.12 Annual growth percentages in employment, gross value added and productivity in SMEs in EU27 by sector of industry, 2007-2011[16]



Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

[16]Data collected for 2009-2011 are now-casts. The data for 2007 are from Eurostat Structural Business Statistics.

Figure 2.13 Annual growth percentages in employment, real value added and real productivity of SMEs in EU27, 2008-2011



Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

2.5 Introduction to technology- and knowledge intensity

The above analysis of productivity, employment and value added indicates that SMEs have an important role to play in enhancing competitiveness in the European Union. Competitiveness typically refers to the set of institutions, policies and factors that determine the level of productivity of a country[17]. Firm-level competitiveness refers to generating growth in value added and job creation (or size, market share and profitability, see Clark and Guy, 1998). R&D and innovation are often seen as crucial factors in shaping the competitiveness of firms, sectors and countries[18]. Hence, it is obvious that at a time when the re-ignition of growth of Member States' SME sector is crucial, a review of the potential to stimulate industries which are thought to make a particular strong contribution to an economy´s dynamism is rather timely.

While the relationship between R&D and innovation in high-tech manufacturing firms and competitiveness has been demonstrated before[19], little attention has been paid to the role of knowledge-intensive service (KIS) sectors in affecting competitiveness. They function as a facilitator, carrier or source of innovation, and through their symbiotic relationship with client firms, some KIS function as co-producers of innovation[20]. The growing role of services and its complementarity with the more traditional manufacturing sectors suggest productivity growth in KIS

, CESifo seminar series, MIT University Press
nship between innovation and competitiveness
Kamshad, 1994; Stam and Wennberg, 2009)

sectors may be an additional source of growth in Europe[21]. The report therefore analyses in which high-growth sectors SMEs are most highly represented.

It is useful to obtain more insights about SMEs in knowledge-intensive service sectors, apart from the high-tech manufacturing ones, for a number of reasons. First, a number of authors have pointed out that the European productivity slowdown can be attributed to the slower emergence of the knowledge economy in Europe (EU15) compared with the United States, as service sectors have experienced faster productivity growth[22] in the United States . McMorrow et al. (2010) provides a breakdown of the gap in total factor productivity (TFP)[23] between the US and the EU at the industry level over the period 1996-2004. They show that only a small number of industries drove the bulk of the aggregate TFP growth rate in favour of the US during this period. Amongst these industries there is only one manufacturing industry, namely "electrical and optical equipment" and a number of private service industries including the retail trade, the renting of manufacturing and equipment and other business activities. The breakdowns by industry demonstrate that ICT-producers and ICT-users such as market services and retail were the industries that accounted for most of the differences between the US and EU in terms of productivity gains from the mid-1990s onwards.

Van Ark et al. (2008) attribute the productivity gap mainly to market services, which include distribution services (retail, wholesale and transport), financial and business services. Half of the gap is due to distribution services, but the other half to financial and business services. However, the productivity gap between Europe and the United States in financial services was likely to be bloated during the year of the credit bubble, which suggests that the productivity gap of market services is not as large as that shown in Van Ark et al. (2008). Nevertheless, an important fraction of the non-financial market services includes KIS, such as, for instance, air transport and a number of business services belong to KIS, which are likely to contribute to the productivity gap.

A second reason, highly relevant to the role of knowledge intensive services, is that international trade in services has increased rapidly in recent years and it has been suggested as an important source for boosting productivity. Typically, knowledge-intensive services are more internationally tradable[24]. Finally, recent research suggests that knowledge-intensive service sectors are often closely linked to the presence of manufacturing[25]. The extent to which (high-tech) manufacturing is relocating may therefore have an impact on the evolution of the knowledge-intensive service sectors. But co-location may also be important for the emergence and development of knowledge-intensive and high-tech firms. This would especially be the case when knowledge spill-overs are important. In this context, the extent to which new knowledge-intensive and high-tech SMEs emerge as spin-offs from research institutions and universities may be a key driver of productivity growth that potentially is of high policy relevance for targeted measures. This will be discussed in chapter 4.

It is expected that productivity and employment growth will be higher in EU Member States with higher shares of SME employment in high-tech industries and knowledge-intensive sectors for a number of reasons. For example, the existence of backward and forward linkages between firms and sectors generate additional triggers enhancing productivity and employment growth beyond the individual firm, extending to the entire region or macro economy.

Innovation, R&D and knowledge intensity are typically seen as important drivers of productivity, growth and competitiveness and SMEs are believed to play a crucial role in the process of

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rvices and points at the fact that firms increasingly tend to develop new services as part of a product package that includes physical, tangible goods. This is a prominent feature of what has been called the "convergence process"

., Timmer, M (2008), "The productivity gap between Europe and the United States: Trends and Causes", Journal of Economic Perspectives, Vol. 22 (1), 25-44.

knowledge generation. It is therefore useful to gauge their relative importance, i.e. know how many SMEs are active in the technology- and knowledge-intensive sectors and what their share in these sectors is vis-à-vis large enterprises. As summarised in Table 2.7, there are over 45 thousand SMEs in high-tech manufacturing sectors, accounting for 0.2 per cent of all EU SMEs. It can be seen that large enterprises have relatively low numbers in high-tech manufacturing (1 141) and KIS (7 483). The importance of SMEs in KIS is much more pervasive, accounting for almost 21 percent of all SMEs. This compares with a fraction of 17 per cent KIS large firms. Unsurprisingly, LKIS SMEs still form the majority of all EU SMEs. These typically include services like the wholesale and retail trade, warehousing, travel agency and services to buildings.

With respect to the distribution of knowledge intensity of persons engaged in the different size classes across sectors, EU Labour Force data from 2010 suggest that medium and large firms have relatively more high-qualified employees than micro and small firms in the same sector. Furthermore, knowledge intensity is more or less distributed according to a similar pattern among the different size classes.

Table 2.4 Number and share of enterprises by technology and knowledge base by size-class in EU-27, 2011 (estimates)

	SMEs		Large	
	Number of Enterprises	% Share of total SMEs	Number of Enterprises	% Share of large enterprises
Manufacturing				
High-tech (HTM)	45 871	0.2	1 141	2.6
Medium-high-tech (MHTM)	192 980	0.9	5 136	11.8
High+medium-high-tech (HMHTM)	238 851	1.2	6 277	14.4
Medium-low-tech (MLTM)	691 096	3.3	4 305	9.9
Low-tech (LTM)	1 060 868	5.1	5 399	12.4
Services				
KIS	4 316 746	20.9	7 483	17.2
- KIMS	3 416 703	16.5	5 057	11.6
- HKIS	749 904	3.6	1 888	4.3
- OKIS	150 139	0.7	538	1.2
LKIS	11 101 425	53.6	15 999	36.8

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

N.B. KIMS = Knowledge-intensive market services; HKIS = High-tech knowledge-intensive services; OKIS = Other knowledge-intensive services

Note: The number of enterprises are now casts developed from Eurostat Structural Business Statistics. The shares are calculated by taking the number of SMEs (or large enterprises) in a certain technology or knowledge segment as a percentage of the total number of SMEs (or large enterprises) in the EU-27.

More examples of technology- and knowledge intensive sectors and a breakdown of the top five countries in which the EU SMEs in those sectors are mostly located can be found in Table 2.8. Table A8 in Annex 1 provides an overview of numbers and shares of enterprises by technology and knowledge category in 2011 per EU Member State.

Table 2.5 Examples of sectors and countries in technology and knowledge intensive categories, 2011 [26]

Category	Sectors	Countries with highest number of SMEs in 2011
Manufacturing		
High-tech	Pharmaceuticals, Computers, electronics	Germany: 17, UK: 15, Italy: 14, CR: 8, France: 8
Medium-high-tech	Chemicals, Machinery, Motor vehicles	Italy: 19, Germany: 14, CR: 13, UK: 9, Spain: 8
Medium-low-tech	Coke, Rubber & plastic, Metal products	Italy: 21, Germany: 11, Spain: 10, France: 9, CR: 9
Low-tech	Food, Beverages, Tobacco, Textiles	Italy: 21, France: 12, Spain: 10, Germany: 8, Poland: 8
Services		
KIS		Italy: 18, UK: 11, Germany: 10, Spain: 10, France: 9
- KIMS	Legal & accounting, Head offices	Italy: 20, Spain: 11, Germany: 10, UK; 10, France: 8
- HKIS	Motion picture, video, TV, Scientific R&D	UK: 17, Italy: 13, France: 12, Germany: 11, Poland: 6
- OKIS	Publishing, Veterinary, Public administration	France: 14, Italy: 12, Spain: 11, Germany: 11, UK:8
LKIS	Wholesale & retail, repair, Warehousing, Postal	Italy: 18, Spain: 14, France: 12, Germany: 11, UK: 7

N.B. Countries are mentioned in sequence of highest number of EU SMEs in the respective categories. The figures after each country show the percentage share of the country in the number of EU SMEs in the corresponding category. For an illustration, 17% of the total number of high-tech manufacturing SMEs in the EU are located in Germany.

Table A8 in Annex 1 shows the number of SMEs and the share of SMEs by technology and knowledge category in Member States in 2011.It appears that the numbers and the shares of the Member States for the knowledge-intensive services are much higher than that for the high-tech and medium-high-tech manufacturing sectors.

[26] For a complete overview of sectors containing the individual technology and knowledge-intensive categories see Annex 1, Tables A3 and A4.

3 Technology- and knowledge intensity and competitiveness of SMEs

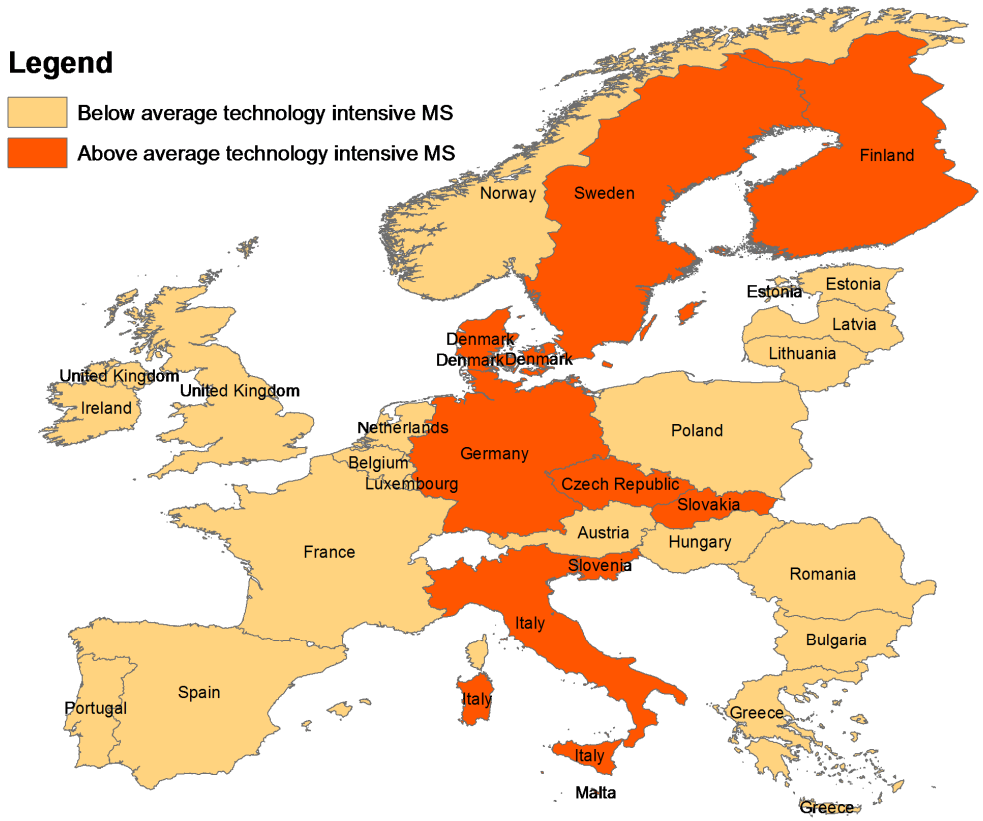
3.1 Technology- and knowledge intensity and their impact on productivity and employment in EU Member States

Based on the findings of chapter 2, this chapter the channels through which hi-tech and in knowledge-intensive SMEs contribute to overall economic growth. Specifically, the performance of SMEs in terms of GVA and employment in Member States with above-average (of all 27 EU countries) proportions of high-and medium-high-tech manufacturing and/or knowledge-intensive services (KIS) SMEs is investigated.

To start the discussion, it is useful to take stock of the distribution of such SMEs across the EU.

In 2009-2011 nine countries had a greater proportion of SME employment in high- and medium-high-tech manufacturing (HMHTM) than the EU average (see Annex 1 Table A2). Slovakia had the highest share, followed by Czech Republic, Slovenia, Finland, Malta, Germany, Sweden, Denmark and Italy (see Figure 3.1a).

Figure 3.1a Categorisation of EU Member States according to their average share of HMHTM SME employment in total SME employment in 2009-2011



Relating these nine countries to the groupings presented in section 2.3, it is clear that they also performed well in terms of real value added and employment, namely:

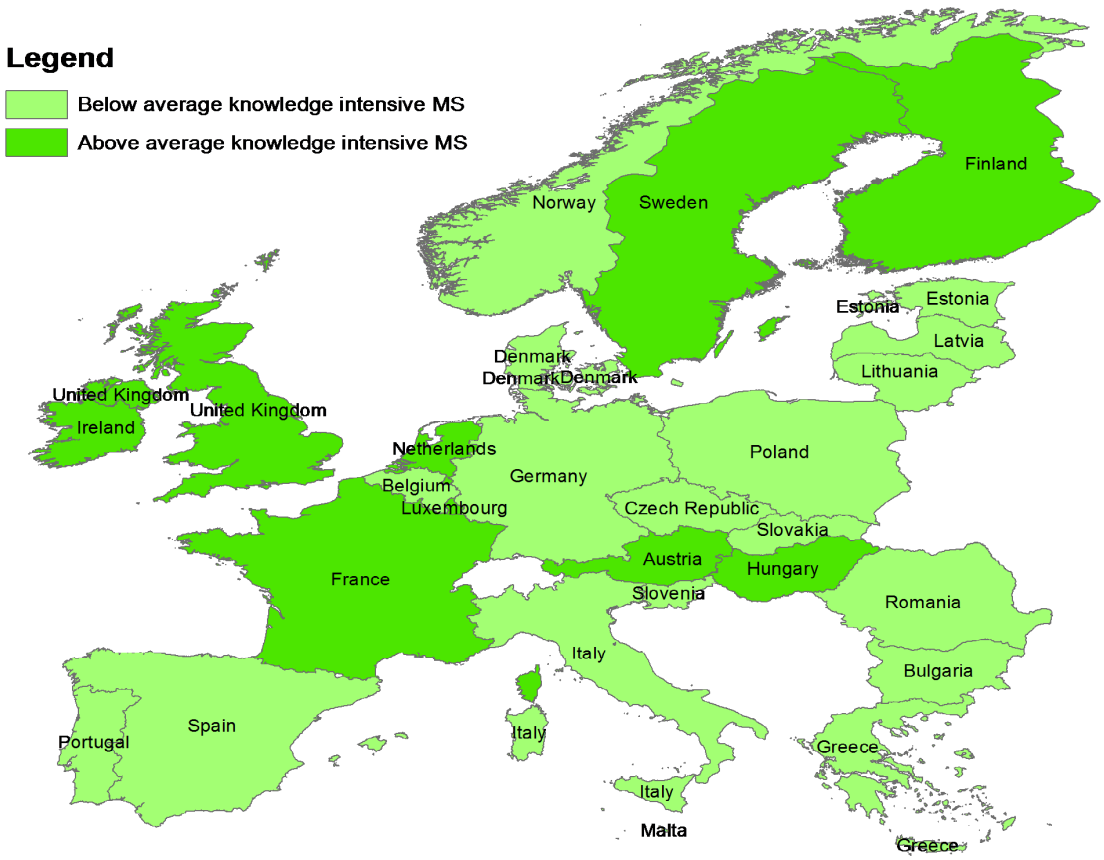
- Malta[27] and Germany exceeded in 2011 their pre-crises level of real value added and employment for SMEs (see Figure 2.8).
- The majority of these nine countries (Slovakia, Malta, Germany, Sweden and Denmark) experienced in 2011 growth in both SME real value added and employment (P-P group) and three countries (Slovenia, Finland and Italy) recorded only real value added growth (P-N group) for SMEs, (see Table 2.5).

Nine Member States also exhibited an above-EU average share of KIS SME employment in the period (see Table 2.5). The United Kingdom had the highest proportion, followed by the Netherlands, France, Luxembourg, Sweden, Finland, Ireland, Hungary and Austria (see Figure 3.1b).

When relating these nine countries to the section 2.3 groupings, similar patterns to those for employment in HMHTM SMEs are found, namely:

- Austria exceeded its pre-crises level of real value added and employment for SMEs in 2011 (see Figure 2.8).
- Five countries (France, Luxembourg, Sweden, Hungary, Austria) experienced growth in both real value added and employment in their SMEs, while three countries (UK, Netherlands, Finland) experienced growth in real value added for SMEs (see Table 2.5).

Figure 3.1b Categorisation of EU Members States according to their average share of KIS SME employment in total SME employment in 2009-2011



The relationship between the growth of real value added among SMEs by Member States and the proportion of high-tech and medium-high-tech manufacturing (HMHTM) employment in total SME employment and the share of KIS employment in total SME employment has been investigated (see Figures 3.2a and 3.2b). Section 3.2 analyses the link between the sectoral labour productivity and technology/knowledge intensity through an econometric model.

The average growth rate of GVA by SMEs in Member States that have above average HMHTM shares during 2009-2011 is higher than the EU average and that of the group of Member States with below average HMHTM SME shares (see Table 3.1).

SME employment in countries with above-average HMHTM shares during 2009-2011 declined by less than the EU average. This contrasts with the group of countries with below-average HMHTM SME shares, which experienced more unemployment than the EU27 as a whole (see Table 3.2).

Table 3.1 Growth of gross value added of SMEs in Member States with below- and above-average employment shares of high- and medium-high-tech manufacturing (HMHTM), 2009-2011

	2009-2011
EU27 average	6.5
MS with below average HMHTM shares	5.2
MS with above average HMHTM shares	8.4

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Table 3.2 Growth of employment of SMEs in Member States with below- and above-average employment shares of high- and medium-high-tech manufacturing (HMHTM), 2009-2011

	2009-2011
EU27 average	-1.3
MS with below average HMHTM shares	-2.0
MS with above average HMHTM shares	-0.3

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

The average growth rate of GVA by SMEs in EU countries with above-average KIS shares is higher in this period than the EU average and that of the group of countries with below average KIS SME shares (see Table 3.3).

The average rate of employment by SMEs in EU countries with above-average proportions of KIS SMEs is also higher than that of countries with below-average proportions of KIS SMEs (see Table 3.4).

Table 3.3 Growth of gross value added of SMEs in Member States with below- and above-average employment shares of knowledge-intensive services (KIS), 2009-2011

	2009-2011
EU27 average	6.5
MS with below average KIS shares	5.8
MS with above average KIS shares	7.5

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Table 3.4 Growth of employment of SMEs in Member States with below- and above-average employment shares of knowledge-intensive services (KIS), 2009-2011

	2009-2011
EU27 average	-1.3
MS with below average KIS shares	-1.5
MS with above average KIS shares	-0.9

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

The productivity of SMEs involved in both high- and medium high-tech manufacturing and knowledge intensive sectors was above that of SMEs in general as evidenced by the results in table 3.5 completes the view by focusing on technology and knowledge intensive SMEs.

Table 3.5 Productivity of SMEs in high- and medium-high-tech manufacturing and knowledge-intensive services compared with the productivity of SMEs of EU27, 2009-2011

	Productivity of SMEs in high-and medium-high tech manufacturing	Productivity of SMEs in knowledge-intensive services	Productivity of EU27 SMEs
2009	46.5	44.8	36.9
2010	53.6	46.3	38.7
2011	57.0	47.4	39.9

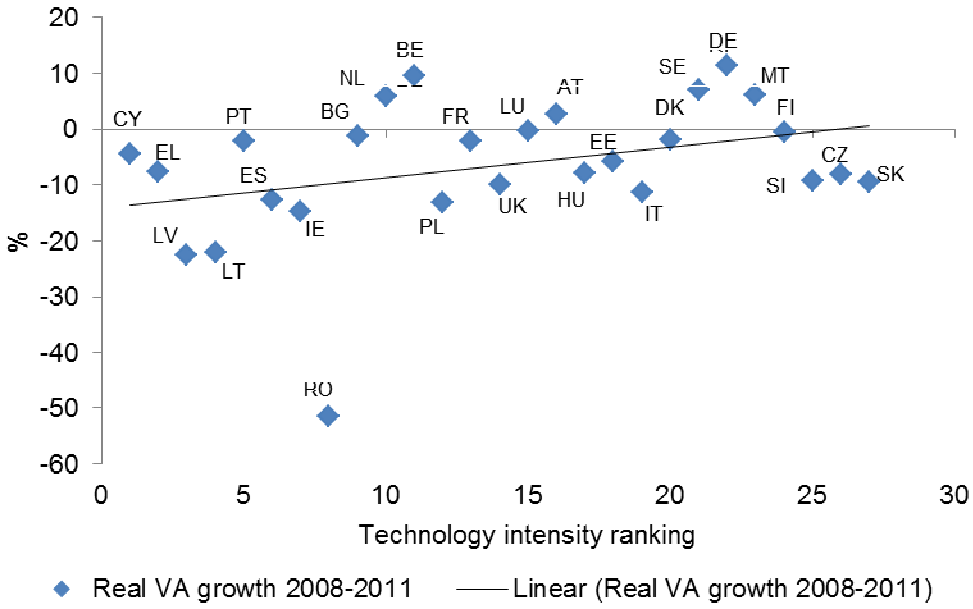
Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Note: Productivity is calculated as the ratio GVA to employment.

In Figure 3.2a Member States are ranked on the x-axis by technology intensity, while on the y-axis by their growth of real value added of SMEs. Technology intensity is again indicated by the share of high-tech and medium-high-tech manufacturing employment in total SME employment. The Figure

shows that there is a strong positive link between the level manufacturing technology intensity in a country and growth rates oGVA.

Figure 3.2a Growth of real value added of SMEs by Member State (sorted on manufacturing technology intensity), 2008-2011[28]



Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

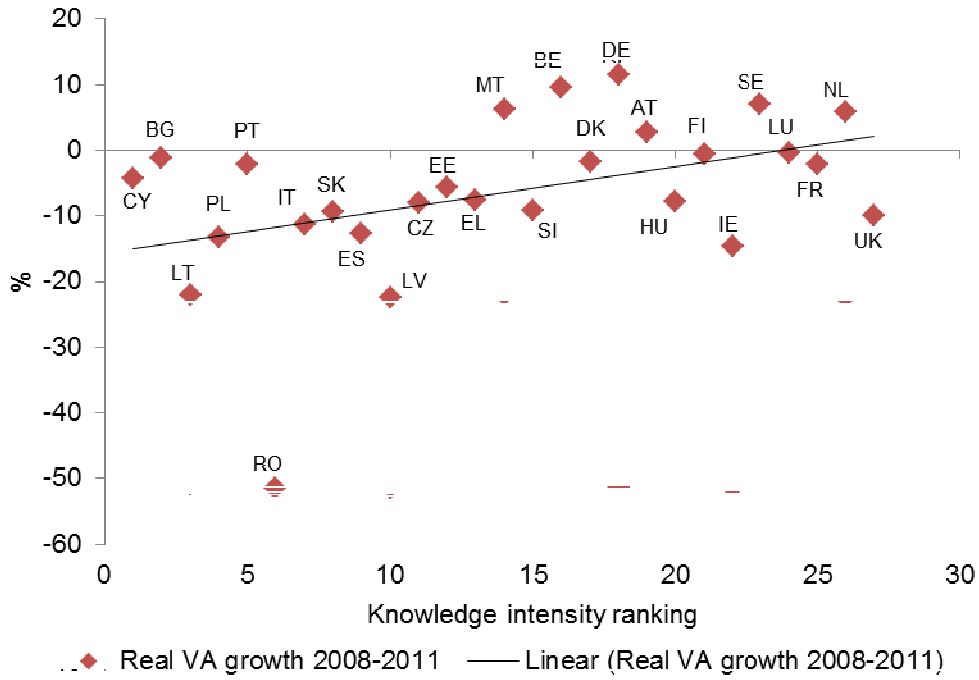
When the 2008-2011 real GVA growth rates of SMEs for all 27 Member States and their shares of employment in high-tech and medium-high-tech manufacturing are put in two vectors, a direct positive correlation is found to be significant at the 10 per cent. level. Hence, there is a link, although its strength is relative.[29] This means that countries with higher shares of SME employment in high-tech and medium-high-tech manufacturing sectors tend to show a better performance in terms of real value added growth in SMEs. In times of crisis this, however, may just mean - as is the case with, e.g. Slovakia and the Czech Republic- that the recession is mitigated as compared to countries with fewer hi-tech SMEs.

In Figure 3.2b the hypothesis is tested that Member States that are relatively more knowledge-intensive have a higher real GVA growth of their SMEs arriving at similar results. On the x-axis the Member States are ranked by the share of KIS SMEs in SME employment starting from the lowest – (Cyprus) to the highest knowledge-intensive Member State (United Kingdom). The shares of KIS SMEs by Member State have been taken from Annex 1 Table A1. Again, there seem to be a positive correlation among EU Member States between the incidence of knowledge-intensive SMEs and real value added growth of SMEs (Figure 3.2b).

[28] Data collected for 2009-2011 are now-casts.

[29] The correlation coefficient was 0.29 and the p-value 0.07. It should be noted that at the 5% and 1% level the positive correlation still exists but at a lower level of significance.

Figure 3.2b Growth of real value added by Member State (sorted on knowledge intensity), 2008-2011[30]



Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

When the data for real GVA growth of SMEs for all 27 Member States and their shares of employment in knowledge-intensive services are combined for the entire period 2008-2011, a direct positive link is found to be significant at the 5 per cent which is somewhat stronger than the hi-tech manufacturing SME and value-added growth nexus[31]. Again, the implications are that more KIS SMEs make it more likely for a country to have a higher aggregated value-added growth rate of its SME sector which as can be seen from graph 3.2 does not exclude that even some Member States with a high incidence of KIS SMEs experience negative GVA growth rates during the crisis.

Table 3.7a. and b and Annex 1 Table A1, A2 and A8 confirm that the group of Member States with positive growth in both GVA and employment generally have the highest SME employment shares in high-tech and medium high-tech manufacturing and knowledge-intensive services[32].

In addition, countries with the best SME performance also appear to have good export performance. A direct positive link between exports of goods and services (as a percentage of GDP) and shares of SME KIS employment is found to be significant at the 5 per cent level (correlation coefficient of 0.25 with a p-value of 0.01). This means that countries with a higher share of KIS SMEs in SME employment tend to have a better export performance. The same correlation holds for countries with a higher share of HMHTM SMEs in SME employment.[33]

Another explanation of the different SME performances by EU Member States may be related to the various degrees of SBA implementation. This Annual Report does not deal with this link.

[30] Data collected for 2009-2011 are now-casts.

[31] With a correlation coefficient 0.36 and a p-value of 0.03.

[33] With a correlation coefficient of 0.19 and a p-value of 0.04.

3.2 Understanding the drivers of SME growth: labour productivity

The contribution of SMEs to economic growth is also dependent on their labour productivity, which, in turn, is reliant on other variables. We have investigated these driving factors behind SME performance (including the relationship between the high- and medium-tech manufacturing sectors and knowledge-intensive services and SME labour productivity) through a regression framework. The key advantage of this approach is that we control for a variety of factors simultaneously (for details, see Box3).

The results suggest that labour productivity (whether measured by country, sector, size class or year) is determined mainly by employment growth, the export rate and the investment rate (see Table 3.6). For example, an increase in the investment rate by 1 per cent is associated with an increase in labour productivity of about 0.14 per cent (in model (1)). The coefficient for employment growth is negative because employment growth leads to lower capital per worker for given levels of investments in the capital stock, and hence to lower labour productivity.

Table 3.6 Fixed-effects models explaining labour productivity of SMEs, EU Member States, 2009-2013[34]

	(1)	(2)	(3)
log investment rate	0.1425 ***	0.1828 ***	0.1730 ***
	(0.0070)	(0.0071)	(0.0068)
log (n + g + •)	-0.0211 ***	-0.0297 ***	-0.0316 ***
	(0.0072)	(0.0071)	(0.0069)
log export rate	0.5532 ***	0.5702 ***	0.6980 ***
	(0.0769)	(0.0757)	(0.0731)
KIS sector (dummy)		0.2928 ***	0.2980 ***
		(0.0131)	(0.0127)
HMHTM sector (dummy)		0.2373 ***	0.2324 ***
		(0.0177)	(0.0171)
Micro firms (dummy)			-0.5241 ***
			(0.0153)
Small firms (dummy)			-0.2669 ***
			(0.0150)
Medium firms (dummy)			-0.1113 ***
			(0.0149)
R-squared (within)	0.0273	0.0581	0.1247
F-value	163.76	216.03	311.60
Observations	17,528	17,528	17,528

[34] The calculations of real value added growth, the employment growth, export rate, and investment rate are as follows:

real value added growth = (real VA growth – real VA growth (t-1)) / real VA growth (t-1) *100

employment growth = (employment – employment (t-1)) / employment (t-1)*100

export rate = (exports of goods and services / GDP)*100

investment rate = (investment / value added at factor costs)*100

N.B. The model explains the log of labour productivity. * means significant at 10%, ** means significant at 5%, *** means significant at 1%.The variable n represents employment growth, and (g + •) is assumed to be 5% (following Mankiw, Romer and Weil).

The sector dummies (included in model (2)) show that the KIS sectors and the HMHTM sectors witness higher labour productivity. HMHTM sectors are 24 per cent more productive than other sectors (everything else being equal) and KIS sectors are 29 per cent more productive. Thirdly (see model (3)), the size of SMEs also influences performance. All three SME categories (micro, small and medium) experience lower labour productivity levels compared with large enterprises in the same sector and country (which form the benchmark in the regressions, so they are omitted in the model). This difference is largest for micro enterprises, which show about 50 per cent lower labour productivity levels relative to large firms. These are huge effects.

Linking these regression results to the findings on the best performing Member States in Chapter 2 it can be seen that the P-P group exhibit relatively higher investment rates, export rates and HMHTM- and KIS shares in SME employment; this link is stronger for 2011 than for 2008-2011 (see Tables 3.7b and 3.7a).

Table 3.7a Annual growth rates of real value added and employment; average investment rates and export rates; and employment shares in knowledge intensive services and high- and medium-high-tech manufacturing, 2008-2011

	Real VA growth	Employment growth	Investment rate	Export rate	KIS share	HMHTM share
P-Pgroup	6.8	4.4	24.0	65.0	16.1	5.4
P-Ngroup	7.6	-3.4	20.5	69.1	19.9	4.3
N-Pgroup	-9.9	1.0	11.8	30.4	24.5	4.2
N-Ngroup	-10.3	-8.5	27.7	57.7	14.5	4.0

N.B. Investment rate, export rate, KIS share and HMHTM share are averages of the period 2008-2011, in percentages. Investment rates are investments divided by value added. The export rate is for the total economy, calculated as total exports of goods and services divided by GDP.

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Table 3.7b Annual growth rates of real value added and employment; average investment rates and export rates; and employment shares in knowledge intensive services and high- and medium-high-tech manufacturing, 2011

	Real VA growth	Employment growth	Investment rate	Export rate	KIS share	HMHTM share
P-Pgroup	2.9	1.3	26.7	76.8	16.5	4.5
P-Ngroup	1.8	-0.8	25.9	48.0	15.6	3.8
N-Pgroup	-0.8	1.7	33.7	35.5	13.1	2.4
N-Ngroup	-1.8	-1.6	18.5	68.2	16.2	4.1

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Box 3: The regression analysis

The starting point of the analysis is a production function of the type Y=Af(K,L), where Y is output, K is capital, L is labour, and A is Total Factor Productivity. If a standard Cobb-Douglas production technology is chosen, one can rewrite the production function to[35]

[35] See Mankiw, N.G., Romer, D. and Weil, D.N. (1992). A contribution to the empirics of economic growth, The Quarterly Journal of Economics (107, 2), pp. 407-437.

(1) log(Y/L) = log(A) - •log(n+g+•) + •log(s)

where Y/L denotes labour productivity, n is employment growth, g is the rate of technological progress, • is the capital depreciation rate, s is the investment rate (investments as a percentage of value added), and • and • are coefficients. This equation shows how labour productivity depends on employment growth and the accumulation of capital. The production function is expressed in logarithms (log). This is the theoretical framework, which will now be implemented.

The database describing economic developments over time of SMEs[36], at two digit NACE level, is used. The empirical framework here is to run a regression model of the type:

(2) $\log(Y/L)_{i,s,c,t} = f_c - \bullet\log(n_{i,s,c,t} + g + \bullet) + \bullet\log(s_{i,s,c,t}) + \bullet\log(export_{c,t}) + \bullet KIS_i + \bullet HMHTM_i + \bullet SIZE_s + \bullet_{i,s,c,t}$

wherei stands for NACE sector, sstands for firm size, c stands for country, and t stands for time. The dependent variable is (the logarithm of) labour productivity (in sector i, firm size category s, country c and year t). We also include the export ratio[37] as an explanatory variable. This is done because export performance is often mentioned in the empirical growth literature as a robust factor explaining growth differences across countries and over time. KIS is a dummy variable taking value 1 if the sector belongs to the KIS group (and 0 otherwise). HMHTM is a dummy variable taking value 1 if the sector belongs to the HMHTM group (and 0 otherwise). SIZE are size dummies. Finally, •, •, •, •, •, • are regression coefficients, and • is an error term. A fixed-effects regression model is used to control for country-specific effects f_c.

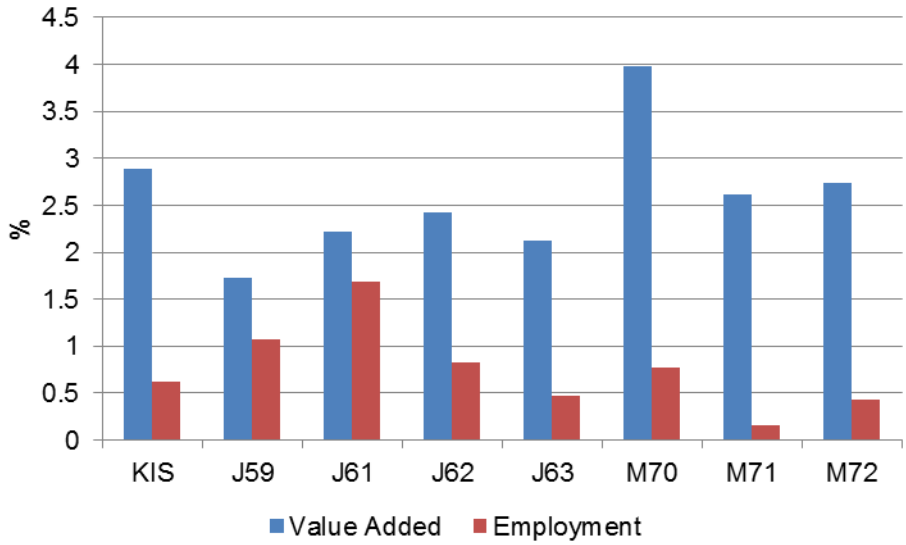
The 2-digit NACE Revision 2 data is available only from 2008. Due to changes in the NACE classification system, the year 2008 was excluded. An overview of empirical evidence explaining different performance of sectors in terms of labour productivity of their SMEs in the period 2009-2013 is provided in Table 3.6. Thanks to the detailed sectoral structure, a large data set is at our disposal (17,528 observations). We estimate three different versions of the regression model. In model (1) we only include the investment rate, employment growth and the export rate. In model (2) we add dummies for the KIS sector and for the HMHTM sector. Finally, in model (3) we also add firm size dummies.
It should be noted, though, that the regression is partially based on estimated figures, especially for the years 2010 and 2011. While this obviously does not invalidate the results as such, it however calls for caution when interpreting them.

[36]The Annual Report database contains the annual Nace Rev. 2 data at one digit level covering the period 2005-2013 for individual MS and EU27 for below-mentioned 5 variables and 12 sectors of non financial business economy, and corresponding Nace Rev. 2 data at two digit level for the period 2008-2013, which allows analysis of knowledge and technology intensity of Member States. Variables: value added, employment, number of enterprises, turnover, investments.
Sectors: mining & quarrying; manufacturing; electricity, gas, steam and air conditioning supply; water supply; construction; wholesale & retail trade & repair; transportation & storage; accommodation & food services; information & communication; real estate; professional, scientific and technical activities; administrative & support services.
The data are available for each of SME size-classes (micro, small, medium) and large enterprises.
Data from 2010 onwards are estimations.

[37]Source of export data: Eurostat.

The importance of the role of knowledge-intensive services in the economies of the advanced Member States of the EU has led to the term of *quarternisation*[38]. Of particular interest, given our focus on innovation, technology and knowledge intensity, is the category of innovative service sectors (see Figure 3.3). TV production, sound recording and music publishing, telecommunications, computer programming, consultancy and the activities of head offices and management consultancy all experienced higher growth in employment than the average for the KIS sector in 2011.

Figure 3.3 Growth rates of GVA and employment in innovative service sectors, 2011



Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

N.B. The following sectors fall under the category of innovative services:

J59: Motion picture, video and television programme production, sound recording and music publishing activities

J61: Telecommunications

J62: Computer programming, consultancy and related activities

J63: Information service activities

M70: Activities of head offices and management consultancy

M71: Architectural and engineering activities; technical testing and analysis

M72: Scientific research and development

3.3 Knowledge and technology intensity and its impact on GVA, productivity and employment

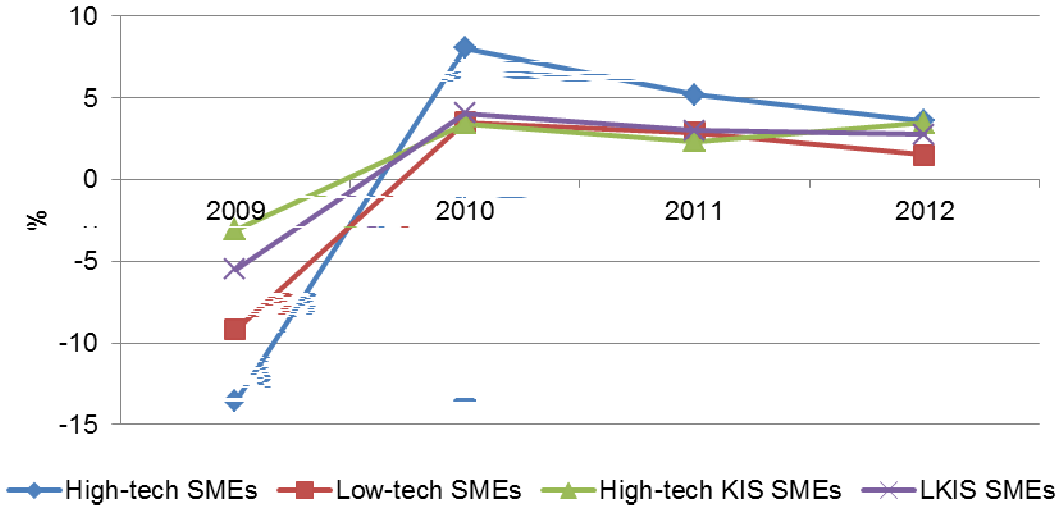
EU SMEs involved in high-tech manufacturing experienced a stronger recovery in terms of GVA from the depths of the 2009 recession than their counterparts in low-tech manufacturing. There are no such clear different GVA growth patterns within the knowledge services sectors (see Figure 3.4a).

With regards to labour productivity, SMEs in high-tech manufacturing and those involved in high-tech KIS SMEs have shown the strongest post-crisis recovery (see Figure 3.4b).

[38]European Commission (2011), European Competitiveness Report 2011, SEC (2011) 1188 final, p.56.

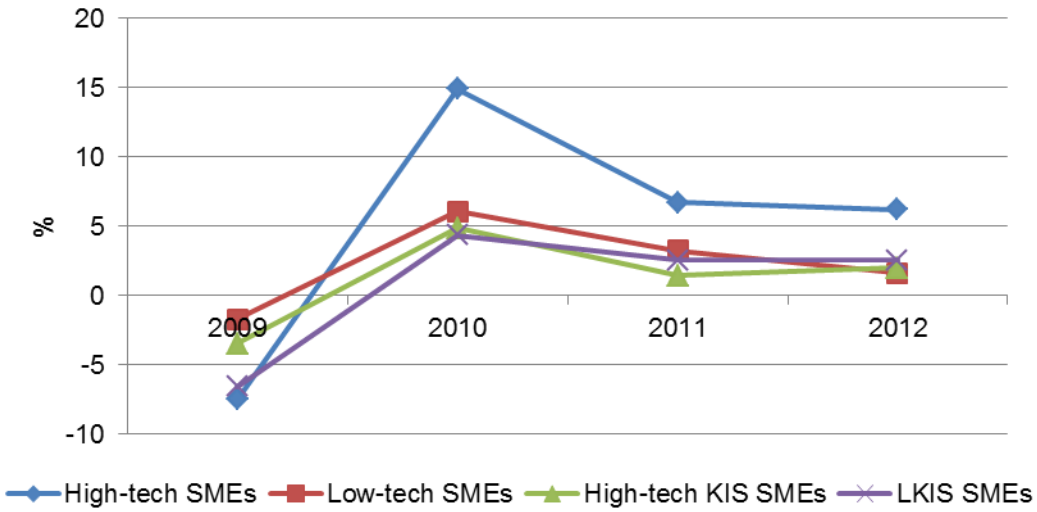
A remarkable growth pattern is evident when evaluating employment among EU SMEs (see Figure 3.4c). Note that employment growth in high-tech manufacturing SMEs is below that of low-tech SMEs. Interestingly, high-tech KIS SMEs have lower employment growth than low KIS SMEs but only in the crisis years 2009 and 2010, and their recovery is fast in 2011, when employment growth is comparable to the low KIS SMEs. In 2012, the employment performance of the high-tech KIS SMEs is outperforming all other categories of firms.

Figure 3.4a Annual growth percentages of GVA of EU SMEs by high- and low-tech manufacturing and high- and low knowledge-intensive services, 2009-2012[39] (estimates)



Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

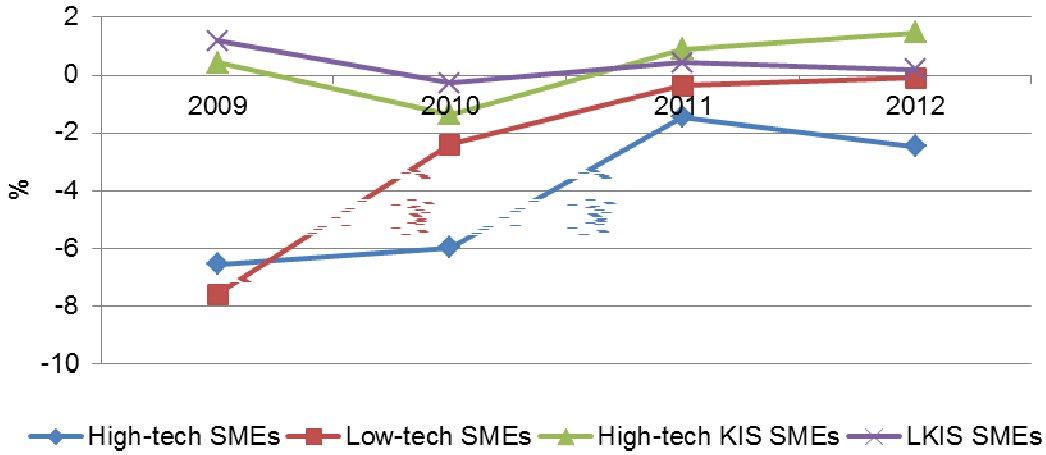
Figure 3.4b Annual growth percentages of labour productivity of EU SMEs by high- and low-tech manufacturing and by high- and low knowledge-intensive services, 2009-2012 (estimates)



Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

[39] Data collected for 2009-2012 are now-casts.

Figure 3.4c Annual growth percentages of employment of EU SMEs by high- and low-tech manufacturing and by high- and low knowledge-intensive services, 2009-2012 (estimates)

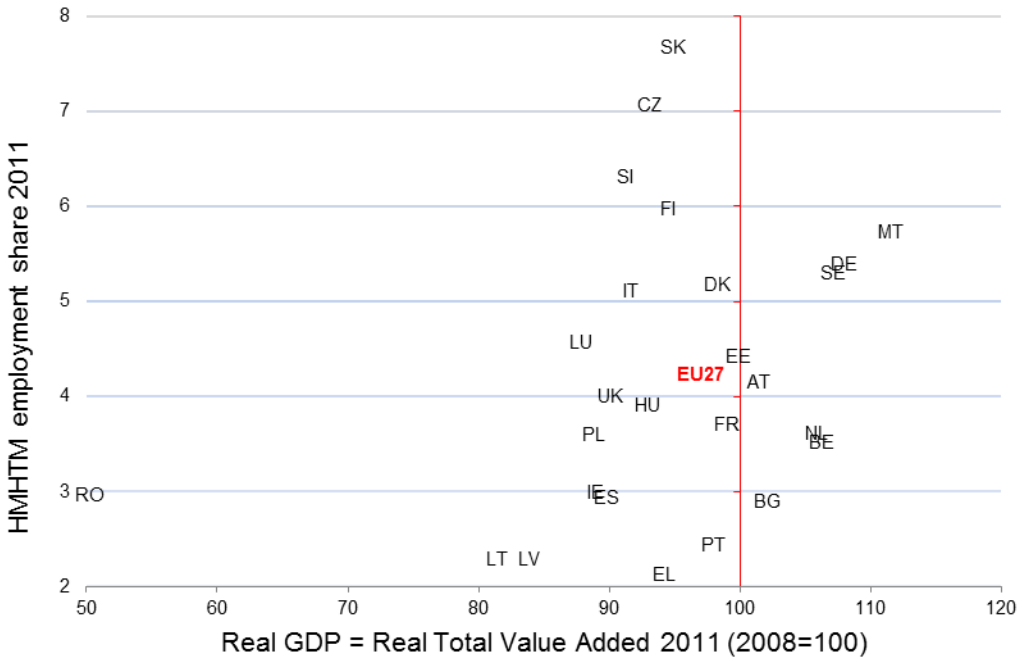


Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

The observation that employment growth in high-tech manufacturing and high-tech KIS SMEs is below that of the low-tech manufacturing and LKIS SMEs can be explained by the collapse in demand triggered by the global crisis. World trade fell dramatically during 2009. The trade in high-tech and medium-high tech goods, which are the main component of EU trade, declined more than the trade in low-tech goods from 2008 to 2009[40]. Furthermore, typically high-tech manufacturing products and knowledge intensive services reflect higher quality products and services, i.e. products that sell at a premium. Typically, the income elasticity of demand for high-quality products and services is higher than for products at the lower end. As shown by Berthou and Emlinger (2010), high quality goods are more sensitive to changes in per capita income than goods of low quality. Hence the collapse in income, both domestically and globally, during the crisis disproportionately affected the high-tech and KIS products and producers (Esposito and Vicarelli, 2011). Conversely, an economy recovery, should also see faster growth of these type of firms. The relatively rapid recovery of high-tech SMEs and high-tech KIS in 2010 and 2011 may be taken as a confirmation of this hypothesis.

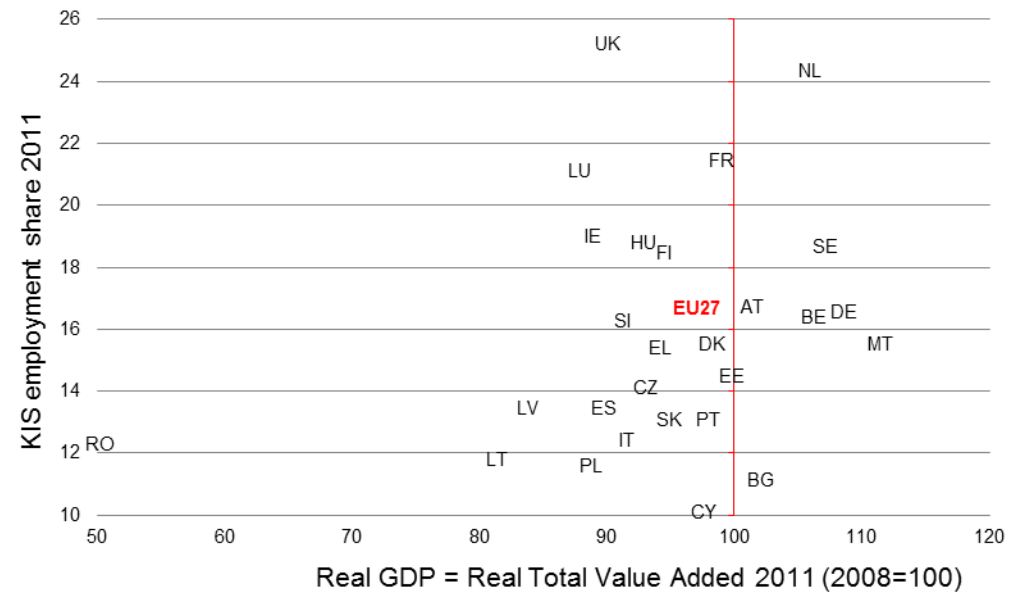
Figures 3.5a and 3.5b show on the horizontal axis whether or not the 2011 total real value added of Member States exceeded the 2008 pre-crisis levels. The total real value added is the gross aggregate national product, or GDP, including the production of both small and large enterprises. Net of depreciation on capital, one arrives at net national income, which equals the sum of the final demand categories private and government consumption and investment plus exports minus imports. On the vertical axis, the degree of specialisation of Member States in high-tech and medium high-tech manufacturing and KIS is presented. It appears that the best performing Member States (Austria and Germany, see the second quadrant of Figure 2.6) have had higher growth of aggregate national product (=GDP=total real value added of both SMEs and large firms) and a relatively high degree of specialisation in high-tech and medium high-tech manufacturing and KIS. It is noteworthy that Sweden, although not in the small elite club of Member States of best performing SMEs, does have both a high GDP growth and an above average degree of specialisation for both SMEs and large enterprises (figures 3.5a as well as 3.5b).

Figure 3.5a Real growth of total value added and degree of specialisation in HMHTM by Member States, 2011



Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Figure 3.5b Real growth of total value added and degree of specialisation in KIS by Member States, 2011



Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Even though high-tech manufacturing SMEs and knowledge intensive service SMEs seem to, relative to the low-tech and LKIS, have suffered more in terms of employment from the crisis, there may be important indirect effects through inter-industry linkages that matter in a structural way and hence for long run competitiveness.

Sectors with high inter-industry linkages were first analysed by Hirschman (1958). Since then, a large theoretical and empirical literature has emerged, pointing out the importance of backward and forward linkages between firms and sectors. Backward linkages can be thought of as channels through which information (knowledge) and inputs flow between a company and its suppliers, which generates a cluster of interdependency. Forward linkages refer to the distribution chain connecting a producer with its customers and can be thought of as demand linkages. They have been shown to facilitate knowledge "spillovers" and generate a process of regional concentration of economic activity, often resulting in co-location of between firms. Thus, high-tech manufacturing and knowledge intensive service SMEs can be seen as contributing to strengthening inter-industry linkages, going beyond their effect as an individual firm.

SMEs often hold not only a technological niche in a global supply chain and generate positive externalities, they also may benefit from knowledge spillovers and accumulated R&D efforts generated by government initiatives, universities and multinational firms. Recent evidence points at the importance of knowledge intensity for SMEs to reach a minimum level of absorptive capacity, i.e. the ability of SMEs to collaborate with other firms, universities and technology transfer centres (Muscio, 2006). [41]

3.4 Innovation by SMEs

The evidence presented in the previous sections clearly suggests that SMEs are important for innovation in manufacturing and services. This section therefore discusses various channels in which SMEs make a difference in terms of innovation. Harrison and Watson (1998) point at the flexibility of SMEs, their simple organizational structure, their low risk and receptivity as the essential features facilitating them to be innovative. There is a substantial body of evidence that demonstrates that SMEs engage in technological innovations in a wide range of sectors and that they are important sources of employment and productivity growth (Audretsch, 2002). However, the innovative capacity of SMEs tends to vary with their sector and the business environment in which they operate as shown by Burrone and Jaiya (2005). Innovation in manufacturing sectors turns out to be an especially complex process, which is related to the type of technology, the gap between the start-up size of a firm and the minimum efficient scale required to operate in a sector amid market uncertainty. This results in a process of Schumpeterian selection in which new innovators replace older and less productive firms (e.g. Audretsch, 1995). This leads to a pattern where young and small firms tend to be an important driver of innovation.

[41] Another important positive contribution that SMEs in these industries can make in terms of employment has to do with business demography, or to put it simpler, that they are on average more likely to survive and have a longer life span than non-hi-tech and low knowledge-intensity firms. More insight into the contribution of different sectors to overall employment generation in the European economy can be obtained from the OECD Timely Indicators and the OECD Structural and Demographic Business Statistics. Firms in the KIS sectors do not seem to generate more employment at their birth than firms in the LKIS sectors. However, the KIS firms do contribute to overall employment growth in a substantial way. For enterprises in the KIS sectors it holds that relatively more enterprises are created, relatively fewer enterprises fail (at least in non-crisis years), and enterprise survival after 2 and 3 years is more likely to occur in the KIS sectors than in the LKIS sectors. This is important to know when economic recovery needs to be fostered.A higher survival rate means that even if the businesses do not grow in size, they may over time increase their share in total employment.

Thus the age profile of EU companies, their size and sectoral specialisation structure are key to understanding Europe's innovation and growth shortcomings. It is therefore useful to distinguish between innovation in high-tech manufacturing SMEs, innovation in knowledge intensive service sectors and innovation in young innovative companies. The latter categories are motivated by a number of recent papers that have emphasized the role of young innovative companies (YIC). For instance, Schneider and Veugelers (2008) – using data from the German community innovation survey – show that firms that combine newness, smallness and high R&D intensity, are rare in their sample of innovative firms, but achieve significantly higher innovative sales, especially innovative sales that are new to the market, than other innovative firms[42].

If a firm has to technologically innovate, it is clear that both supply and demand conditions have to be in place. On the supply side, the technological know-how and expertise is essential, on the demand side either implicit or explicit market opportunities need to exist. This can take the form of being part of a global supply chain where the SME takes a niche position in the intermediate production process. Innovation can take the form of either product or process innovation or both. Apart from the supply and demand conditions SMEs are facing, certain internal factors inherent to the particular SME may also be crucial in their ability to innovate. These include the level of human capital and the absorptive capacity of SMEs, while external factors typically refer to the backward and forward linkages that were discussed in section 3.3.

A number of studies point at the important role of internal factors, but others emphasize external conditions. Overall, it seems that both internal and external factors are important for innovation in manufacturing SMEs. Furthermore, it turns out that no clear pattern emerges with respect to the type of innovation. High-tech manufacturing SMEs engage in product innovation, process innovation or both (e.g. Hoffman et al., 1998).

Inklaar, Timmer and Van Ark (2007, 2008) have shown that the differences in aggregate productivity levels and growth rates for Europe and the Unites States are largely attributable to the service sectors. Service innovation differs from innovation in manufacturing sectors. Services are mostly developed in close interaction with clients. Innovation in manufacturing takes place in R&D departments whereas services are innovated in networks and in co-locations of knowledge-intensive sectors and manufacturing activities.

Service innovations in the sense of developing a new production process usually exist because SMEs are networking and connecting along the value chain to enhance production processes. In addition, knowledge-intensive business services in collaboration with their customers can improve the technology used and the business models applied.

In addition to improving their services, knowledge-intensive business services also affect the competitiveness of their clients sectors, including manufacturing firms. For instance, Arnold, Javorcik and Mattoo (2011) demonstrate how improved competitiveness in the service sectors (through service liberalization) in the Czech Republic benefited firms in downstream manufacturing sectors. Business service sectors can also be decisive for export performance. An increase in the variety of business services available in a host country reduces a manufacturer's cost and hence makes that country a more attractive location for further manufacturing investment. Analysis of export data, and number and employment shares of KIS SMEs of individual Member States for the period 2009-2011 confirmed a positive relationship between the availability of KIS and export performance of a country.

[42]Related papers that tune in on the role of YICs include Veron and Philippon (2008), Holz (2008), BEPA (2008)

In recent years, an increased interest has emerged in the role of young innovative companies (YICs) in generating productivity growth and competitiveness. One of the explanations for Europe's innovation and growth short comings relative to the United States has been the revealed capacity of the US economy to generate more young innovative firms which manage to survive, introduce new products and move into the core of emerging sectors. In contrast, as pointed out by Santarelli and Vivarelli (2007) young European firms reveal lower innovative capacity and most of them do not survive very long, which results in more churning rather than innovative dynamics.

Pellegrino, Piva and Vivarelli (2009) analysed YICs in Italy. They found that innovation intensity in the YICs is mainly dependent on embodied technical change from external sources, while • in contrast with the incumbent firms – in-house R&D does not play a significant role.

Schneider and Veugelers (2008) used a German sample to show that firms that combine newness, smallness and high R&D intensity achieve significantly higher innovative sales than other innovative firms, especially innovative sales that are new to the market. Unsurprisingly, YICs view financial constraints, both internal and external, as an important factor hampering their innovation activities, significantly more so than other innovation active firms. This access to finance problem is often used as a motive and rationale for more government intervention.

The regional dimension and business environment is often seen as an important factor to determine the success or failure of young innovative firms, both for high-tech manufacturing and knowledge intensive services.

For innovation in knowledge-intensive business services certain skill sets must be available, such as networking with clients and experience with contact and integration with customers. Knowledge-intensive business services also require employees in computer science and engineering. There is a need for increasing the supply of high skilled labour that can work in the knowledge-intensive services as these sectors perform relatively better. Universities have a potential role here.

Regionally, the geographical location of knowledge-intensive services is linked to advanced regions with a high international profile (Merino and Rubalcaba, 2006). The location of knowledge-intensive sectors can also be explained by the efforts made in regional innovation and the presence of spatial clusters (Rodriguez and Camacho, 2009).

The performance of knowledge-intensive business services (KIBS) is linked to their functional and regional integration. The functional integration of KIBS with knowledge providers, customers and cooperation partners needs to be very close. With regard to regional integration, KIBS that increase their employment are able to extend their markets by having partners outside their own region (Koch and Strotmann, 2004).

To sum up, the relationship between growth of real value added and technology intensity results in Member States with a larger share of high-tech and medium-tech manufacturing employment in total SME employment tending to exhibit higher growth. A similar positive relationship is found between knowledge intensity and value added growth. As was noted the strength and significance of this nexus appears to be stronger for services than for manufacturing. When linking the results with chapter 2, one can observe that the P-P group of Member States (with both positive real value added and employment growth) have relatively higher investment rates, export rates and HMHTM- and KIS shares in SME employment, which holds especially for the year 2011. The latter factors have been shown to drive the labour productivity growth of SMEs, whereby the labour productivity

growth has been used as a measure of SME growth. These findings lead invariably to the question of potential for policy intervention.

4 Supporting the creation of high-tech SMEs via universities

4.1 Introduction

The preceding chapters clearly established how important high-tech, knowledge-intensive, innovative SMEs are to future economic growth in the EU. At the same time, it is widely accepted that they often face greater obstacles than other firms, and so deserve support from governmental institutions. Economists have provided two rationales for such a view. Firstly, it is claimed that there are severe market failures that prevent these firms from fair access to key inputs, in particular access to finance. Secondly, a strong case for public support for these companies hinges on the special role they play in promoting dynamism in advanced economies. As the benefits to society arising from the innovative activity of new technology-based firms largely exceed those that can be appropriated by them, such positive externalities justify government support (Colombo and Delmastro (2002))[43]. While the focus on start-ups emerging from universities in this chapter is consistent with the findings of Chapter 3 of this report, as new technology- and knowledge-intensive firms are found to have a bigger positive impact in terms of employment and value added, new business creation by universities and public research organizations is not only important for job creation and growth, but also considered important for the image of public sector research, illustrating their dynamism and the applicability of their research. (Mustar, 2002).

Against this backdrop, the obvious next question to ask is: How do you best promote the emergence of further hi-tech and knowledge-intensive SMEs?
It goes without saying that a host of factors and policy instruments need to be considered in this regard. Starting from general policy issues regarding education, training as well as entrepreneurship promotion to intellectual property rights and even immigration policy there are numerous policy domains which could – and actually are- put to use so as to work towards this goal. In the limited context of this report, it is obviously impossible to allow for a comprehensive and profound discussion of all relevant issues. Therefore, the report deliberately focuses in one specific policy domain, namely the fostering of the university-start-up nexus. Why? The idea of extending the traditional design universities and other institutions of higher education by allowing them to also become spring-boards for start-up firms is an area which has attracted attention only fairly recently, at least in most EU Member States. This increased interest is met not only with a substantial lack of experience but also with a considerable potential for creating such initiatives all over Europe. The currently modest significance of this phenomenon, as portrayed below, should not led one to underestimate the substantial opportunities for increasing the number of hi-tech and knowledge-intensive SMEs. This chapter, therefore, tries to provide a detailed overview of existing programs, lessons learnt and available policy options.

This chapter discusses the role of universities in particular in stimulating more innovative start-ups by bridging the gap between public sector research and the business world. Businesses created from higher education and research institutions are at the intersection between policies to support innovative SMEs and policies to promote the convergence of research and industry (Mustar,

[43] Colombo M. and M. Delmastro, "How effective are technology incubators? Evidence from Italy", Research Policy, Vol. 31, p. 1103–1122, 2002.

2002)[44]. Policies to promote university spin-offs reveal the current focus of innovation policies on the conditions of technological competitiveness rather than on competitiveness itself, the latter being the firm's own responsibility.

4.2 Facts and figures

Entrepreneurship at universities

Universities can stimulate entrepreneurship in many different ways:[45]

- Promoting the development of entrepreneurial attitudes by teaching students to become more enterprising;
- Providing students with internship opportunities in businesses in the local economy which will teach them business skills;
- Supporting staff and students to start up their own businesses, so-called spin-outs or spin-offs. This support can be through assistance in drafting a business plan, provision of free office space, use of equipment, specialist advice from business mentors and financial assistance.

This chapter focuses on the last point: supporting staff and students to start up their own businesses. Shane (2004) refers to a Research-Based Spin-off, which is defined as a new company founded to exploit a piece of intellectual property created by faculty or staff in an academic institution[46]. Research-based start-ups typically begin life in "business incubators". The research-based spin-offs from private corporations are more common than public research/university spin-offs.

At present there are more than 150 fully certified business incubators in the EU that are supported by a European BIC network, an NGO based in Brussels.

Across several European countries, researchers have shown that there has been a substantial increase in the creation of research-based spin offs. Mustar et al. (2008) mention the following three contextual factors as an explanation for this rise:

1. The ownership of intellectual property rights by technology transfer offices relative to that of faculty has increased.
2. There is increasing institutional pressure on public research organizations to commercialise research.
3. The availability of public funds aimed at addressing the so-called financing and knowledge gap.[47]

Spin-off creation and their impact on the economy

Spin-offs are not a homogeneous group of companies. In the research program REBASPINOFF three types were identified: 1) The "venture capital backed type" is the ideal-model of most policies but is rare due to its characteristics: it is based not on one patent but on a balanced portfolio and it

[44] Mustar P., "Public Support for the Spin-Off Companies from Higher Education and Research Institutions", Proceedings of the STRATA consolidating workshop, Session 4: new instruments for science & technology policy implementation, Brussels, 22 & 23 April 2002

[45] EC Regional Policy (2011), Connecting Universities to Regional Growth, a practical guide, September.

[47] Mustar, Ph., M. Wright and B. Clarysse, "University spin-off firms: lessons from ten years of experience in Eurpe", Science and Public Policy, 35(2), March 2008, pages 67-80.

requires not an individual researcher but an established team backing the technologies; 2) The "prospector type" is far narrower in scope, focusing on one patent and one "beta product"; and 3) The most common "lifestyle type", which is based on contract research and consulting.

The total number of spin-offs created each year in Europe is stable, around 500, according to the latest survey of ProTon on knowledge transfer activities in European Universities. This survey points to a relatively low number of spin-offs created per university in Europe with an average number of 1.6, compared with 2.9 in the US[48]. Other sources report higher number of spin-offs, such as Geuna and Rossi (2011)[49] who report about 200 spin-offs established annually in UK universities in the period 2005-2009[50].

In 2009, 473 spin-off companies were created with the support of European Knowledge Transfer Offices (KTOs)[51], the average being 1.5 per KTO, slightly fewer than in previous years (typically around 3 per year).According to the CEMI survey[52] which was addressed to the Technology Transfer Offices (TTOs) of all universities in Western Europe, TTOs from Sweden, the Netherlands, Finland, Switzerland and Germany create more start-ups than the European average. The European average in 2007 was 4.1 start-ups per TTO, with a minimum of 0 and a maximum of 35. TTOs from Denmark and France on average created the lowest number of start-ups.

Comparison of the ASTP and AUTM survey results from 2007 shows that European KTOs outperform American KTOs, producing 1 spin-off for every US$53.8 million PPP of research expenditures, versus a cost of US$87.9 million PPP per spin-off in the United States[53]. However, for four other outcome measures (invention disclosures, patent applications, patent grants and license agreements), American KTOs outperform European KTOs. These findings are confirmed by more recent results from the European Knowledge Transfer Indicators Survey[54].

Zhang (2008) finds that university spin-offs are concentrated in the biotechnology and information technology industries. He observed that university spin-offs in the US have a higher survival rate but are otherwise little different from other start-ups. Zhang also found that more than two-thirds of university spin-offs are located in the same state as the parent university.

Gregorio and Shane (2003) conclude that significant differences exist across universities in their generation of new firms to exploit university inventions. Both university policies and intellectual eminence influence this variation, generating important implications for research and policy towards university technology transfer[55].
Factors that explain why universities are successful in generating spin offs include:[56]

- A strong science and engineering resource base at the university, together with connections with industry and government;
- Excellent staff research activities and attraction of top students;
- Leadership to commit the university to promoting spin offs and policy supportive to entrepreneurship;
- A culture within the university that champions commercialisation of research activities;

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48 The ProTon Europe Survey (FY 2006-08).
Geuna, A., Rossi, F. Changes to university IPR regulations in Europe and the impact on academic patenting. Research Policy 40, 2011, pp. 1068-1076.

51 The ProTon Europe Survey (FY 2009), p.13.

52 Conti and Gaule (2008), The CEMI Survey of University Technology Transfer Offices in Europe.

53 Arundel and Bordoy (2010), Summary Respondent Report: ASTP Survey for Fiscal Year 2008.
Knowledge Transfer Study 2010-2012. Version 1.1, February 2012, p. 6.

56 O'Shea, R.P. et al (2007), Delineating the anatomy of an entrepreneurial university: The Massachusetts Institute of Technology experience, R&D management 37, 1.

- A regional environment in which the university has innovative customers, and access to resources and finance.

With respect to their impact on the economy, it should be mentioned that it takes a long time to transfer academic research into a commercial product. Furthermore, most studies show that the majority of public-research spin-offs are and remain very small enterprises, even if these spin-offs are a fast growing subpopulation of the entire population of young-technology based firms. According to Helm and Mauroner (2007), university spin-offs perform better compared to traditional start-ups in terms of survival rate and employment growth, but worse in terms of productivity and credit rating[57]. With respect to the higher survival rates, Djokovic and Souitaris (2008) notice that it is still unclear if these can be attributed to higher 'fitness' of university spin-outs or rather that the support systems of their parent organisations are keeping them "alive".[58] In general, it is still quite early to evaluate the longer-term importance of spin-offs for the economy. Perhaps one should not look at the general picture of academic spin-offs as one spin-off has shown to be able to create an entire industry.

4.3 Policies to support research-based spin-offs

Universities clearly have an important role to play in creating start-ups. EU, national and regional policymakers, as well as university administrators, should therefore consider the most effective ways to stimulate economic development through research-based academic spin-offs.

Some evidence (Gilsing et al. (2010)) underlines the importance of respecting that the process of spin-off creation needs to be separated from its subsequent success or failure and so should the policies to foster spin-offs.[59]According to these authors, higher institutional levels are responsible for the conditions that affect the establishment of spin-offs, whereas the low(er) levels form the conditions that mostly affect their success chances once established.[60]

Another general remark refers to the time horizon for policy initiatives to support spin-offs as this needs careful consideration (Mustar et al. (2008). Sufficient levels of support over a sufficient period of time are necessary if objectives of promoting spin-offs that create wealth are to be achieved. There is a need for longer-term policy initiatives that help create the basis to develop self-sustained spin-offs and avoids a short-sighted policy only focussing on the initial start-up phase.
Wright et al. (2004) point to an important policy debate concerning the nature of support to be provided to spin-off companies. Recent research recognises the heterogeneity of spin-offs in terms of the environments in which they emerge, the skills of the entrepreneurs and the resources they require. This suggests that policy measures need to be more sophisticated than simple one-size-fits-all support. Rather they need to be tailor-made on the basis of the existing circumstances of the educational institutions in question and economic and political setting there are operating in.

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57 Helm R. and O. Mauroner, "Success of research-basd spin-offs – State of the art and guidelines for further research", Review of Managerial Science, Volume 1, Number 3, pages 237-270, 2007

58 Djokovic, D. and V. Souitaris, "Spin-outs from academic institutions: a literature review with suggestions for further research", Journal of Technology Transfer, 33, pages 225-247, 2008

59 Gilsing V.A., E. van Burg, A.G.L. Romme, "Policy principles forthe creation and success of corporate and academic spin-offs", Technovation, 30, pages 12-23, 2010.

60 The four institutional layers that these authors distinguish in the context of spin-offs from a university or public research organization (PRO) are (from high to low): (1) national law and policy, (2) technology development patterns, (3) public research organization or university and (4) regional policy.

In this section an overview of policies and support measures from the side of universities and the government is provided, including:

1. Revision of researcher's status;
2. Rules on intellectual property;
3. Presenting annual awards to entrepreneurial universities and students;
4. Focusing support measures to campus entrepreneurs;
5. Improving access to finance for student entrepreneurs;
6. Support for business incubators;
7. Certifying procedures of incubators;
8. Support for result-oriented Knowledge Transfer Offices.

Revision of researcher's status

In several countries, academics' status has prevented them from participating in the creation of private enterprises to validate the results of their research. But this status has now been revised in many countries, allowing academics to start a business or participate in the creation of a company and leave their laboratory without losing their status and with provisions for the researcher's return to his or her institution in case of failure of the start-up (Mustar (2002)).

More generally, the presence of an "entrepreneurial climate" at a university positively influences the creation of spin-offs (Gilsing et al. (2010)). A decision to start a spin-off is, to a large extent, socially conditioned: previous efforts by pioneering entrepreneurial faculty members to start a company make other academics believe that it is an acceptable and desirable activity.

Rules on intellectual property

In the past, issues such as intellectual property rights, conflicts of interest or investment in start-ups sometimes varied substantially within the same public sector research institution, depending on the project, because they were dealt with on an ad hoc basis. Today, most research organizations have set up a general framework as a basis for discussions with entrepreneurs in order to ensure that the institution is not totally excluded from any profits derived from the start-up (Mustar, 2002).

A potential issue with the intellectual property developed at the university and applied in spin-offs is the distraction from basic research, although Thursby and Thursby (2011) show an increase of both basic and applied research because of commercialization efforts, with applied research increasing relatively to a greater extent[61].

See Box 4 for the trade off between research and entrepreneurship.

Box 4 A policy trade-off between basic research and academic entrepreneurship

The US Small Business Innovation Research (SBIR) programme is an interesting model to look at as it fosters academic entrepreneurship. The programme has been used by biomedical scientists. The programme funds early-stage university-based technology firms so that the entrepreneurs of these firms can concentrate on their technical and market uncertainties. A policy trade-off exists between knowledge creation through academic research and commercialization of business ideas. Academic researchers lose time to devote to academic knowledge creation and this has been insufficiently accounted for in recent policies to promote spin-offs. Crucial to this is the form of faculty involvement because it mediates the degree to which the faculty member is drawn away from academic research. The contribution of academic scientists to a firm's patent productivity depends on the depth of their scientifically oriented human capital. When scientists start a for-profit firm commercially oriented academic capital is also needed (Toole and Czarnitzki, 2007, 2009 and 2010).

Presenting annual awards

Presenting awards may stimulate universities and research institutes in Europe to play a more active role in terms of innovation, particularly in translating research and transferring technology to businesses and supporting the creation of research-based spin offs. The UK Minister for Universities and Science, for example, presents an annual award to outstanding Entrepreneurial Universities in the UK. Competitions for creating innovative businesses are also proliferating with financial support, provided at national and/or regional level, for the most promising projects. Germany runs since some years a ranking scheme resulting in yearly awards to those universities which have been most active in developing their infrastructure for boosting entrepreneurial spin-offs.

Other examples are provided by Portugal, Slovakia and the Netherlands. The 9th Concurso PoliEmpreende (PoliEnterprising Contest), targeted at Polytechnic University students in Portugal, aims to stimulate business exploitation of knowledge acquired by the students. A Regional Advisory and Information Centre in Presov, Slovakia, initiated a competition of high school and university students to support creative entrepreneurship potential of students.
The Dutch Ministry of Economic Affairs, Agriculture and Innovation provides economic incentives to soon-to-be graduating students to become more entrepreneurial. Currently, repayment of a student loan is based on income. When students own a profitable firm in their last year of study, the earned profit does not increase their monthly obligation to repay the debt.

Focus on campus entrepreneurs

Astebro, Bazzazian, and Braguinsky (2012) found that in general, start-ups by recent university graduates outnumber faculty spin-offs by at least an order of magnitude. This is not just a volume effect driven by the larger number of graduates, although graduation volumes certainly matter. Recent graduates are twice as likely as their faculty to create a start-up within three years of graduation.

The 2011 Yearbook of the Academic Enterprise Awards notes that US universities have been supporting campus entrepreneurs and technology transfer programs since the early 1980s, and UK universities have done so since the 1990s. Overall, promoting these spin-offs by campus entrepreneurs is a relatively new role for European universities.

There are different initiatives in several regions in the Netherlands stimulating entrepreneurship. For example, temporary office premises, production facilities and research space are provided to techno-entrepreneurs at the Technical University in Delft. In the East of the country coaching programmes for starting entrepreneurs were introduced.

Access to finance for student entrepreneurs

Capital required for spin-offs can run into the range of €1-4 million per venture. Using the Global University Entrepreneurial Spirit Students' Survey, Sieger et al. (2011) noted that founding their own company directly after studies is of relatively low importance to students; however, for those who do go for it access to financial capital represents the most important barrier to founding a company.

Support for business incubators

The creation of research-based spin-offs is typically done in so-called business incubators, which constitute an environment, especially designed to hatch enterprises. Many of these incubators receive public funding. Bergek and Norrman (2008) define a business incubator as a 'protected space' for start ups and fledgling companies made up of four main components: (1) shared office space, which is rented under more or less favourable conditions to the users of the incubator; (2) a pool of shared support services to reduce overhead costs; (3) professional business support or advice ('coaching') and (4) network provision, internal and/or external. The concepts of 'protected space' and 'shared office space' can also be extended to a 'virtual space', considering the progress in new technologies and the opportunity to have a virtual office space. So business incubators provide tenant companies with several facilities, allowing the start-up to concentrate on its business plan. From the side of the university there is usually a Technology Transfer Office or Knowledge Transfer Office that oversees the cooperation between the university and the business incubators.

A typology of incubation models for managing the spin-out process from European universities and research institutions has been given by Clarysse et al (2004). Three reference models are distinguished[62]:

1. The "low selective model" of spin-out activity fits closely with the idea of an entrepreneurial university. Its objective is to stimulate as many entrepreneurial ventures as possible. The model facilitates the spin-off process through granting small amounts of money to potential entrepreneurs and the provision of office space at the university. These spin-outs are seen as an alternative to employment at an established firm. The majority of the spin-offs created fit the "life-style type".
2. The" incubator model" has the explicit objective to generate growth oriented, financially attractive spin-outs. This model focuses on what is called "venture capital backed type" of companies. The top management of a Research Institute makes the decision to create a spin-off being highly selective in projects it supports: it is not the quantity but the quality of the created ventures that counts. Selection criteria are the global orientation of the spin-out company, dynamic growth perspectives and a very strong technical base. The ventures from this model achieve higher levels of innovative activity than ventures spun-out under the first and third model.
3. The "supportive model" is an in-between type. It is not as selective in terms of the kind of spin-offs it wants to stimulate but the companies that receive support usually embody a formal transfer of technology from the university to the company. The university gives the entrepreneurial team extensive support in the pre-start phase. The starting entrepreneurs have to prepare a business plan before being admitted to the spin-out service. This model provides public/private funds in support of a selected business plan. The company model that best fits the kind of companies targeted by this model is the "prospector type".

[62] See also Mustar et al (2008) referred to above.

Because public support for business incubators has become a popular instrument to support the development of research-based spin-offs, the next section discusses in more detail their effectiveness and the lessons that have been learned.

Certifying business incubators

From the side of public policy the certification of business incubators could be instrumental in mainstreaming this policy instrument. Aerts, Matthyssens, and Vandenbempt (2007) propose the introduction of a quality label, administered by an independent and reliable organisation, that could be beneficial to the incubator business. This label could be introduced at both the national and international level. A start-up company will have more faith in an acknowledged and high-quality incubator. In times of recession, this guarantee could make the difference between 'go' and 'no go' for potential entrepreneurs. However, as of now, there is no evidence that – on the national level- such a label has been successfully introduced.

Support for result-oriented KTOs

According to the Knowledge Transfer Study 2010-2012 most European KTOs are still young, with 59.4 per cent established after 2000 (data are from 2010). Furthermore, 48.1 per cent have fewer than six employees (FTE). These results suggest that many European KTOs are still developing experience and capabilities with managing the intellectual property produced by their affiliated university or research institute. They could also be struggling with a lack of sufficient staff. Both of these factors could result in lower performance than expected, in terms of the number of patent applications, patent grants, start-ups, licenses, and license income.

The study finds that the number of knowledge transfer office staff has a substantial, positive effect on knowledge transfer outputs, including license income, after controlling for the size of the public research organisation, the policy for intellectual property ownership, and other factors. This provides a strong argument for supporting well-funded knowledge-transfer offices.

Moreover, the study concludes that there is no "one-size-fits-all" approach to knowledge transfer. For an illustration, representatives from different industries pointed to the fact that knowledge transfer staff are biased to the opportunities of the biotechnology and pharmaceuticals industry and less familiar with the situation in other industries.

Universities generally have an interest in transferring knowledge and research into the market because of the revenues from licensing and royalties. Most universities can also receive equity for the intellectual property developed at the university and applied in the spin offs. Fernandez-Zubieta et al. (2009) find that the total budget of a Technology Transfer Office is positively correlated with the number of spinoffs. In addition, high-patenting activity of a university is highly correlated with high-spinoff activity.

In 2010, European universities and research organisations outperformed their American counterparts for the amount of research expenditures required to produce one patent grant, start up and license agreement. On the other hand, American universities and research organisations are better at producing invention disclosures, patent applications and license income. On average, license income in Europe equals 1.5 per cent of the research expenditures by universities and research institutes, whereas in the United States license income equals 4 per cent of research expenditures.

4.4 Business incubators: opportunities and threats

This section focuses on business incubators as an important instrument to support research-based spin-offs for the following reasons. First, policymakers of national and local levels view business incubators as a key tool for promoting economic development, innovativeness and the emergence of new technology-based growth firms (Bergek and Norman (2008)). Second, technology incubators associated with universities provide the access to knowledge-based assets that are often needed for technology-based start-ups. Third, the incubators provide new technology-based firms with advice and support services aimed at, among others, strengthening entrepreneurial skills, dealing with intellectual property rules and accessing finance, and recognise heterogeneity of these firms in terms of the environment in which they emerge, the skills of entrepreneurs and the resources they require.

Considering the large amounts of money invested in incubators by governments, universities, research institutions, municipal agencies and other interested parties[63], the question of what return society gets on these investments has been raised. As there is a lack of theoretical base for incubator performance evaluation in general and the identification of best practices in particular, views on the effectiveness of business incubators may differ. This section reviews recent findings in the evaluation of effectiveness of business incubators, characterizes the link to university, and draws preliminary conclusions on success factors and dangers of business incubator establishment.

The effectiveness of business incubators

In spite of the diffusion of business incubators in Europe, it is still unclear whether the business incubator model has been successful in fostering the establishment and growth of research-based spin-offs. Some authors are very critical about the effectiveness of business incubators. Tamasy (2007)[64] for example claims that technology-oriented business incubators tend to fail in supporting entrepreneurship, innovation, and regional development and, therefore, do not fulfill their expected role as policy instrument. The evaluation results she reports upon show that incubators can be a costly policy instrument. First, they have a low motivating effect and it seems likely that business incubators have only provided minor stimulus for individuals starting a business. Second, the empirical results suggest that business incubators do not increase the likelihood of firm survival, innovativeness, and growth. Third, the costs of incubators seem to be positively correlated with the level of funding without a hard budget constraint. Finally, the business incubator idea in practice is actually a very modest contributor to regional economic development. She concludes that these findings do not legitimise the use of public funds to support the incubation industry.

Other studies comparing on- and off-park firms through the analysis of matched pairs samples have provided mixed results (Colombo and Delmastro, 2002)[65]. First, there is no clear evidence that independent park firms outperform comparable firms located off park. Similarly, no statistically significant difference emerges between on- and off-park firms as to the number of patents and copyrights they generate. Nor tenant firms outperform firms located off-park in the number of new products and services launched to both existing customers and new markets. Lastly, it is also questionable whether the establishment of parks contributes to close the gap between New Technology Based Firms (NTBFs) and the scientific community. Their own empirical findings for

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63 According to the ProTon Europe Survey FY 2009, The average budget of European KTOs in 2009 was about Euro 422,000,[…].

64 Tamasy C., "Rethinking Technology-Oriented Business Incubators: Developing a Robust Policy Instrument for Entrepreneurship, Innovation and Regional Development ?", Growth and Change, Vol. 38, No. 3, p. 460-473, 2007

65 Colombo M. and M. Delmastro, "How effective are technology incubators? Evidence from Italy", Research Policy, Vol. 31, p. 1103–1122, 2002

Italy suggest a more positive view of science parks and business incubators. Italian parks managed to attract entrepreneurs with better human capital, as measured by educational attainments and prior working experience. In addition, on-incubator firms show higher growth rates than their off-incubator counterparts. They also perform better in terms of adoption of advanced technologies, aptitude to participating in international R&D programs, and establishment of collaborative arrangements, especially with universities. Lastly, they find it easier to get access to public subsidies. Altogether, these mixed findings illustrate that one needs to be prudent in concluding that science parks are an important element of a technology policy in favor of NTBFs.

More recent research comes to the conclusion that the performance of incubators very much depends on the type of incubator and its goals. Barbaro et al. (2012)[66] for example make a distinction between four archetypes: basic research, university, economic development and private incubator. The basic research incubator links incubation with fundamental research. In this type, technologies that are developed take the form of intellectual property that can be licensed by commercial partners or exercised by spin off companies. The university business incubator has a mixed (public/private) nature as they are dependent on university funding as well as on companies' funds for the transfer of venture generated IP. In their view, the main purpose of economic development incubators is the promotion of entrepreneurship in areas with below-average economic indicators. Finally, the incubation efforts of private incubators have a private and corporate nature. They add value through business development and through private financing.

They further determined the objectives each archetype is created for and subsequently evaluated their performance using a sample of 70 incubators in Andalucia (Spain). They conclude that not all archetypes perform equally but that there are significant differences in the performance of the different archetypes. Some types perform better in specific performance measures while others perform worse. They found that economic development incubator performed poorly, university incubators performed satisfactorily, while the performance of private incubator and basic research incubators performance was outstanding.

Also Tavolletti (2012)[67] stresses the fact that performance evaluations should take into account the different goals of an incubator. The main expectation of policy makers that invest public money in business incubation are that incubator graduates have the potential to create jobs, revitalise cities and regions, diversify local economies, commercialise new technologies, transfer technology from universities and major corporations and strengthen local and national economies in general. So they may have many different goals and vary in the way they deliver their services, in their organisational structure and in the types of clients they serve.

Different incubator goals require different incubator models and different models produce different outcomes and performances and therefore need different evaluations of ‘effectiveness’. In general, different goals depend on different stakeholders (and in the case of business incubation there can be very different stakeholders: national, regional or local policy makers; a university; a public or private research lab; the incubator owner) but the same stakeholders can also have different goals. In fact, measuring outcomes without putting them in relation to different stakeholders and their different goals is meaningless, and comparisons should only be made between incubators that have the same goals.

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66 Barbero, J.L., J.C. Casillas, A. Ramos and S. Guitar, “Revisiting incubation performance: How incubator typology affects results”, Technological Forecasting & Social Changes, vol. 79, p. 888-902, 2012

67 Tavoletti, E., “Business Incubators: Effective Infrastructures or Waste of Public Money? Looking for a Theoretical Framework, Guidelines and Criteria”, Journal of Knowledge Economy, 2012

Also Bergek and Norman (2008) concluded that comparisons should only be made between incubators that have the same goal(s) and that outcome indicators should be chosen carefully as to correspond to these goals.

University linkages

One of the arguments for technology incubators associated with universities is the access to knowledge-based assets that are often needed for technology-based start-ups. Several studies have suggested that knowledge spillovers tend to be localized. However, more university involvement in the spin-offs does not appear to be an efficient policy. According to Rothaermel and Thursby (2005)[68] there is a trade-off when incubating a new venture that relies on a strong university link either through a technology license and/or having one or more university faculty as part of the senior management team.

They examined incubator firm performance, as measured by failure, graduation or continued incubation, as a function of firm ties to the sponsoring university, controlling for other factors such as linkages to other, non-sponsoring research universities, firm patents, industry classification, firm size, total amount of funding obtained, and sources of funding. What they found is that strong ties to the sponsoring university, as measured by licensed technology or faculty as senior management reduce the likelihood of firm failure but also retard graduation from the incubator. The former effect may be due to strong IP protection and potential inventor involvement in the new venture, while the latter is caused by a potentially overly optimistic inventor and a technology that is likely to be embryonic in its development. Having an inventor in the incubator firm's senior management reduces both the probability of outright failure and the likelihood of timely graduation from the incubator within 3 years or less. They suggest that, perhaps, a balanced approach combining the necessary university link for some start-ups with professional managers might ameliorate some of these challenges. The combination of professional management and a strong university linkage through a university license might reduce incubator firm failure, while still allowing for timely graduation from the incubator.

Gilsing et al. (2010) also indicate that the spin-off company being highly embedded in the university environment and its network can have detrimental effects because the spin-off may remain too oriented on the academic world. Therefore universities and public research organisations should be stimulated to gradually loosen and break their ties with a particular spin-off firm, to motivate the spin-off to develop a strong market orientation and obtain access to new contacts and information. Science parks for example allow spin-offs to operate independently from their parent universities so they can engage in frequent interaction with others.

Another issue found in evaluations of incubators is the lengthy duration that the incubatees spend in the incubator. To prevent this phenomenon the "incubator model" of Clarysse (2004) focused on timely exiting financially attractive spin-outs is advocated.

Other lessons and recommendations

Aerts et al (2007) observed that a minority of incubators invest in the tenants and provide real support. Nevertheless, this is exactly what Europe needs to encourage innovation. Their study indicates that national and European governments are frequently involved in incubator financing. Governments should realise that it is important that incubators that deliver a lot of added value to the tenants and concentrate on enterprise development, receive financial support or other privileges.

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[68] Rothaermel, F.T. and M. Thursby, "Incubator firm failure or graduation ? The role of university linkages", Research Policy, 34, p. 1076-1090, 2005

The same authors also point out that it is advantageous for an incubator to concentrate on a limited number of sectors. Governments could encourage this by rewarding 'specialists' and thereby lessen the number of 'generalists'. However, attention should be paid to the introduction of early warning systems to reduce the vulnerability that is associated with specialisation.

The incubator sector has suffered from the weak economy: the number of establishments has collapsed and the existing incubators have been severely hit. Aerts et al (2007) suggest to explore the path of counter-cyclic support for incubators: for more support in a recession, stimulating creativity, innovation and entrepreneurship— and thus offering more and better support to entrepreneurs— is crucial in their opinion. This can be realised in two fields: on the one hand the government can encourage incubator establishment and, on the other, support existing incubators (though with a clear preference for those that give the most added value).

Summing up the main findings of this chapter, the main recommendation for public policy is to strengthen the work on best-practice frameworks for incubators and benchmarking European incubation models, oriented to spin-offs in high-tech and medium high-tech manufacturing and/or knowledge-intensive services. There is certainly a need for a best-practice incubation model designed for research-based spin-offs in the latter sectors.

5 Conclusions

SMEs in the EU are operating their businesses in a difficult macroeconomic environment and continue to struggle to recover to pre-crisis levels of value added and employment.

There are diverging trends of SME performance among Member States. In 2011 only Austria, Germany and Malta[69] exceeded their 2008 levels of real value added and employment in their SMEs. Belgium, Finland, France and Luxembourg have experienced a flat SME performance since 2008. In the remaining EU countries, SMEs have not recovered to their pre-crises levels of real value added and employment.

Three main factors explain why SMEs in Austria and Germany performed better than elsewhere. First, SME employment is relatively concentrated in high-tech and medium high-tech manufacturing and knowledge-intensive services. Second, our regression analysis that sectoral labour productivity levels are higher when the sector shows higher investment rates, higher export rates, and when the sector belongs to high-tech and medium high-tech manufacturing and knowledge-intensive services. The best performing countries have generally met these conditions. Third, the best performing countries have combined SME employment growth with SME labour productivity growth, although the former growth factor has been much higher than the latter.

Pronounced performance differences across SME sectors in the EU can also be observed. SME employment has grown in services and trade but contracted in (inter alia) mining and construction. In terms of value added, growth was relatively high in manufacturing and trade. A decomposition exercise of the growth of value added into growth of productivity and growth of employment confirms that in most sectors value added growth is only derived from productivity growth and not from employment growth.

Given that the best performing countries have a relatively high proportion of SMEs in high-tech and medium high-tech manufacturing and knowledge-intensive services, the question is how to support these technology- and knowledge-intensive SMEs. Universities have an important role in stimulating the creation of knowledge- and technology-intensive SMEs and bridging the gap between public-sector research and the business world. Support measures, aimed at increasing the number of research-based spin-offs, include: revision of researcher's status, introducing intellectual property rules, presenting annual awards, promoting campus entrepreneurs, improving access to finance for student entrepreneurs, supporting business incubators, certifying business incubators and providing support for result-oriented knowledge transfer offices.

Policymakers, both nationally and regionally, view business incubators as a tool for promoting economic development, innovativeness and the emergence of new technology-based growth firms. The establishment of an incubator requires considerable investment by various stakeholders, while views on its returns to the society differ. Therefore, there is a need for developing a best-practice incubation model designed for spin-offs in high-tech and medium high-tech manufacturing and knowledge-intensive services.

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Annex 1: Additional tables

Table A1 Share of KIS SMEs and growth of real GVA and employment of SMEs by Member State, 2011 (estimates)

	% share of KIS SME employment in total SME employment				% growth of real value added of all SMEs	% growth of employment of all SMEs
	2009	2010	2011	average		
EU27	**16.4**	**16.6**	**16.7**	**16.5**	**2.2**	**0.0**
Austria	16.6	16.7	16.7	16.7	3.7	1.1
Belgium	15.9	16.1	16.4	16.1	1.5	0.1
Bulgaria	10.8	10.9	11.1	10.9	2.4	-1.0
Cyprus	10.0	10.4	10.1	10.1	0.3	-0.8
Czech Republic	14.2	14.4	14.1	14.2	-0.6	-0.4
Denmark	16.0	16.3	16.5	16.3	1.8	0.6
Estonia	13.9	14.4	14.5	14.3	5.9	5.0
Finland	18.6	18.9	18.5	18.7	1.9	0.0
France	21.1	21.3	21.5	21.3	2.3	0.7
Germany	16.1	16.4	16.4	16.3	4.9	1.8
Greece	15.3	15.3	15.4	15.3	-3.1	-2.4
Hungary	17.8	18.5	18.8	18.3	2.4	0.1
Ireland	18.3	18.8	19.0	18.7	-1.7	-2.1
Italy	12.6	12.7	12.4	12.6	0.3	-1.2
Latvia	13.0	12.9	13.5	13.1	0.5	2.7
Lithuania	11.0	11.4	11.8	11.4	3.5	2.3
Luxembourg	20.6	20.8	21.1	20.8	4.3	0.3
Malta	15.3	15.3	15.6	15.4	1.9	0.1
Netherlands	24.8	24.2	24.4	24.5	2.0	-0.1
Poland	11.4	11.7	11.6	11.6	3.7	-1.1
Portugal	11.5	11.9	13.1	12.1	-0.8	1.7
Romania	12.3	12.6	12.3	12.4	2.6	-0.4
Slovakia	13.3	12.9	13.1	13.1	1.9	1.0
Slovenia	15.3	16.6	16.3	16.1	2.2	-1.6
Spain	12.6	13.2	13.5	13.1	0.9	-0.9
Sweden	20.0	18.7	18.7	19.1	3.4	0.6
United Kingdom	24.4	24.9	25.2	24.8	1.2	-0.8

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Table A2 Annual growth percentage of GVA and employment of SMEs and share of HMHTM SMEs by Member State, 2011 (estimates)

	% share of HMHTM SME employment in total SME employment				% growth of real value added of all SMEs	% growth of employment of all SMEs
	2009	2010	2011	average		
EU27	**4.5**	**4.3**	**4.2**	**4.3**	**2.2**	**0.0**
Austria	4.3	4.2	4.2	4.2	3.7	1.1
Belgium	3.8	3.6	3.5	3.6	1.5	0.1
Bulgaria	3.1	3.1	2.9	3.0	2.4	-1.0
Cyprus	1.4	1.0	1.0	1.1	0.3	-0.8
Czech Republic	7.6	7.2	7.1	7.3	-0.6	-0.4
Denmark	5.7	5.3	5.2	5.4	1.8	0.6
Estonia	4.2	4.3	4.4	4.3	5.9	5.0
Finland	6.0	5.9	6.0	6.0	1.9	0.0
France	4.0	3.8	3.7	3.8	2.3	0.7
Germany	5.9	5.5	5.4	5.6	4.9	1.8
Greece	2.1	2.1	2.1	2.1	-3.1	-2.4
Hungary	4.6	4.2	3.9	4.2	2.4	0.1
Ireland	3.0	2.8	3.0	3.0	-1.7	-2.1
Italy	5.7	5.3	5.1	5.3	0.3	-1.2
Latvia	1.8	2.3	2.3	2.1	0.5	2.7
Lithuania	2.2	2.3	2.3	2.2	3.5	2.3
Luxembourg	4.1	3.8	4.6	4.2	4.3	0.3
Malta	6.2	5.8	5.7	5.9	1.9	0.1
Netherlands	3.6	3.7	3.6	3.6	2.0	-0.1
Poland	3.9	3.6	3.6	3.7	3.7	-1.1
Portugal	2.5	2.4	2.4	2.5	-0.8	1.7
Romania	3.2	2.8	3.0	3.0	2.6	-0.4
Slovakia	7.6	7.8	7.7	7.7	1.9	1.0
Slovenia	6.5	6.3	6.3	6.4	2.2	-1.6
Spain	2.9	2.9	2.9	2.9	0.9	-0.9
Sweden	5.7	5.4	5.3	5.5	3.4	0.6
United Kingdom	4.1	4.1	4.0	4.1	1.2	-0.8

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Table A3 Aggregations of manufacturing based on NACE Rev. 2

Manufacturing industries	NACE Rev. 2 codes – 2-digit level
High-technology	**21** Manufacture of basic pharmaceutical products and pharmaceutical preparations **26** Manufacture of computer, electronic and optical products
Medium-high-technology	**20** Manufacture of chemicals and chemical products **27 to 30** Manufacture of electrical equipment, Manufacture of machinery and equipment n.e.c., Manufacture of motor vehicles, trailers and semi-trailers, Manufacture of other transport equipment
Medium-low-technology	**19** Manufacture of coke and refined petroleum products **22 to 25** Manufacture of rubber and plastic products, Manufacture of other non-metallic mineral products, Manufacture of basic metals, Manufacture of fabricated metal products, except machinery and equipment **33** Repair and installation of machinery and equipment
Low-technology	**10 to 18** Manufacture of food products, beverages, tobacco products, textiles, wearing apparel, leather and related products, wood and of products of wood, paper and paper products, printing and reproduction of recorded media. **31 to 32** Manufacture of furniture, Other manufacturing

Table A4 Aggregations of services based on NACE Rev. 2

Knowledge based services	NACE Rev. 2 codes – 2-digit level
Knowledge-intensive services (KIS)	**50 to 51** Water transport, Air transport **58 to 63** Publishing activities, Motion picture, video and television programme production, sound recording and music publishing activities, Programming and broadcasting activities, Telecommunications, Computer programming, consultancy and related activities, Information service activities (section J) **64 to 66** Financial and insurance activities (section K) **69 to 75** Legal and accounting activities, Activities of head offices; management consultancy activities, Architectural and engineering activities; technical testing and analysis, Scientific research and development, Advertising and market research, Other professional, scientific and technical activities, Veterinary activities (section M) **78** Employment activities **80** Security and investigation activities **84 to 93** Public administration and defence, compulsory social security (section O), Education (section P), Human health and social work activities (section Q), Arts, entertainment and recreation (section R)
Knowledge-intensive market services (excluding high-tech and financial services)	**50 to 51** Water transport, Air transport **69 to 71** Legal and accounting activities, Activities of head offices; management consultancy activities, Architectural and engineering activities; technical testing and analysis **73 to 74** Advertising and market research, Other professional, scientific and technical activities

	78 Employment activities **80** Security and investigation activities
High-tech knowledge-intensive services	**59 to 63** Motion picture, video and television programme production, sound recording and musicpublishing activities, Programming and broadcastingactivities, Telecommunications, Computer programming, consultancy and related activities, Information service activities **72** Scientific research and development
Knowledge-intensive financial services	**64 to 66** Financial and insurance activities (section K)
Other knowledge-intensive services	**58** Publishing activities **75** Veterinary activities **84 to 93** Public administration and defence, compulsory social security (section O), Education (section P), Human health and social work activities (section Q), Arts, entertainment and recreation (section R)
Less knowledge-intensive services (LKIS)	**45 to 47** Wholesale and retail trade; repair of motor vehicles and motorcycles (section G) **49** Land transport and transport via pipelines **52 to 53** Warehousing and support activities for transportation, Postal and courier activities **55 to 56** Accommodation and food service activities (section I) **68** Real estate activities (section L) **77** Rental and leasing activities **79** Travel agency, tour operator reservation service and related activities **81** Services to buildings and landscape activities **82** Office administrative, office support and other business support activities **94 to 96** Activities of membership organisations, Repair of computers and personal and household goods, Other personal service activities (section S) **97 to 99** Activities of households as employers of domestic personnel; Undifferentiated goods- and services-producing activities of private households for own use (section T), Activities of extraterritorial organisations and bodies (section U)
Less knowledge-intensive market services	**45 to 47** Wholesale and retail trade; repair of motor vehicles and motorcycles (section G) **49** Land transport and transport via pipelines **52** Warehousing and support activities for transportation **55 to 56** Accommodation and food service activities (Section I) **68** Real estate activities **77** Rental and leasing activities **79** Travel agency, tour operator reservation service and related activities **81** Services to buildings and landscape activities **82** Office administrative, office support and other business support activities **95** Repair of computers and personal and household goods
Other less knowledge-intensive services	**53** Postal and courier activities **94** Activities of membership organisations **96** Other personal service activities **97 to 99** Activities of households as employers of domestic personnel; Undifferentiated goods- and services-producing activities of private households for own use (section T), Activities of extraterritorial organisations and bodies (section U)

Table A5 Categorisation of Member States according to their real VA growth and employment growth over the period 2008-2011 (estimates from 2010 onwards)

	Above average growth	About average growth	Below average growth
Real value added	Austria Belgium Bulgaria Denmark Finland France Germany Luxembourg Malta Netherlands Portugal Sweden		Cyprus Czech Republic Estonia Greece Hungary Ireland Italy Latvia Lithuania Poland Romania Slovakia Slovenia Spain United Kingdom
Employment	Austria Belgium France Germany Luxembourg Malta United Kingdom	Czech Republic Finland	Bulgaria Cyprus Denmark Estonia Greece Hungary Ireland Latvia Lithuania Netherlands Poland Portugal Romania Slovakia Slovenia Spain Sweden

Table A6 Categorization of Member States according to their real VA growth and employment growth in 2009-2011 (P-P, P-N, N-P, N-N) (estimates from 2010 onwards)

	2009	2010	2011
P-P	Germany	Austria Belgium Germany Hungary Luxembourg Malta Romania Sweden	Austria Belgium Denmark Estonia France Germany Hungary Latvia Lithuania Luxembourg Malta Slovakia Sweden
P-N	Belgium Netherlands	Bulgaria Czech Republic Denmark Estonia Finland France Italy Latvia Lithuania Poland Portugal Slovakia Slovenia United Kingdom	Bulgaria Cyprus Finland Italy Netherlands Poland Romania Slovenia Spain United Kingdom
N-P	Bulgaria United Kingdom		Portugal
N-N	Austria Cyprus Czech Republic Denmark Estonia Finland France Greece Hungary Ireland Italy Latvia Lithuania Luxembourg Malta Poland Portugal Romania	Cyprus Greece Ireland Netherlands Spain	Czech Republic Greece Ireland

	Slovakia Slovenia Spain Sweden		

Table A7 The performance of four groups of EU Member States by SME employment shares in hi-tech and medium-hi-tech manufacturing and KIS, 2011

	Share of hi-tech and medium hi-tech SME in SME employment	Share of KIS SMEs in SME employment	
Groups of EU Member States			
P-P group			
Austria	4,2	16,7	
Belgium	3,5	16,4	
Denmark	5,2	16,5	
Estonia	4,4	14,5	
France	3,7	21,5	
Germany	5,4	16,4	
Hungary	3,9	18,8	
Latvia	2,3	13,5	
Lithuania	2,3	11,8	
Luxembourg	4,6	21,1	
Malta	5,7	15,6	
Slovakia	7,7	13,1	
Sweden	5,3	18,7	
Average P-P group	**4,5**	**16,5**	
P-N group			
Bulgaria	2,9	11,1	
Cyprus	1,0	10,1	
Finland	6,0	18,5	
Italy	5,1	12,4	
Netherlands	3,6	24,4	
Poland	3,6	11,6	
Romania	3,0	12,3	
Slovenia	6,3	16,3	
Spain	2,9	13,5	
United Kingdom	4,0	25,2	
Average P-N group	**3,8**	**15,6**	
N-P group			
Portugal	2,4	13,1	
Average N-P group	**2,4**	**13,1**	
N-N group			
Czech Republic	7,1	14,1	
Greece	2,1	15,4	
Ireland	3,0	19,0	
Average N-N group	**4,1**	**16,2**	

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Table A8 Number and share of enterprises by technology and knowledge categoryin EU Member States, 2011 (estimates)

		Hi-tech		High+medium-high-tech		Medium-low-tech		Low-tech		KIS		KIMS		HKIS		OKIS		LKIS	
	AllSMEs	Number	Share	Number	Share	Number	Share	Number	Share	Number	Share	Number	Share	Number	Share	Number	Share	Number	Share
EU27	**20703172**	**45871**	**0.2**	**238851**	**1.2**	**691096**	**3.3**	**1060868**	**5.1**	**4316746**	**20.9**	**3416703**	**16.5**	**749904**	**3.6**	**150139**	**0.7**	**11101425**	**53.6**
Austria	293893	620	0.2	2971	1.0	7765	2.6	14393	4.9	74227	25.3	56717	19.3	14533	4.9	2977	1.0	159884	54.4
Belgium	498229	742	0.1	3973	0.8	10984	2.2	21510	4.3	114758	23.0	89968	18.1	19417	3.9	5373	1.1	255740	51.3
Bulgaria	306436	450	0.1	2550	0.8	10097	3.3	20012	6.5	42877	14.0	33334	10.9	7849	2.6	1694	0.6	207864	67.8
Cyprus	45917	9	0.0	220	0.5	1784	3.9	3653	8.0	5278	11.5	4208	9.2	748	1.6	322	0.7	28869	62.9
CzechRepublic	930941	3876	0.4	28133	3.0	59698	6.4	73370	7.9	189278	20.3	154239	16.6	28338	3.0	6701	0.7	407168	43.7
Denmark	198089	497	0.3	2473	1.2	5912	3.0	5559	2.8	46075	23.3	33229	16.8	10795	5.4	2051	1.0	103868	52.4
Estonia	53594	138	0.3	567	1.1	2331	4.3	2842	5.3	11843	22.1	9567	17.9	1962	3.7	314	0.6	28585	53.3
Finland	212509	593	0.3	3513	1.7	8999	4.2	9489	4.5	41888	19.7	31610	14.9	8249	3.9	2029	1.0	102913	48.4
France	2377297	3734	0.2	17079	0.7	61600	2.6	128179	5.4	381117	16.0	270416	11.4	89540	3.8	21161	0.9	1275634	53.7
Germany	2086667	7985	0.4	33944	1.6	72332	3.5	85563	4.1	445077	21.3	346457	16.6	82165	3.9	16455	0.8	1190916	57.1
Greece	765837	481	0.1	5676	0.7	21292	2.8	47306	6.2	150235	19.6	135979	17.8	11706	1.5	2550	0.3	439276	57.4
Hungary	572888	1430	0.2	5750	1.0	19584	3.4	25645	4.5	167676	29.3	126972	22.2	35058	6.1	5646	1.0	277846	48.5
Ireland	154484	131	0.1	657	0.4	1393	0.9	2017	1.3	36197	23.4	27356	17.7	7817	5.1	1024	0.7	78298	50.7
Italy	3813811	6347	0.2	43287	1.1	144121	3.8	227062	6.0	783599	20.5	668206	17.5	97932	2.6	17461	0.5	1983017	52.0
Latvia	78736	158	0.2	612	0.8	1935	2.5	5483	7.0	16141	20.5	12560	16.0	2702	3.4	879	1.1	46391	58.9
Lithuania	104626	181	0.2	553	0.5	3059	2.9	9016	8.6	15749	15.1	12307	11.8	2113	2.0	1329	1.3	66232	63.3
Luxembourg	28942	8	0.0	78	0.3	309	1.1	458	1.6	8979	31.0	7059	24.4	1647	5.7	273	0.9	15663	54.1
Malta	29873	637	2.1	1138	3.8	251	0.8	1921	6.4	5391	18.0	4407	14.8	834	2.8	150	0.5	17274	57.8
Netherlands	629066	1730	0.3	8363	1.3	15135	2.4	23250	3.7	194556	30.9	155722	24.8	33943	5.4	4891	0.8	263473	41.9
Poland	1396709	2419	0.2	12737	0.9	64214	4.6	82695	5.9	241802	17.3	182450	13.1	47626	3.4	11726	0.8	776958	55.6
Portugal	749827	526	0.1	4494	0.6	21638	2.9	44045	5.9	150589	20.1	129644	17.3	16737	2.2	4208	0.6	423929	56.5
Romania	529014	1124	0.2	5028	1.0	15192	2.9	34924	6.6	87737	16.6	65857	12.4	16935	3.2	4945	0.9	313272	59.2
Slovakia	62571	230	0.4	1506	2.4	2879	4.6	3443	5.5	11063	17.7	10212	16.3	747	1.2	104	0.2	37874	60.5
Slovenia	108144	297	0.3	1755	1.6	7300	6.8	7130	6.6	27805	25.7	21105	19.5	6003	5.6	697	0.6	45905	42.4
Spain	2470979	2928	0.1	18133	0.7	66091	2.7	102505	4.1	444012	18.0	388408	15.7	38285	1.5	17319	0.7	1515555	61.3
Sweden	555160	1865	0.3	8797	1.6	23340	4.2	24858	4.5	142908	25.7	99435	17.9	38059	6.9	5414	1.0	259197	46.7
United Kingdom	1648933	6735	0.4	24864	1.5	41861	2.5	54540	3.3	479889	29.1	339279	20.6	128164	7.8	12446	0.8	779824	47.3

Source: Eurostat/National Statistics Offices of Member States/Cambridge Econometrics/Ecorys

Figure A1 Countries with above average SME employment growth (2008=100, estimations from 2010 onwards)

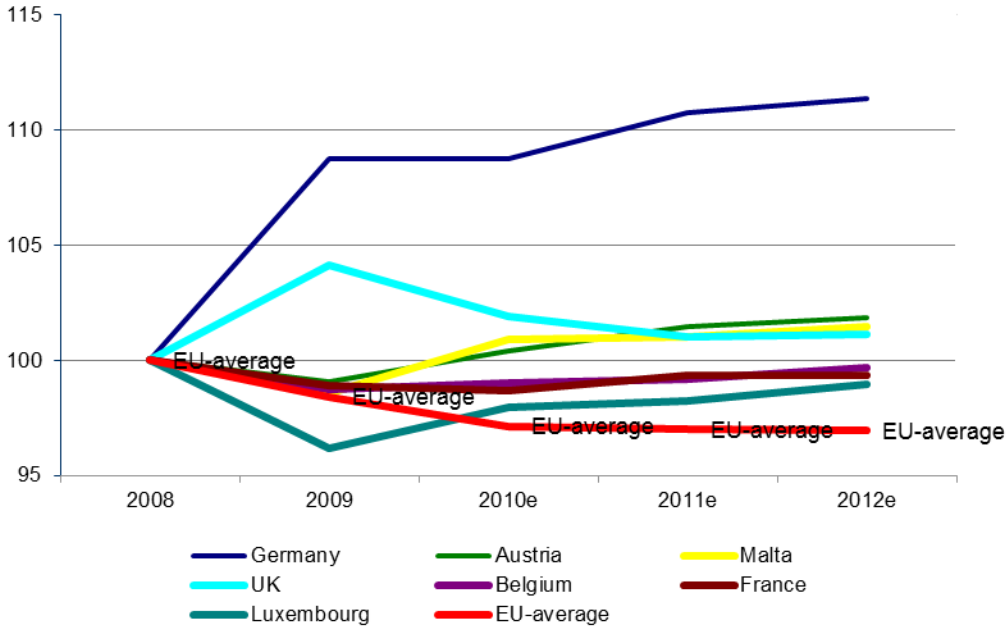


Figure A2 Countries with below average SME employment growth (1) (2008=100, estimations from 2010 onwards)

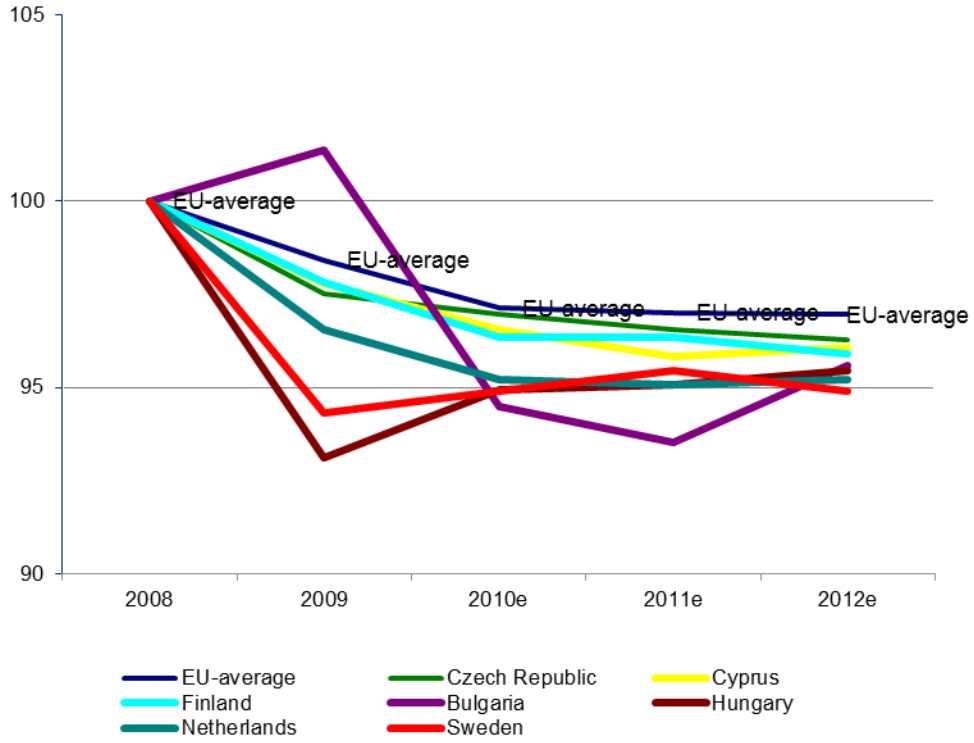

105
100
95
90
EU-average
EU-average
EU-average
EU-average
EU-average
2008
2009
2010e
2011e
2012e
EU-average
Czech Republic
Cyprus
Finland
Bulgaria
Hungary
Netherlands
Sweden

Figure A3 Countries with below average SME employment growth (2) (2008=100, estimations from 2010 onwards)

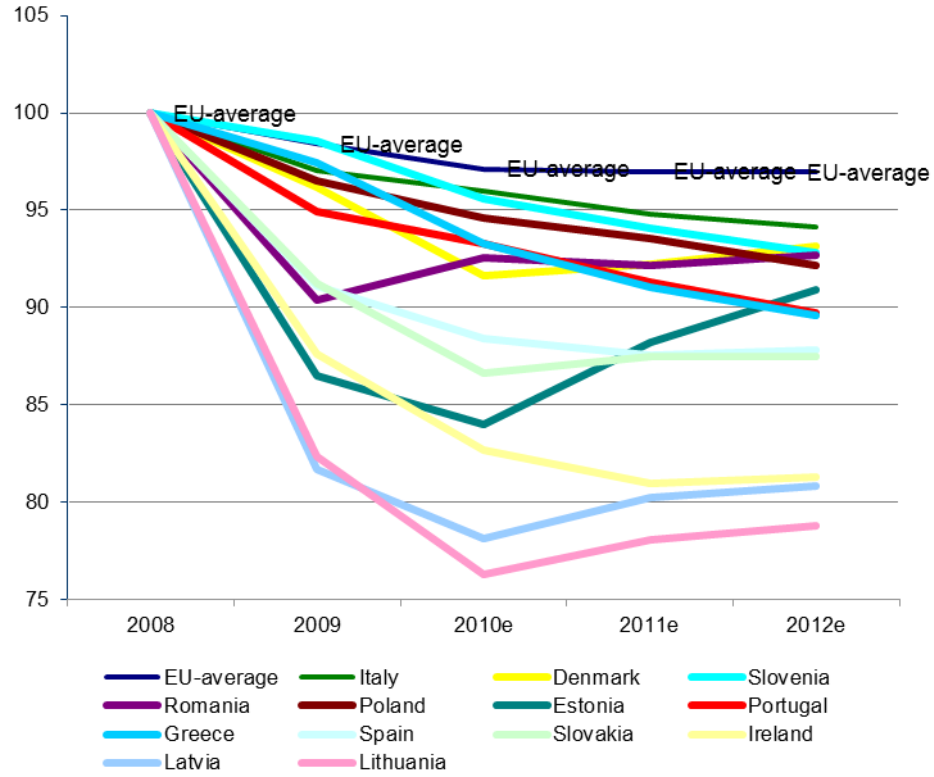


Figure A4 Countries with above average SME value added growth (2008=100, estimations from 2010)

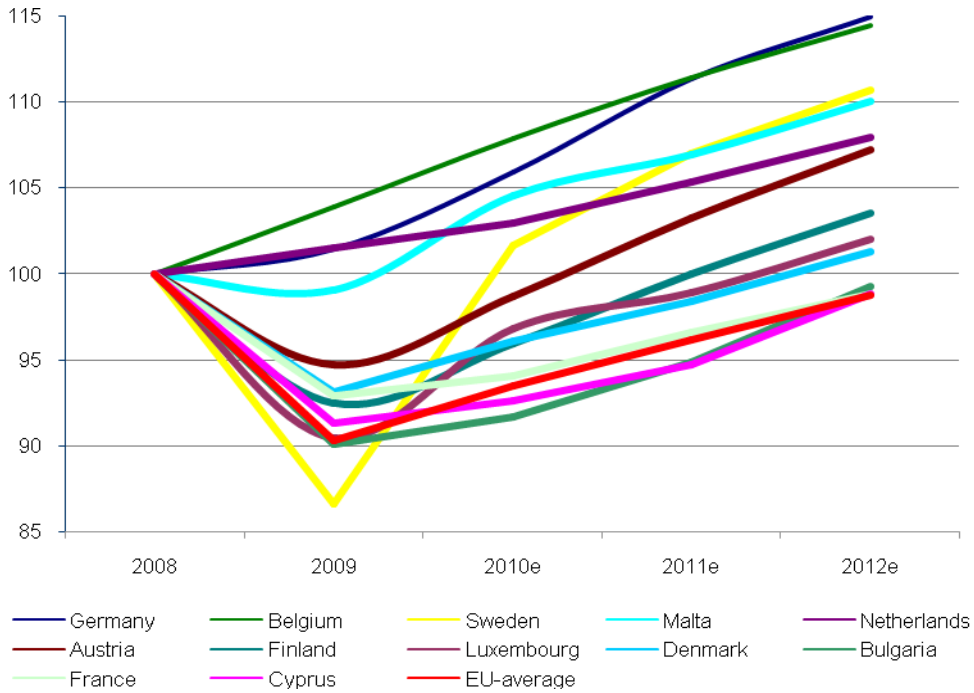
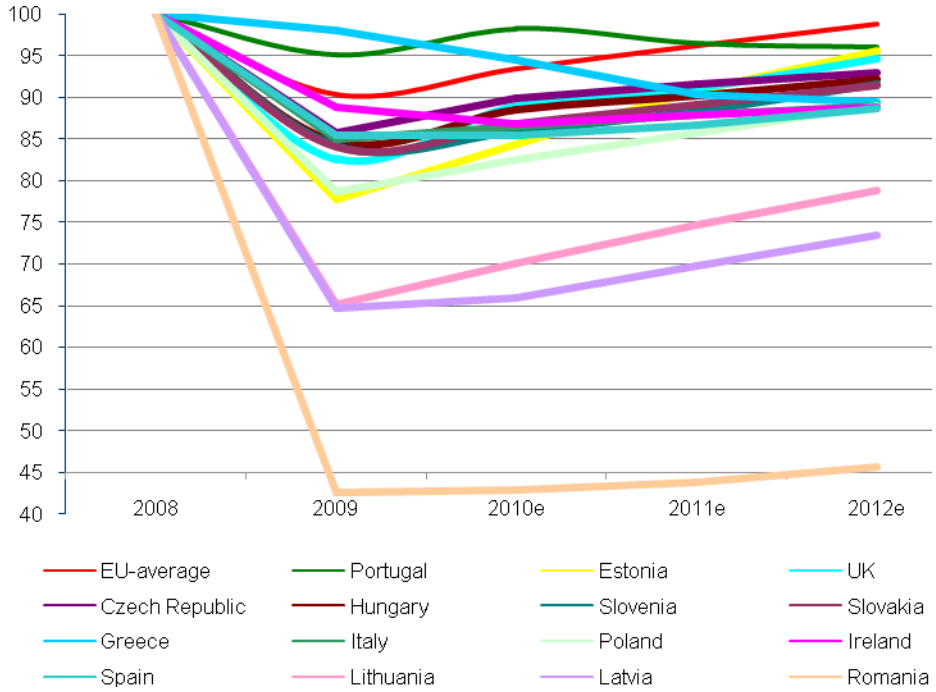


Figure A5 Countries with below average SME value added growth (2008=100, estimations from 2010)



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