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2016 COMPETITIVENESS REPORT

Towards Qualitative Growth

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Économie

Observatoire de la compétitivité

2016 COMPETITIVENESS REPORT

Towards Qualitative Growth

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2016 Competitiveness Report

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Introduction

In Luxembourg, 2015 and 2016 were characterised by relatively good results for a range of economic indicators, both in terms of economic activity and employment. STATEC's economic growth forecasts are +3.7% for 2016 and +4.2% for 2017. Increased economic activity enables unemployment to be reduced and creates a significant increase in job offers. Luxembourg is also one of the top performers in both the European Union and the euro area.

In spite of a favourable short and medium-term national economic environment, Luxembourg still has to grapple with more long-term structural challenges. Over the last few years, the country's growth potential has waned and productivity growth is relatively weak. Therefore, the structural economic policy priorities of the last few years remain on the agenda but efforts need to be further intensified to ensure that the national reform programme can deliver a sustainable recovery, free-up investment and boost productivity whilst also implementing responsible fiscal policies.

I wish to draw a few conclusions from this report.

The *Observatoire de la Compétitivité* monitors several dozen international benchmarks and rankings related to competitiveness and Luxembourg often performs reasonably well. The government needs to keep a close eye on such benchmarks. In terms of national promotion, it is wise for us to closely analyse what is said abroad about Luxembourg's competitiveness as the aforementioned rankings are often consulted by international investors when deciding where to base their economic activities. Furthermore, such benchmarks and rankings enable a certain number of weaknesses to be identified and, if necessary, remedied. Therefore, we should not merely consider Luxembourg's overall ranking, but rather analyse each individual indicator so as to more accurately pinpoint our country's strengths and weaknesses.

In 2003, the Tripartite Coordination Committee requested the establishment of a national scoreboard to more effectively account for our country's specificities. In the 2016 overall standings, Luxembourg ranks 7th of the 28 EU Member States and thus occupies a position in the chasing pack, just behing the front-runners. This rank is consistent with the average over the last five years and is in step with the other major benchmarks assessed by large international organisations. A review of the national scoreboard was recently drafted by the Economic and Social Council, which unanimously approved its opinion on the national indicator system in July 2016. The new, modernised and structured scoreboard will be based on the national indicator system and should be operational before the publication of the next Competitiveness Report, i.e. in 2017.

The *Observatoire* has also re-estimated the economic impact of the new priority sectors that the government is actively developing in order to replace sovreignity niches with skills niches, with a view to reducing dependancy and vulnerability. This analysis shows in particular how the ICT sector has grown significantly over the last few years in terms of economic activity, business creation and jobs. Such analysis contributes to the critical assessment of our multisectoral specialisation policy, which we have been pursuing for over 10 years and should, if necessary, reconsider in the future.

In addition to analysis of three main pillars, this report also includes a new series of thematic assessments, including a productivity analysis. Such analysis is of particular importance as productivity constitutes the determining factor for economic growth and wellbeing. Given the importance of this significant indicator, the government asked the Economic and Social Council to draft an opinion on productivity, its determining factors and consequences, in an international context. All of this analysis should also feed into discussions on the establishment of a Luxembourg National Productivity Council, as recently recommended by the EU Council of Ministers in a bid to bring the Economic and Monetary Union to fulfilment.

In conclusion, I hope that this report will be a springboard for discussions between the government and social partners as part of our national social dialogue and for the follow-up discussions to the 'Qualitative Wuesstem' series of events organised by the government in November 2016. These discussions, and the conclusions which will be drawn from them, will enable us to achieve sustainable economic development in the medium and long-term.

Francine Closener
Secretary of State for the Economy

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1 The *Observatoire de la compétitivité*

1.1 The *Observatoire de la compétitivité*: Role and missions

The role of the *Observatoire de la compétitivité* is to assist the Government and the social partners in providing guidelines and formulating policies that promote and/or are suited to the concept of long-term competitiveness, which is the source of growth and well-being.

As such, it is a tool for documenting, observing and analysing evolution in the country's competitive position. It is a monitoring unit, responsible for leading a constructive debate between the social partners.

The main tasks of the *Observatoire de la compétitivité* are as follows:

- Collect, analyse and compare existing data on the national, regional and international levels that relate to economic competitiveness;
- Accurately target the dissemination of selected and processed information, which is useful for strategic decision-making;
- Undertake or commission studies and research on competitiveness, its factors, etc.;
- Contribute to the works and to the analyses of international organizations dealing with competitiveness (EU Council, OECD, etc.);
- Coordinate the work and the drafting of the Luxembourg's National Reform Programme (NRP) within the framework of the European Strategy for Growth and Jobs (Lisbon strategy and Europe 2020 strategy).

1.2 From the Lisbon strategy to the Europe 2020 strategy

Within the Government, the Minister of the Economy is responsible for coordinating the implementation of the European strategy for growth and jobs on the national level. The *Observatoire de la compétitivité* was commissioned in the autumn of 2005 to prepare the National Plan for Innovation and Full employment, which was submitted to the European Commission within the framework of the Lisbon strategy. In order to optimize government coordination, to ensure consultation procedures and to guarantee assimilation of reforms nationally, an ad hoc structure was set up at the inter-ministerial level in 2005, whose structure is coordinated by the *Observatoire de la compétitivité*. This network brings together Lisbon strategy coordinators within each of the relevant ministerial departments and administrations concerned. The Government then submitted annual implementation reports to the Commission, until the Lisbon strategy expired in 2010.

At the end of 2009, the European Commission began the works to define a new strategy for the next decade: the Europe 2020 strategy[1]. Based on European Commission proposals, the June 2010 European Council decided upon the development of this new strategy, the governance of which will take place at three integrated levels:

- A level of macroeconomic monitoring to focus on macroeconomic and structural policies;
- A thematic coordination level, covering the five major European objectives and their national implementation;
- A simultaneous monitoring level, taking place within the framework of the Stability and Growth Pact (SGP).

In November 2010 each Member State had to submit to the European Commission a first draft of the National Reform Programme (NRP), developed in the framework of the Europe 2020 strategy. In November 2010 Luxembourg submitted its interim NRP draft to the Commission, and the Government finally decided on the finalized NRP for Luxembourg in April 2011 which was then submitted to the European Commission, along with the SGP. The sixth update of Luxembourg's finalized NRP was sent to the European Commission in April 2016, along with the SGP 2016-2020[2]. Based on the NRP and the SGP, the Council issued in July 2016 country-specific recommendations for Luxembourg, for consideration during the national discussions to be conducted about the 2017 draft budget.

[1] For additional details: http://ec.europa.eu/eu2020/index_fr.htm

[2] For additional details: http://www.mf.public.lu

1.3 Agency for standardization and the knowledge economy (ANEC)

Through the creation of the economic interest group ANEC in 2012, the government wanted to promote and support advocacy, awareness, training and monitoring in the field of standardization in order to support the competitiveness of companies in Luxembourg while developing a centre of excellence in research, development and innovation.

Research projects from 'Knowledge Economy Department' are followed among others by the *Observatoire de la compétitivité*, in collaboration with STATEC. For 2016, the work program plans to deepen the activities undertaken to fulfil the foremost mission of ANEC, which consists in valuing STATEC's available statistical data through applied research. The work to be performed by ANEC in 2016 remains structured around applied research in the following areas: productivity, determinants of productivity (human capital, innovation, entrepreneurship, ICT), quality of life and solidarity economy[3]. There were several highlights in 2016, the first of which is the extension of productivity research to the financial sector. Research into productivity has already pinpointed significant indicators as to the development, efficiency and allocation of resources in the manufacturing and services sector in Luxembourg. These findings will be further developed and disseminated. Secondly, the *PIBien-être* ('GDProsperity') project seeks to provide a basis to monitor quality of life in Luxembourg. Thirdly, the GEM entrepreneurship project will provide information on entrepreneurs and entrepreneurial spirit in Luxembourg along with significant data for methodological research. Fourthly, a new project is looking at how globalisation is affecting the performance of the local labour market whilst also continuing research into the links between innovation and competition as well as between innovation and employment.

[3] For additional details: http://www.statistiques.public.lu/en/actors/statec/organisation/red/index.html

1.4 Events and publications in 2015-2016

The *Observatoire de la compétitivité* aims to inform both the economic players and the general public on competitiveness issues. To achieve this, multiple communication channels are used, such as organising public events (seminars, conferences, etc.) and publishing analytical documents on competitiveness. All information concerning events organized by the *Observatoire de la compétitivité* and its publications can be downloaded.

1.4.1 Seminars and conferences

The communication strategy of the *Observatoire de la compétitivité* is consistent with its 'competitiveness monitoring' mission and is in particular useful for initiating public debate on the major axes that define the competitiveness of the Luxembourg economy and the Europe 2020 strategy. The organization of public events is a part of this mission.

Economy Day 2016[4]

In February, the Ministry of the Economy, the Chamber of Commerce and Fedil joined forces with PwC to organise the 2016 Economy Day focussing on *'Investing in talents: How to attract, grow and retain them?'*. National and international experts discussed Luxembourg's potential to become a world-leader in talent development. Thematic workshops were organised to ensure more in-depth discussion of the three pillars of Luxembourg's investment in talent: attraction, development and retaining talent in the national economy.

Conference: 'The new competitiveness indicators'[5]

On 3 May 2016, the Ministry of the Economy's *Observatoire de la compétitivité* organised a conference on new competitiveness indicators. Professor Stefan Collignon was the keynote speaker and gave a presentation on his work on developing new competitiveness indicators based on unit labour costs. With a view to encouraging a debate, the *Observatoire de la compétitivité* asked Professor Collignon to calculate such indicators for Luxembourg. The results are presented in chapter 9 of this report.

[4] For additional details: http://www.jecolux.lu//events/economyday/index.html

[5] For additional details: http://www.gouvernement.lu/5904530/2016-05-03-conference-collignon?context=971540

Conference: 'Do small States fare better in the European Union?'[6]

On 30 June 2016, the Ministry of the Economy's *Observatoire de la compétitivité* partnered with STATEC to organise a conference entitled *'Do small States fare better in the European Union?'*. The conference saw Professor Lino Briguglio launch his new book entitled *'Small States and the European Union'*, published by Routledge. In his presentation, Lino Briguglio, an economics professor at the University of Malta, discussed and presented the latest findings of his intensive research into Europe's small economies. A State is deemed small if it has a population of under 3 million. According to this definition, 7 of the European Union Member States are small States: Cyprus, Estonia, Latvia, Lithuania, Luxembourg, Malta and Slovenia. The book features a chapter on the Luxembourg economy but is not limited merely to EU States as Macedonia and Montenegro, both candidates for EU accession, are analysed along with Iceland. Professor Briguglio stressed that small States face specific economic constraints and drawbacks such as their small domestic markets, limited natural resources and the need to diversify their economies. In spite of them being vulnerable due to their exposure to external economic conditions that are beyond their control, some of them have performed remarkably well in terms of economic growth. Appropriate policies can enable them to mitigate their economic vulnerability.

Conference: 'Measuring global poverty: past, present and future'[7]

On 8 July 2016, the Ministry of the Economy's *Observatoire de la compétitivité*, in co-operation with the LIS Cross-National Data Center, organised a conference entitled *'Measuring Global Poverty: Past, Present and Future'*. Professor Francisco Ferreira was the keynote speaker.

[6] For additional details: http://www.gouvernement.lu/6024915/2016-06-30-conferencebriguglio?context=971540

[7] PFor additional details: http://www.gouvernement.lu/6144383/2016-07-08-conference-LIS

1.4.2 *Perspectives de Politique économique*

Through the publication *'Perspectives de Politique économique'*, the *Observatoire de la compétitivité* disseminates the findings of studies and/or commissioned research from academics or consultants, as well as papers written by members of the *Observatoire de la compétitivité*. This publication is also intended to publicize the reports of lectures, seminars or conferences that the Ministry of the Economy organizes on issues of economic policy. Finally, its goal is also to clarify the possible policy options, to assess the effectiveness of certain measures, and so to foster the public debate on economic policy.

1.4.3 The *Observatoire de la compétitivité* website

The *Observatoire de la compétitivité* has a website that gathers all the information and publications regarding the competitiveness of the national economy: http://www.odc.public.lu. In particular this site provides information on Luxembourg's competitiveness in foreign publications. It acts as a communication platform for all those involved in the implementation of the Europe 2020 strategy in Luxembourg and enables to make the Competitiveness Scoreboard data available. The website announces upcoming events and publications. Documents relating to conferences and seminars, as well as the publications, can be downloaded for free from this site.

1.5 An overview of the 2016 Competitiveness Report

Chapter 2 presents the performance of Luxembourg according to major international composite indicators (IMD, WEF, etc.) and also looks at various rankings less known by the general public.

Chapter 3 analyses, on a yearly basis, the evolution of the competitiveness of Luxembourg in comparison with EU Member States according to the national Competitiveness Scoreboard indicators established in 2004. The calculation of a composite indicator of competitiveness based on this national scoreboard allows us to understand the relative competitive position of Luxembourg over the years.

Chapter 4 aims at providing an overview of the European Semester, presenting the priorities and objectives of the structural thematic coordination of the Europe 2020 strategy and make an intermediate appraisal of Luxembourg's position for the indicators in the EU macroeconomic surveillance scoreboard, before the publication of the new edition by the end of 2016 by the European Commission.

Chapter 5 aims to provide an overview and monitoring of the five priority economic sectors in Luxembourg, whose development is being promoted actively by the Ministry of the Economy: ICT, logistics, health sciences and technologies, eco-technologies and space technologies.

Chapter 6 provides an overview of discussions on the establishment of National Productivity Boards in euro area Member States and also features a summary of the Bruegel conference which took place in Luxembourg in November 2015.

Chapter 7 features a presentation of the outcomes of the studies conducted by ANEC-STATEC researchers as part of the research agreement signed by ANEC, STATEC and the *Observatoire de la compétitivité* on productivity.

Chapter 8 covers the role of small economies with a focus on competitiveness. This chapter is a follow-up to the launch of Professor Briguglio's new book on small countries, which was organised by the *Observatoire de la compétitivité* in June 2016.

Chapter 9 presents the sectoral results for Luxembourg as calculated by Professor Collignon as part of his study on new competitiveness indicators.

2 Benchmarks and comparative competitiveness analysis

2.1 Introduction

The debate on 'territorial competitiveness' is re-launched when benchmarks and international rankings are published. Composite indices enable comparisons as they draw together multiple sets of information under a single numerical value[1], thus covering a variety of characteristics to provide an approximate summary of complex issues such as competitiveness, attractiveness, innovation or quality of life (albeit one which is by no means devoid of methodological limitations).

This chapter seeks on one hand to provide an overview of a raft of international benchmarks which have been published since the last edition of this Report in Autumn 2015, and on the other hand to analyse more specifically Luxembourg's position and to compare it to those of other EU Member States[2].

[1] For more information on composite indicators, see the European Commission's Joint Research Centre website: http://composite-indicators.jrc.ec.europa.eu/

[2] A list of more benchmarks may also be found on the website of the *Observatoire de la compétitivité*: http://www.odc.public.lu/indicateurs/benchmarks_internationaux/index.html

2.2 Luxembourg's rankings

In the debate about the determinant factors of regional competitiveness, the best-known benchmarks and rankings published annually are those of the World Economic Forum (WEF), the International Institute for Management Development (IMD), the Heritage Foundation and the European Commission. In addition to these four classifications, there are a multitude of other reports, some of which we will look at in this chapter.

2.2.1 WEF, IMD, Heritage Foundation and European Commission

a. Growth Competitiveness Index[3]

Early September 2016 the World Economic Forum (WEF) published a new edition of its comparative study regarding the competitiveness of countries around the world. The objective of this study, called 'Global Competitiveness Report', is to assess the world economies' potential to achieve sustainable growth in both the medium and long term. In the context of this study competitiveness is defined as 'the set of institutions, policies and factors that determine the level of productivity of a country.' This study takes into account that all countries are not at the same level of economic development. The relative importance of the various factors of competitiveness is thus dependent on initial conditions.

The competitiveness level of 138 countries around the world is measured through 114 indicators spread among three pillars:

- The basic requirements of competitiveness (institutions, infrastructure, macroeconomic environment, health and primary education);
- Efficiency enhancers (higher education and training, goods market efficiency, labour market efficiency, financial market development, technological readiness, market size);
- Innovation and sophistication factors (business sophistication and innovation).

Based on these indicators the authors calculate a composite index called 'Growth Competitiveness Index' (GCI) is calculated in order to rank countries on a scale from 1 (the least competitive) to 7 (the most competitive). This GCI composite index is constructed through 114 indicators, based on using a combination of statistical data and survey results, including the survey of business leaders, which is carried out annually by the WEF in collaboration with its network of partner institutes. This composite index is constructed by a combination of statistical data and an annual qualitative survey of business leaders. This survey is carried out in collaboration with a network of partner institutes, including Luxembourg Chamber of Commerce.

[3] For more information: https://www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1/#.VNx7MS73jpI#.VNx7MS73jpI#.VNx7MS73jpI#.VNx7MS73jpI

In 2016, Switzerland (5.81/7) tops the world rankings ahead of Singapore (5.72) and the United States (5.70). Luxembourg (5.20) places 20th with the Netherlands (5.57) in 4th place, Germany (5.57) 5th, Belgium (5.25) 17th and France (5.20) ranking 21st. The EU standings are headed by the Netherlands with Luxembourg in 9th place.

Table 1
Luxembourg's position according to the GCI (2016-2017)

	Economy	Score	Prev.	Trend
1	Switzerland	5.81	1	
2	Singapore	5.72	2	
3	United States	5.70	3	
4	Netherlands	5.57	5	
5	Germany	5.57	4	
6	Sweden	5.53	9	
7	United Kingdom	5.49	10	
8	Japan	5.48	6	
9	Hong Kong SAR	5.48	7	
10	Finland	5.44	8	
11	Norway	5.44	11	
12	Denmark	5.35	12	
13	New Zealand	5.31	16	
14	Chinese Taipei	5.28	15	
15	Canada	5.27	13	
16	United Arab Emirates	5.26	17	
17	Belgium	5.25	19	
18	Qatar	5.23	14	
19	Austria	5.22	23	
20	**Luxembourg**	**5.20**	**20**	

Source: WEF

As regards the three main pillars, Luxembourg ranks as follows:

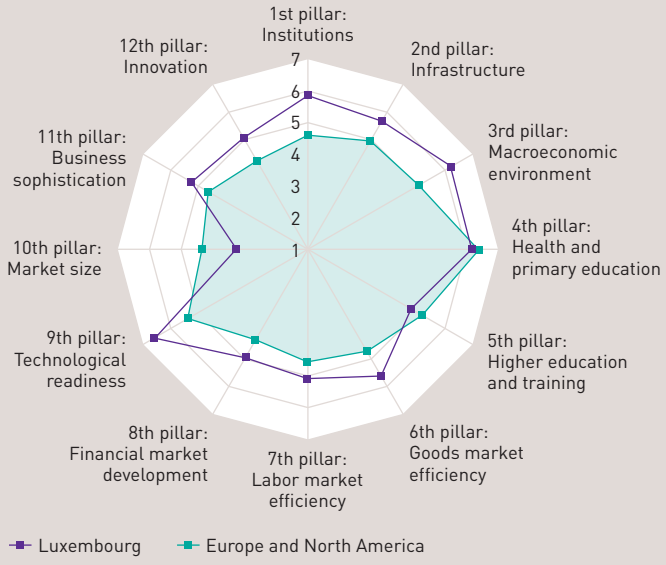
- Luxembourg (5.9) places 9th for the basic requirements of competitiveness, ranking 8th for institutions, 16th for infrastructure, 7th for macroeconomic environment and 43rd for health and primary education;

- Luxembourg (5.0) ranks 23rd for efficiency enhancers, placing 47th for higher education and training, 4th for goods market efficiency, 16th for labour market efficiency, 14th for financial market development, 2nd for technological readiness and 93rd for market size;

- Luxembourg (5.1) occupies 16th position for innovation and sophistication factors, placing 15th for business sophistication and 16th for innovation.

Chart 1
Luxembourg's performance within the different pillars

	Rank (/138)	Score (1-7)	Trend	Distance from best	Edition	2012-13	2013-14	2014-15	2015-16	2016-17
Global Competitiveness Index	20	5.2			Rank	22/144	22/148	19/144	20/140	20/138
Sub-index A: Basic requirements	**9**	**5.9**			Score	5.1	5.1	5.2	5.2	5.2
1st pillar: Institutions	8	5.8								
2nd pillar: Infrastructure	16	5.7								
3rd pillar: Macroeconomic environment	7	6.2								
4th pillar: Health and primary education	43	6.2								
Sub-index B: Efficiency enhancers	**23**	**5.0**								
5th pillar: Higher education and training	47	4.8								
6th pillar: Goods market efficiency	4	5.5								
7th pillar: Labor market efficiency	16	5.0								
8th pillar: Financial market development	14	5.0								
9th pillar: Technological readiness	2	6.4								
10th pillar: Market size	93	3.2								
Sub-index C: Innovation and sophistication factors	**16**	**5.1**								
11th pillar: Business sophistication	15	5.2								
12th pillar: Innovation	16	4.9								



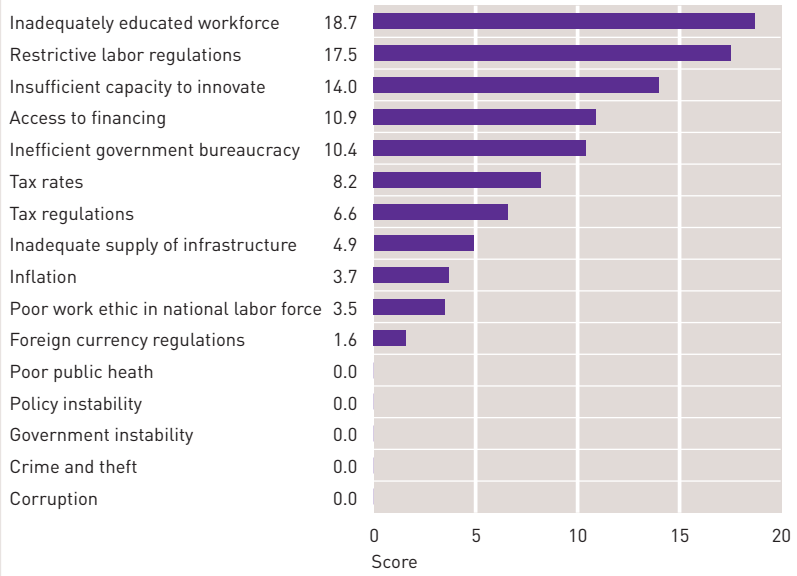
Source: WEF

Frame 1

Results of the survey carried out in Luxembourg (WEF poll)

The WEF annual survey, which is carried out among business leaders, makes it also possible to identify main factors hindering national business environment. The survey shows the five main problems for doing business in Luxembourg result from an inadequately educated workforce, a too restrictive labour regulation, problems of access to financing and inefficient government bureaucracy.

Most problematic factors for doing business



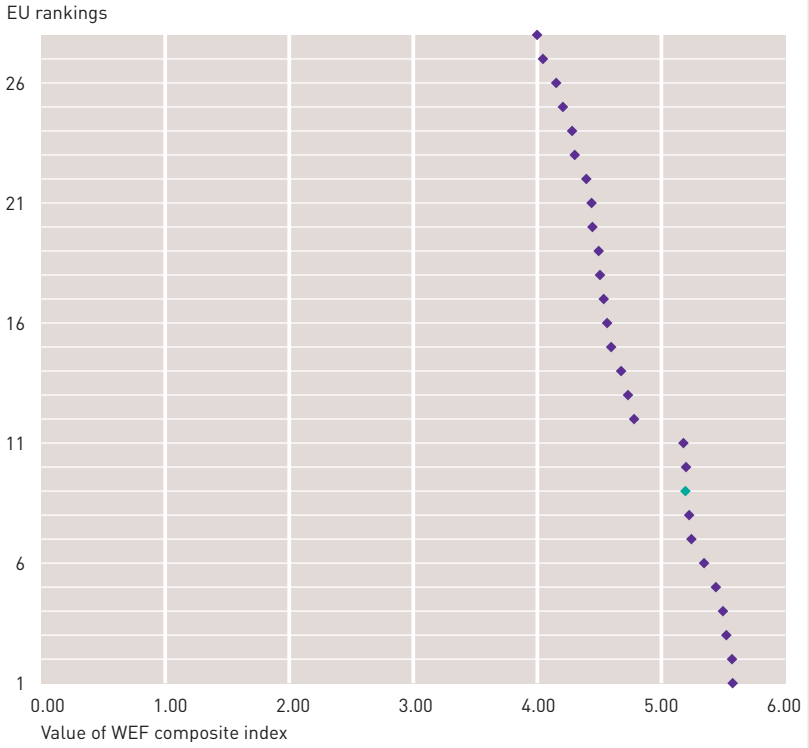
Note: Respondents are invited to select the 5 most problematic factors for doing business in their country from a list of 15, and to rank them from 1 (most problematic) to 5. Figures in this chart show the resulting answers weighted by their ranking.

Source: World Economic Forum, Executive Opinion Survey 2016

Frame 2

Composite indices and EU rankings (2016)

The chart below shows the composite index values and positions in the EU rankings in the 2016 WEF Report. There are sometimes only slight differences between the indicator values across Member States, meaning that a slight variation in a composite index can lead to a change in position in the rankings. For example, Luxembourg ranks 9th in the EU with a score of 5.20. We can see that a number of countries are very close in terms of performance, from Belgium (7th; 5.25) to Ireland (11th; 5.18).



Source: WEF

Frame 3

IDEA Foundation analysis – Simulation of a greater consideration of Luxembourg's specificities in the WEF 2015-2016 rankings[4]

In early September 2016, the IDEA Foundation published its analysis of Luxembourg's position in the 2015 WEF competitiveness rankings. Interestingly, a section of this analysis focuses on what would happen to Luxembourg's position in the rankings if some statistical bias were to be removed from Luxembourg's data, such as the omission from the data of Luxembourg students in tertiary education programmes abroad or the insufficient consideration of the size of Luxembourg's market, which is limited to Luxembourg itself and does not include the Greater Region or the EU internal market.

The analysis shows the WEF calculation is heavily dependent on how the indicators are measured. IDEA's calculations have in no way changed the methodology and the only difference between the re-calculation and the 2015-2016 WEF rankings is the neutralisation, via alignment with the four neighbouring countries, of the bias which affects just three indicators for Luxembourg out of a total of 112. The re-calculation sees Luxembourg's composite indicator score rise from 5.20 to 5.43. Given that the differences between the countries featuring in the top 20 were rather minimal, an increase of 0.23 points would see Luxembourg climb 9 places in the final ranking. The correction of the higher education bias would not have much of an effect on the final standings as Luxembourg's composite indicator score would be 5.24 as supposed to 5.20, resulting in a gain of only two places in the standings, i.e. from 20th to 18th. The most significant indicator is the size of the domestic market, which restricts the size of the Luxembourg economy and ignores the country's strong international openness. A reduction in the methodological gap would see Luxembourg rank 12th, thus gaining 8 places with a composite indicator score of 5.36).

b. Global Competitiveness Index[5]

The Swiss Institute IMD published in 2016 the latest version of its annual report on competitiveness, the 'World Competitiveness Yearbook' (WCY). This report is published yearly since 1989. In this new edition, 61 countries are analysed through more than 300 criteria. These criteria are both quantitative and qualitative (survey of business leaders), split into four main subcategories: economic performance, government efficiency, business environment and infrastructure.

The 2016 world rankings are led by Hong Kong (100/100) ahead of Switzerland (98.01) and the United States (97.88). Luxembourg (90.016) ranks 11th with a competitiveness composite index score very close to that of 9th placed Norway (90.054) and 10th placed Canada (90.048). The Netherlands (91.32) places 8th, Germany (88.56) 12th, Belgium (80.68) 22nd and France (73.46) 32nd. Therefore, Luxembourg has dropped 5 places in the world rankings (from 6th in 2015 to 11th in 2016) in spite of a slight increase in its level of competitiveness (composite indicator total) in comparison with last year's figure (90.01 in 2016 versus 89.40 in 2015).

[4] IDEA, WEF: POUR UN LUXEMBOURG CLASSÉ « AU TOP », No. 14, Luxembourg, September 2016 Source: http://www.fondation-idea.lu/2016/09/07/idee-du-mois-n14-wef-pour-un-luxembourg-classe-au-top/

[5] For more information: http://www.imd.org/wcc/

The European standings feature Switzerland in 1st place with Luxembourg placing 7th. Amongst the European Union Member States, Sweden (92.35) leads the way followed by Denmark (91.75) and Ireland (91.54) with Luxembourg ranked 5th.

Table 2
IMD global ranking (2016)

	0 10 20 30 40 50 60 70 80 90
100.00	(2) China Hong Kong 1
98.018	(4) Switzerland 2
97.881	(1) USA 3
97.649	(3) Singapore 4
92.353	(9) Sweden 5
91.756	(8) Denmark 6
91.540	(16) Ireland 7
91.321	(15) Netherlands 8
90.054	(7) Norway 9
90.048	(5) Canada 10
90.016	**(6) Luxembourg 11**
88.569	(10) Germany 12
86.716	(13) Qatar 13
86.374	(11) Taiwan 14
86.065	(12) UAE 15
85.606	(17) New Zealand 16
84.270	(18) Australia 17
83.338	(19) United Kingdom 18
83.048	(14) Malaysia 19
82.037	(20) Finland 20
80.827	(21) Israel 21
80.688	(23) Belgium 22
80.580	(24) Iceland 23
80.159	(26) Austria 24
79.351	(22) China Mainland 25
78.716	(27) Japan 26
76.145	(29) Czech Republic 27
74.681	(30) Thailand 28
74.195	(25) Korea Rep. 29
74.039	(28) Lithuania 30

(2015 rankings are in parentheses)
Source: IMD

As regards the four sub-categories which make up the 2016 GCI, Luxembourg ranks as follows:

- For macroeconomic performance, Luxembourg is in 7th place in the world rankings, scoring particularly highly on international trade (3rd), international investment (7th) and the domestic economy (5th). However, it performed less well on employment (21st) and prices (29th);

- As regards government efficiency, Luxembourg ranks 12th overall, placing 7th for public finance, 38th for fiscal policy, 7th for institutional framework, 16th for business legislation and 12th for societal framework;

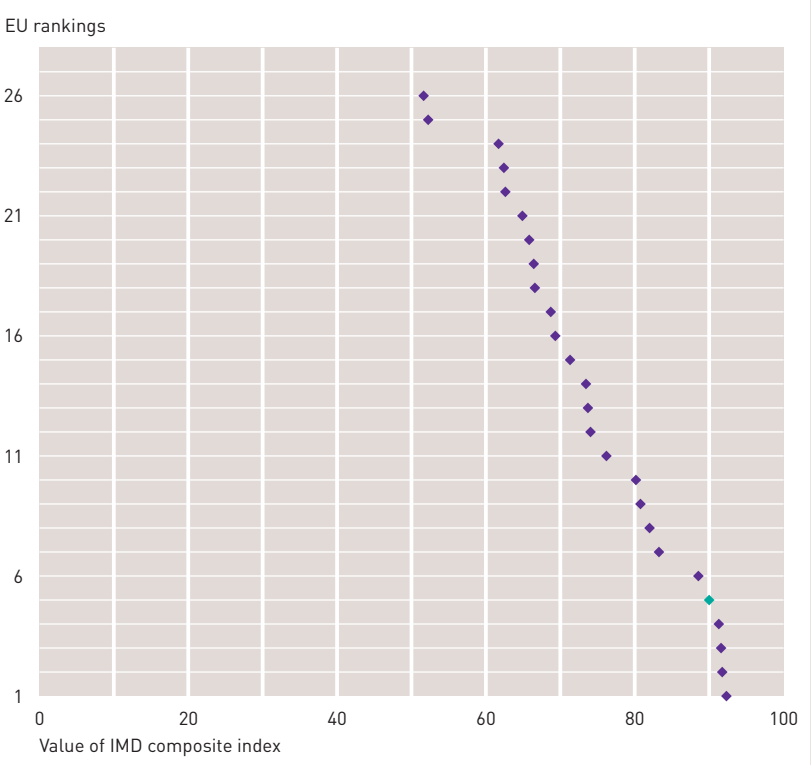
- Luxembourg ranks 9th for business efficiency, performing particularly well in finance (4th), productivity (2nd) and management practices (11th) but less well in attitudes and values (22nd) and the labour market (23rd);

- In the infrastructure sub-category, Luxembourg occupies 22nd place overall. This was Luxembourg's poorest performance across the sub-categories with the country placing 23rd for basic infrastructure, 24th for technological infrastructure, 24th for scientific infrastructure, 20th for health and environment and 20th for education.

Frame 4

Composite indices and EU rankings (2016)

The chart below shows composite index values and positions in the EU rankings in the 2016 IMD Report. Analysis of the available data for EU countries reveals that the differences in indicator levels between Member States are sometimes very small, meaning that a slight variation in composite index levels can lead to a significant change in the rankings.



c. Index of Economic Freedom[6]

At the beginning of 2016, the American Heritage Foundation, in collaboration with The Wall Street Journal, published the 22nd edition of the 'Index of Economic Freedom'. Economic freedom is defined as the absence of any government coercion or constraint on production, supply or consumption of goods and services beyond the extent necessary to protect and maintain the liberty of citizens. Economic freedom is measured through composite indicators spread among four categories ('rule of law', 'government size', 'regulatory efficiency' and 'open markets') in 186 countries across the world, divided into subcategories. Economic freedom is supposed to favour productivity and economic growth by supporting entrepreneurship and creation of value added. The more open an economy is (the closer its ranking is to 100), the fewer barriers there are to free trade and the better a country ranks.

Hong Kong (88.6/100) leads the 2016 world rankings ahead of Singapore (87.8) and New Zealand (81.6) with Luxembourg (73.9) placing 19th. Luxembourg is considered 'mostly free'. The Netherlands (74.6) placed 16th, Germany (74.4) 17th, Belgium (68.4) 44th and France (62.3) 75th. In Europe, Luxembourg occupies 9th place with the standings being topped by Switzerland (81.0; 4th in the world rankings).

Table 3
Excerpt of the rankings (2016)

World Rank	Country	Overall Score	Change from 2014	Property Rights	Freedom from Corruption	Fiscal Freedom	Government Spending	Business Freedom	Labor Freedom	Monetary Freedom	Trade Freedom	Investment Freedom	Financial Freedom
1	Hong Kong	88.6	-1.0	90.0	74.0	92.6	90.7	97.4	89.0	81.8	90.0	90	90
2	Singapore	87.8	-1.6	90.0	84.0	91.2	90.1	95.0	90.7	81.8	90.0	85	80
3	New Zealand	81.6	-0.5	95.0	91.0	71.0	46.0	91.4	85.9	88.1	87.2	80	80
4	Switzerland	81.0	0.5	90.0	86.0	70.9	66.3	82.2	72.1	87.8	90.0	85	80
5	Australia	80.3	-1.1	90.0	80.0	63.2	62.0	89.4	77.2	85.2	86.4	80	90
6	Canada	78.0	-1.1	90.0	81.0	80.0	50.4	81.8	72.6	76.9	87.0	80	80
7	Chile	77.7	-0.8	85.0	73.0	74.8	83.1	72.1	64.3	87.9	86.4	85	70
8	Ireland	77.3	0.7	90.0	74.0	73.6	50.3	79.6	72.1	85.5	88.0	90	70
9	Estonia	77.2	0.4	90.0	69.0	81.9	54.9	79.0	57.2	82.2	88.0	90	80
10	United Kingdom	76.4	0.6	90.0	78.0	64.9	39.0	86.0	71.8	76.4	88.0	90	80
11	United States	75.4	-0.8	80.0	74.0	65.6	54.7	84.7	91.4	77.0	87.0	70	70
12	Denmark	75.3	-1.0	95.0	92.0	39.5	2.3	95.4	86.0	84.4	88.0	90	80
13	Lithuania	75.2	0.5	65.0	58.0	92.9	63.8	80.0	60.0	84.6	88.0	80	80
14	Taiwan	74.7	-0.4	70.0	61.0	76.1	88.7	93.2	53.8	83.2	86.4	75	60
15	Mauritius	74.7	-1.7	60.0	54.0	92.0	81.5	77.5	65.0	78.7	88.6	80	70
16	Netherlands	74.6	0.9	90.0	83.0	52.7	34.4	80.0	64.0	83.4	88.0	90	80
17	Germany	74.4	0.6	90.0	79.0	61.5	41.3	90.0	50.6	83.3	88.0	90	70
18	Bahrain	74.3	0.9	60.0	49.0	99.9	75.4	71.9	79.1	74.6	82.6	70	80
19	**Luxembourg**	**73.9**	**0.7**	**90.0**	**82.0**	**61.1**	**43.0**	**73.7**	**42.6**	**83.2**	**88.0**	**95**	**80**
20	Iceland	73.3	1.3	90.0	79.0	73.3	42.1	90.1	61.6	79.5	87.8	70	60

Source: The Heritage Foundation

[6] For more information: http://www.heritage.org/index/

Luxembourg ranks as follows in the different sub-categories:

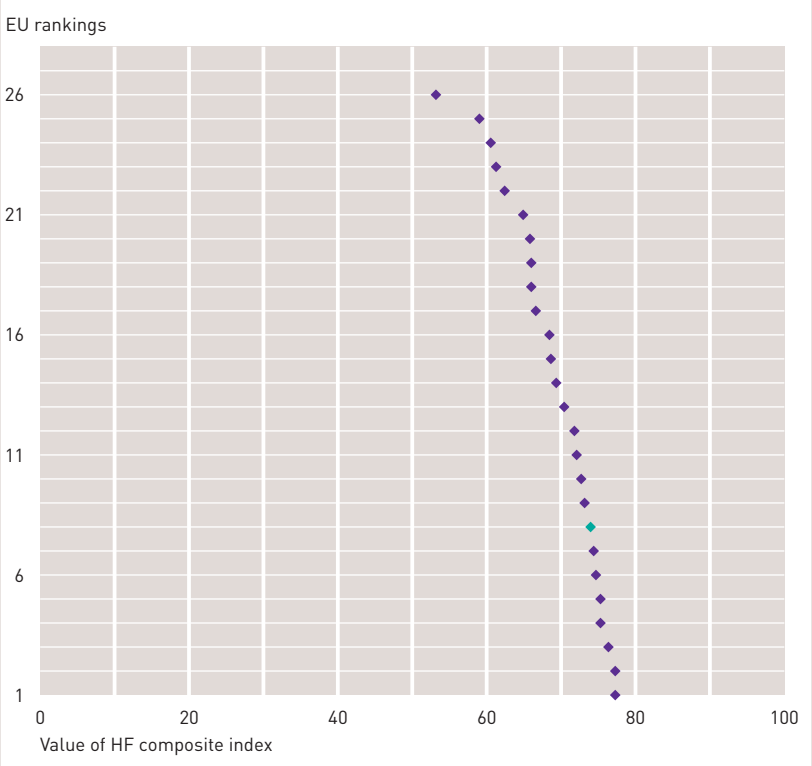
- Excellent performance in property rights (90/100; 3rd in the world rankings) and freedom from corruption (82.0; 9th);
- Mixed performance as regards fiscal freedom (61.1; 164th) and government spending (43.0; 148th);
- Good performance in business (73.7; 49th) and monetary freedom (83.2; 33rd) but mixed performance in terms of the labour market (42.6; 165th);
- Very good performance in trade (88.0; 10th), investment (95.0; 1st) and finance (80.0; 3rd).

In conclusion, the Heritage Foundation makes the following observation with regard to Luxembourg: *'Sustaining a competitive business environment, Luxembourg continues to be economically resilient with well-functioning institutions. The legal framework remains among the world's best, providing effective protection of property rights. The rule of law is well maintained, and a strong tradition of minimum tolerance for corruption is firmly in place. Luxembourg has demonstrated a commitment to restoring the soundness of public finance and the credibility of its fiscal policies. Deficit-cutting efforts involving reductions in government spending have encouraged economic recovery. The efficiency of the regulatory system, though still above average, has declined relative to the most competitive economies.'*

Frame 5

Composite indices and EU rankings (2016)

The chart below shows composite index values and positions in the EU rankings for 2016. Analysis of EU countries reveals that the differences in indicator levels between Member States are sometimes very small, meaning that a slight variation in composite index levels can lead to a significant change in the rankings.



d. European innovation scoreboard[7]

In July 2016, the European Commission published the latest edition of its European Innovation Scoreboard (EIS), the 15th edition since its inception in 2001. The innovation performance of States is measured on the basis of an average of 25 indicators. The scoreboard enables the relative innovation performance of the different countries to be measured and compared and provides an analysis of the strengths and weaknesses of national research and innovation systems.

[7] For more information: http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards/index_en.htm

The European Innovation Scoreboard is drawn up on the basis of three indicator types and eight innovation criteria:

- 'Enablers' includes all the main innovation drivers outside of companies and cover three innovation criteria: human resources, open, excellent and attractive research systems, and finance and support;
- 'Firm activities' looks at the innovation efforts made by companies and are broken down into three innovation criteria: firm investments, linkages and entrepreneurship, and intellectual assets;
- 'Outputs' covers companies' innovation activities in two innovation areas: innovators and economic effects.

On the basis of the average innovation results, calculated using a composite indicator entitled 'Summary Innovation Index' (SII) and ranging from 0 (poor) to 1 (best performance), countries are placed into four different groups:

- 'Innovation Leaders', whose results in terms of innovation are well above the EU average (score at least 20% above the EU average);
- 'Innovation Followers', whose results are above or close to the EU average (score of between 90% et 120% of EU average);
- 'Moderate Innovators', whose results are below the EU average (score of between 50% and 90% of the EU average);
- 'Modest Innovators', whose results are well below the EU average (score of <50% of the EU average).

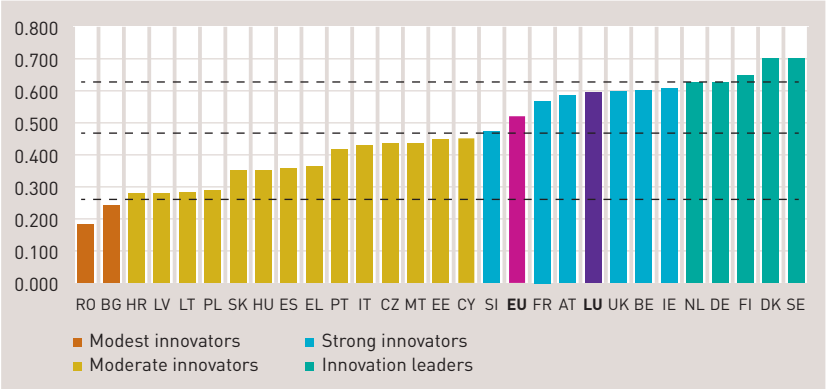
In 2016, the EU standings were led by Sweden (0.704) ahead of Denmark (0.700) and Finland (0.649). Germany (0.632), in 4th place, and the Netherlands (0.631), 5th, also feature in the 'innovation leaders' category. Luxembourg (9th; 0.598), Belgium (7th; 0.602) and France (11th; 0.568) are all classed as 'innovation followers' with quite similar scores.

As regards the eight innovation criteria, Luxembourg fared as follows:

- Enablers: human resources (0.431), open, excellent research systems (0.771), finance and support (0.372);
- Firm activities: firm investments (0.136), linkages and entrepreneurship (0.544), intellectual assets (0.720);
- Outputs: innovators (0.704), economic effects (0.742).

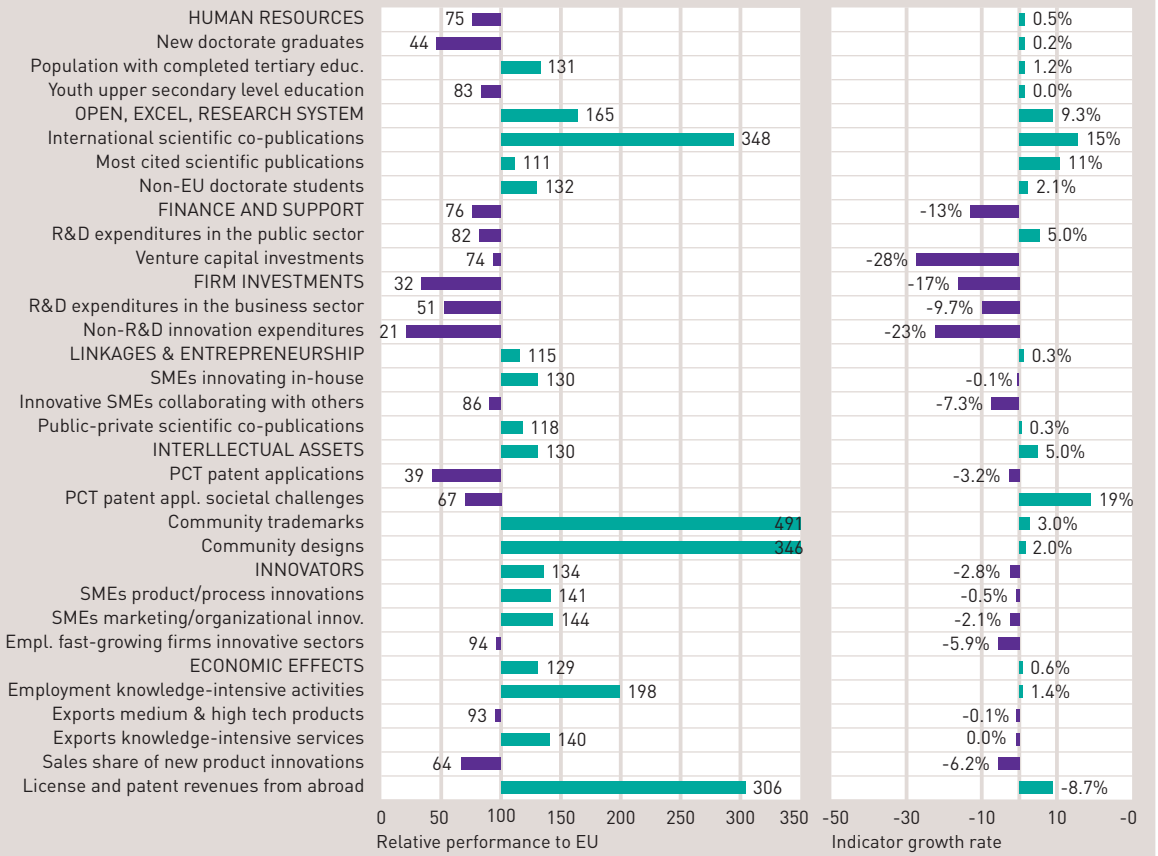
In conclusion, the report notes the following regarding Luxembourg: *'Luxembourg is a Strong Innovator. Performance declined in 2010 and 2011 (due to a much worse performance in Non-R&D innovation expenditures), but more than fully recovered in 2012 and 2013. However, in 2014 and 2015 there is again a significant decline, and the innovation index in 2015 is even below the level of 2008. The performance relative to the EU has declined over time from 28% above the EU in 2008 to about 15% above the EU in 2015. Luxembourg performs best on the dimensions Open and excellent research systems and Innovators. Relative strengths for Luxembourg at the indicator level are Community trademarks, International scientific co-publications, Community designs, and License and patent revenues from abroad. Luxembourg performs well below the average on the dimension Firm investments, in particular at the indicator level on Non-R&D innovation expenditures. Performance in Luxembourg's research system has been growing strongly (9.3%), mainly because of high growth in International scientific co-publications (15%) and Most cited publications (11%). Strong declines are observed in Venture capital investments (-28%), Non-R&D innovation expenditures (-23%) and R&D expenditures in the business sector (-9.7%).'*

Chart 2
EIS rankings of EU Member States (2016)



Source: European Commission

Chart 3
Performance of Luxembourg (2016)

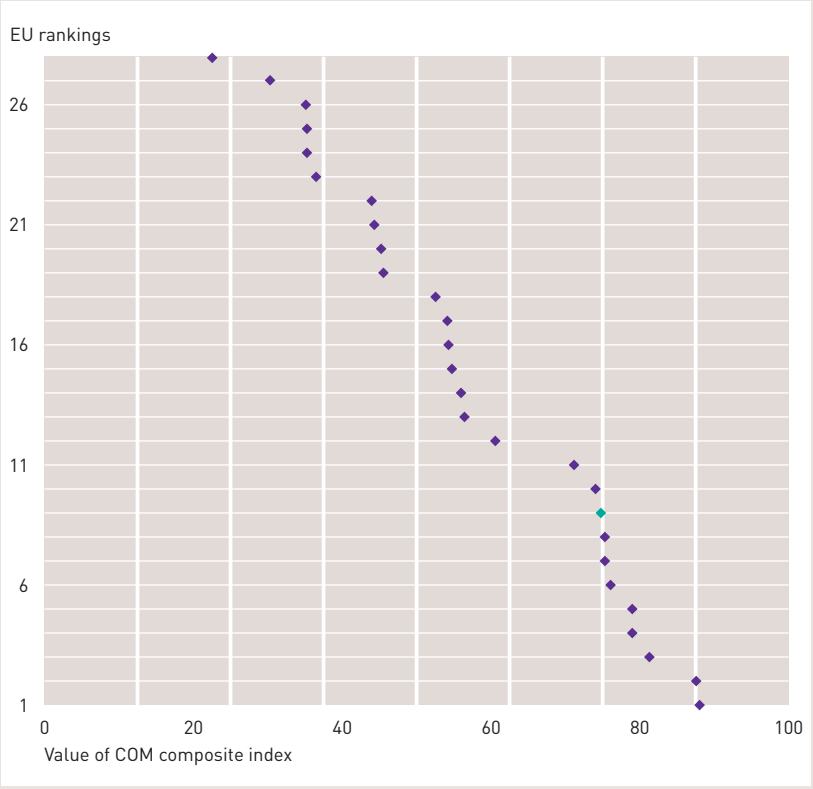


Source: European Commission

Frame 6

Composite indices and EU rankings (2016)

The graph below shows the composite indices and the position in the EU standings. Luxembourg ranks 9th in the EU with a score of 0.598, which is relatively close to the countries which precede it in the standings, i.e. Ireland (6th, 0.609), Belgium (7th, 0.602) and the United Kingdom (8th, 0.602).



e. Ranking comparison and correlation analysis

To illustrate, the table below shows an extract of the rankings of the four major composite indicators that had been reviewed above, in which Luxembourg is appearing[8].

Table 4
Four major rankings (reports published in 2016)

	N°	World Economic Forum	IMD	Heritage Foundation	European Commission
		GCI	***GCI***	***Economic freedom***	***SII***
+	1.	Switzerland	Hong Kong	Hong Kong	Switzerland
	2.	Singapore	Switzerland	Singapore	Sweden
	3.	United States	United States	New Zealand	Denmark
	4.	Netherlands	Singapore	Switzerland	Finland
	5.	Germany	Sweden	Australia	Germany
	6.	Sweden	Denmark	Canada	Netherlands
	7.	United Kingdom	Ireland	Chile	Ireland
	8.	Japan	Netherlands	Ireland	Belgium
	9.	Hong Kong	Norway	Estonia	United Kingdom
	10.	Finland	Canada	United Kingdom	**Luxembourg**
	11.	Norway	**Luxembourg**	United States	Austria
	12.	Denmark	Germany	Denmark	Israel
	13.	New Zealand	Qatar	Lithuania	Iceland
	14.	Taipei	Taiwan	Taiwan	France
	15.	Canada	United Arab Emirates	Mauritius	Slovenia
	16.	United Arab Emirates	New Zealand	Netherlands	Norway
	17.	Belgium	Australia	Germany	Cyprus
	18.	Qatar	United Kingdom	Bahrain	Estonia
	19.	Austria	Malaysia	**Luxembourg**	Malta
	20.	**Luxembourg**	Finland	Iceland	Czech Republic
	21.	France	Israel	Czech Republic	Italy
	22.	Australia	Belgium	Japan	Portugal
	23.	Ireland	Iceland	Georgia	Greece
	24.	Israel	Austria	Finland	Spain
-	25.	Malaysia	China	United Arab Emirates	Hungary

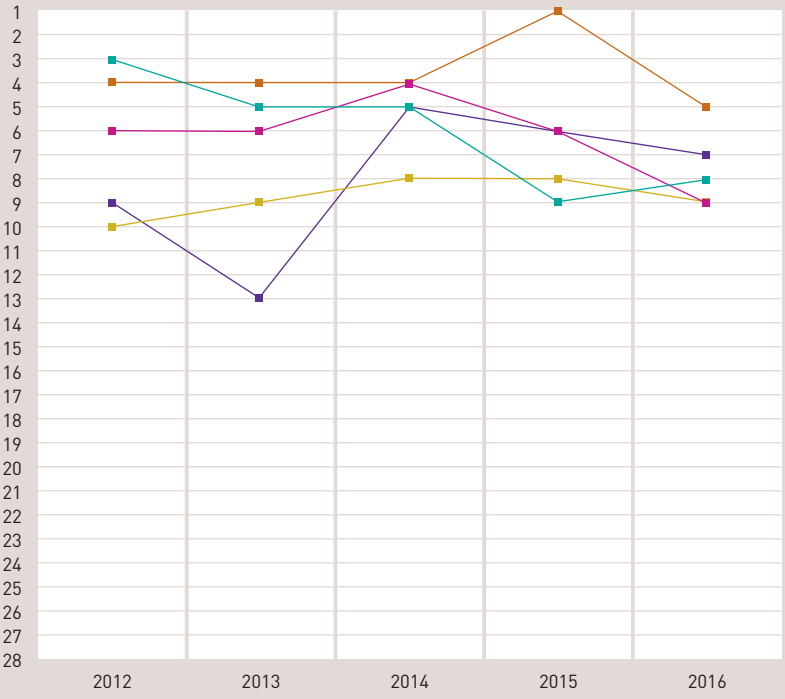
Note: Luxembourg's neighbouring countries (Germany, Belgium, France), and the Netherlands as a Member State of the Benelux, are highlighted in green when their ranking is better than Luxembourg's and otherwise in red.

The table above shows the best performers in the world rankings. Amongst European countries, Luxembourg ranks 11th in the WEF rankings (9th in the EU), 7th in the IMD rankings (5th in the EU), 9th in the Heritage Foundation rankings (8th in the EU) and 10th in the European Commission standings (9th in the EU).

The four rankings shown above can be used to analyse Luxembourg's development. For example, in the WEF EU rankings Luxembourg ranks 9th in 2016 and has lost 1 position, and in the IMD EU rankings, Luxembourg ranks 5th and has lost 4 positions.

[8] Annual changes in country rankings should be consulted with a certain caution, because over the years methodological changes in the calculation of the index may have occurred without a recalculation of the ranks for all the years.

Chart 4
Evolution of Luxembourg in the EU-28 rankings (2012-2016)



Note: The time axis refers to the report's year of publication. Time series should be consulted with caution, because methodological changes might have occurred without the ranks for all prior years being recalculated.

In reports published in 2016, Luxembourg's ranking varies in range from 5th (IMD) to 9th (WEF and European Commission) in the EU. In the 2016 ranking drawn up by the *Observatoire de la compétitivité*[9], Luxembourg also ranks within this bracket (7th).

In general, it is useful to analyse the correlation between these four major benchmarks. Kendall's coefficient is suitable for this type of analysis as it measures the degree of agreement. This correlation has been calculated on the basis of the EU countries[10]. The coefficient takes a value between 0 (no relation) and 1 (a perfect agreement between rankings and judges).

In each of the previous years' Competitiveness Reports, there has been a strong correlation between the four rankings[11]. From the 2015 version of the report, a fifth ranking has been added to the mix, namely the national scoreboard published by the *Observatoire de la compétitivité*. On the basis of these 5 rankings, the Kendall coefficient equates to 0,82 (2016). Therefore, as in previous years, there is a strong correlation between the different EU rankings[12].

9 For more information regarding the rankings of the *Observatoire de la compétitivité*, see chapter 3 of this 2016 Competitiveness Report.

10 EU-28 excluding Cyprus and Malta. The list of countries used for making this calculation has changed over the years. Since the publication of the 2011 Competitiveness Report, only EU Member States are taken into account. Since the 2014 edition, Croatia has been added as new EU Member State.

11 Kendall's coefficient for the same countries was 0.86 in 2006, 0.83 in 2007, 0.86 in 2008, 0.87 in 2009, 0.84 in 2010, 0.83 in 2011, 0.83 in 2012, 0.83 in 2013 and 0.85 in 2014. Comparability between results before 2011 and after 2011 is limited. On one hand, another list of countries was used from 2011 (only countries being part of the EU). In the 2014 report, Croatia was added as new Member State. On the other hand, the SII indicator calculated by the European Commission is taken from the European Innovation Union Scoreboard (EIU) since 2011 and from the new European Innovation Scoreboard (EIS) since 2016.

12 The 2015 Competitiveness Report was the first to include the ODC national rankings in calculating the Kendall coefficient (0,82). Consequently, the results as of 2015 are not fully comparable with those of previous years.

Table 5
Adjustment of the EU-26 rankings (2016)

Country	WEF	IMD	HF	EC	ODC
Germany	2	6	7	4	11
Austria	8	10	12	10	9
Belgium	7	9	16	7	19
Bulgaria	20	24	19	25	21
Croatia	25	26	25	24	24
Denmark	6	2	4	2	2
Spain	14	16	15	18	25
Estonia	12	13	2	13	10
Finland	5	8	10	3	5
France	10	14	22	11	13
Greece	26	25	26	17	26
Hungary	24	22	18	19	22
Ireland	11	3	1	6	8
Italy	17	17	23	15	20
Latvia	19	18	13	23	14
Lithuania	15	12	5	22	15
Luxembourg	**9**	**5**	**8**	**9**	**7**
Netherlands	1	4	6	5	3
Poland	16	15	14	21	18
Portugal	18	19	21	16	23
Slovak Republic	23	20	17	20	12
Czech Republic	13	11	9	14	6
Romania	22	23	20	26	17
United Kingdom	4	7	3	8	4
Slovenia	21	21	24	12	16
Sweden	3	1	11	1	1

Note: Excluding Cyprus and Malta
Source: *Observatoire de la compétitivité*

2.2.2 Other international benchmarks

Besides the four composite indicators and rankings analysed in the previous chapter, a multitude of other ones can be found. Some of these will be considered below.

a. General indicators of competitiveness

a.1 Euro plus monitor 2015[13]

In late 2015, Germany's Berenberg Bank and the Brussels-based think tank The Lisbon Council published the 5th edition of their study on the adjustment progress and the overall economic health of the 18 euro area countries as well as Sweden, Poland and the United Kingdom. This study bases its analysis on two composite indices and rates countries on a scale of 0 (poor) to 10 (best) for each of the following sub-categories and indicators:

[13] For more information: http://www.lisboncouncil.net/

- Adjustment Progress Indicator (API): external adjustment (change in export, export ratio, etc.), budget adjustment capacity (change in balance), unit labour cost adjustments (real and nominal), structural reforms;

- Fundamental Health Indicator (FHI): growth potential (trend growth, human capital, labour market, savings capacity), competitiveness (export ratio in the economy), fiscal sustainability (government outlays, structural balance, public debt), resilience (current account, public debt held abroad, household savings rate, etc.).

In 2015, Luxembourg ranks much higher for the current health of its economy, occupying 3rd place with an FHI of 7.5/10, than for its adjustment, where it ranks 15th with an API of 3.0. Germany places 2nd and 18th respectively, Belgium is 14th and 19th, France ranks 16th for both indicators and the Netherlands is 4th and 13th for the respective indicators. The authors of the study report that most countries with an above average FHI score make less of an effort to improve and thus receive lower API scores. However, they also mentioned that a lower API score could also mean that a country is unwilling to make adjustments or doesn't need to do any, given the good health of its economy.

Table 6
Country rankings according to API and FHI

Adjustment Progress Indicator																	
Rank		**Country**	**Total Score**			**External adj.**			**Fiscal adj.**			**Labour cost adj.**			**Reform drive**		
2015	**2014**		**2015**	***Change***	**2014**	**2015**	***Change***	**2014**	**2015**	***Change***	**2014**	**2015**	***Change***	**2014**	**2015**	***Change***	**2014**
1	2	Ireland	7.7	*-0.5*	8.2	7.4	*-1.0*	8.4	6.6	*-0.3*	6.9	9.2	*0.1*	9.1	7.5	*-1.0*	8.5
2	1	Greece	7.6	*-1.2*	8.8	7.4	*-0.2*	7.5	8.5	*-1.1*	9.7	7.7	*-0.2*	7.9	6.9	*-3.1*	10.0
3	4	Portugal	6.5	*-0.2*	6.7	5.9	*0.0*	6.0	7.1	*-0.8*	7.9	5.6	*0.4*	5.2	7.3	*-0.5*	2.8
4	3	Spain	6.5	*-0.4*	6.9	7.0	*0.2*	6.8	6.3	*-0.8*	7.1	5.7	*0.0*	5.7	6.7	*-1.2*	7.9
5	7	Cyprus	6.0	*0.1*	6.0	4.8	*-0.4*	5.2	6.4	*0.3*	6.2	6.9	*0.3*	6.5	n.a.	*n.a.*	n.a.
6	5	Latvia	5.9	*-0.5*	6.4	9.1	*0.2*	9.0	3.5	*-0.9*	4.4	5.0	*-0.8*	5.9	n.a.	*n.a.*	n.a.
7	8	Slovakia	5.7	*-0.1*	5.8	6.3	*0.2*	6.1	6.3	*-0.5*	6.9	4.3	*-0.3*	4.6	5.6	*0.1*	5.5
8	6	Estonia	5.6	*-0.4*	6.0	7.9	*0.3*	7.6	2.3	*0.6*	1.7	5.2	*-1.2*	6.4	7.1	*-1.2*	8.3
9	9	Slovenia	4.7	*0.0*	4.7	6.8	*0.2*	6.5	4.3	*-0.7*	5.1	4.3	*0.6*	3.7	3.6	*0.0*	3.6
10	11	Italy	4.3	*0.0*	4.3	4.2	*0.0*	4.2	4.3	*-0.8*	5.1	2.9	*-0.2*	3.1	6.0	*1.1*	5.0
11	10	Poland	4.1	*-0.3*	4.4	4.8	*0.4*	4.3	5.5	*-0.7*	6.2	1.5	*-0.1*	1.6	4.8	*-0.6*	5.4
-	**-**	**Euro 18**	**4.0**	***0.0***	**4.0**	**4.3**	***0.3***	**4.0**	**4.0**	***-0.5***	**4.5**	**2.4**	***0.0***	**2.4**	**5.5**	***0.3***	**5.2**
12	12	United Kingdom	3.9	*-0.4*	4.3	2.9	*0.2*	2.8	4.8	*0.0*	4.8	2.4	*-1.2*	3.6	5.6	*-0.5*	6.1
13	13	Netherlands	3.3	*0.1*	3.2	5.0	*0.4*	4.7	3.1	*-0.9*	4.0	2.2	*0.2*	1.9	3.0	*0.6*	2.4
14	14	Malta	3.2	*-0.1*	3.2	5.4	*-0.8*	6.2	2.2	*0.2*	2.0	1.8	*0.4*	1.5	n.a.	*n.a.*	n.a.
15	**15**	**Luxembourg**	**3.0**	***0.0***	**3.1**	**4.8**	***-0.2***	**5.0**	**0.7**	***-0.4***	**1.1**	**4.8**	***-0.3***	**5.0**	**1.9**	***0.7***	**1.2**
16	16	France	3.0	*0.1*	2.9	2.8	*0.0*	2.8	3.7	*0.0*	3.7	1.7	*0.1*	1.6	3.9	*0.1*	3.7
17	17	Austria	2.7	*0.0*	2.7	3.4	*0.6*	2.7	2.3	*0.4*	1.9	0.7	*-0.4*	1.1	4.4	*-0.8*	5.1
18	18	Germany	2.5	*-0.1*	2.6	3.5	*0.3*	3.2	3.1	*-0.9*	4.0	0.8	*-0.1*	0.9	2.8	*0.4*	2.4
19	20	Belgium	2.4	*0.2*	2.2	4.0	*0.1*	3.8	1.3	*-0.1*	1.4	2.2	*0.4*	1.8	2.0	*0.3*	1.8
20	19	Finland	2.2	*0.0*	2.2	1.5	*0.1*	1.3	0.0	*-0.1*	0.1	2.6	*0.2*	2.4	4.8	*-0.3*	5.1
21	21	Sweden	1.3	*-0.4*	1.7	*2.1*	*0.1*	2.0	0.0	*0.0*	0.0	0.8	*0.2*	0.7	2.4	*-1.6*	4.0

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Table 6
Continued

Fundamental Health Indicator																	
Rank		**Country**	**Total Score**			**Growth**			**Competitiveness**			**Fiscal sustainability**			**Resilience**		
2015	**2014**		**2015**	***Change***	**2014**	**2015**	***Change***	**2014**	**2015**	***Change***	**2014**	**2015**	***Change***	**2014**	**2015**	***Change***	**2014**
1	1	Estonia	7.6	*0.0*	7.5	6.7	*-0.1*	6.8	6.1	*-0.1*	6.2	9.4	*0.2*	9.2	8.1	*0.1*	8.0
2	3	Germany	7.5	*0.1*	7.4	6.2	*0.1*	6.0	8.2	*0.1*	8.2	7.8	*0.1*	7.7	7.8	*0.2*	7.6
3	**2**	**Luxembourg**	**7.5**	***0.0***	**7.5**	**7.0**	***0.0***	**7.0**	**7.6**	***0.2***	**7.4**	**9.4**	***-0.1***	**9.5**	**5.8**	***-0.1***	**5.9**
4	4	Netherlands	6.9	*0.0*	6.9	6.9	*-0.2*	7.1	8.1	*0.2*	7.9	6.4	*-0.3*	6.6	6.3	*0.2*	6.1
5	5	Slovakia	6.8	*0.0*	6.9	5.8	*-0.1*	5.8	7.3	*0.0*	7.3	7.2	*-0.1*	7.3	7.1	*0.1*	7.0
6	7	Malta	6.8	*0.1*	6.6	7.0	*0.1*	6.9	7.4	*-0.2*	7.5	6.8	*0.3*	6.5	6.0	*0.3*	5.7
7	6	Poland	6.7	*0.0*	6.7	6.0	*0.0*	6.0	7.5	*0.0*	7.4	6.4	*-0.1*	6.5	6.8	*0.1*	6.7
8	8	Latvia	6.5	*0.1*	6.4	5.9	*0.1*	5.8	5.4	*0.1*	5.3	8.0	*-0.1*	8.1	6.6	*0.3*	6.4
9	11	Ireland	6.3	*0.2*	6.1	6.8	*0.0*	6.8	7.9	*0.5*	7.4	6.7	*0.3*	6.4	3.9	*-0.1*	3.9
10	9	Sweden	6.3	*0.0*	6.3	6.9	*0.0*	6.9	4.2	*0.0*	4.1	6.8	*0.1*	6.7	7.4	*0.0*	7.4
11	10	Slovenia	6.1	*0.0*	6.2	5.8	*0.1*	5.7	6.1	*0.2*	5.9	5.5	*-0.2*	5.7	7.2	*-0.2*	7.3
-	-	**Euro 18**	**5.8**	***0.0***	**5.8**	**4.8**	***0.0***	**4.8**	**6.2**	***0.1***	**6.1**	**6.2**	***-0.1***	**6.3**	**6.1**	***0.1***	**6.0**
12	12	Austria	5.6	*0.0*	5.6	5.9	*-0.1*	6.0	4.7	*-0.1*	4.8	5.6	*0.2*	5.4	6.4	*0.1*	6.3
13	13	United Kingdom	5.5	*0.0*	5.5	5.1	*0.0*	5.0	6.2	*-0.3*	6.5	5.6	*0.2*	5.4	5.2	*0.3*	5.0
14	14	Belgium	5.3	*0.0*	5.3	5.1	*-0.1*	5.2	6.9	*0.3*	6.6	4.0	*-0.1*	4.1	5.2	*0.0*	5.2
15	15	Spain	5.0	*-0.1*	5.1	3.4	*-0.2*	3.6	5.2	*-0.1*	5.3	6.0	*-0.3*	6.3	5.3	*0.2*	5.1
16	17	France	4.8	*0.0*	4.8	4.9	*0.0*	4.9	4.9	*0.2*	4.7	4.3	*0.0*	4.3	5.4	*0.0*	5.4
17	16	Finland	4.7	*-0.2*	4.9	5.3	*-0.1*	5.4	2.4	*-0.1*	2.5	5.5	*-0.5*	6.0	5.5	*0.0*	5.5
18	18	Italy	4.5	*0.0*	4.5	3.1	*-0.2*	3.3	4.1	*0.2*	3.9	5.3	*-0.2*	5.4	5.6	*0.0*	5.5
19	19	Portugal	4.5	*0.0*	4.5	3.3	*-0.2*	3.5	5.8	*0.0*	5.8	4.7	*-0.2*	4.9	4.1	*0.3*	3.8
20	20	Cyprus	4.2	*0.1*	4.1	3.0	*-0.1*	3.1	4.1	*0.2*	3.9	7.1	*0.2*	6.9	2.7	*0.1*	2.7
21	21	Greece	3.9	*-0.2*	4.1	2.0	*-0.3*	2.3	4.9	*0.0*	4.9	4.0	*-1.1*	5.1	4.7	*0.6*	4.2

Scores: For the scores, we rank all sub-indicators on a linear scale of 10 (best) to 0 (worst). Having calculated the results of the sub-indicators, we aggregate them into an overall score for each country, separately for the Adjustment Progress Indicator and the Fundamental Health Indicator.
Change refers to the change in score relative to last year. Note that our scores and ranks for 2014 can differ slightly for some countries from those published in *The 2014 Euro Plus Monitor* due to subsequent revisions of back data for labour costs, net exports and some other parameters.
Ranks: Based on the scores, we calculate the relative ranking of each country, with the No. 1 rank to the country with the highest and the No. 21 rank to the one with the lowest score.
Source : Berenberg Bank / The Lisbon Council

As regards the API adjustment composite indicator (average score 3.0):

- Luxembourg ranks 12th for external adjustment (4.8);
- Luxembourg occupies 19th place for fiscal adjustment capacity (0.7);
- Luxembourg places 8th for labour cost adjustment;
- Luxembourg is 18th for reform drive (1.9).

As for the FHI global health indicator (average score 7.5):

- Luxembourg ranks 1st for growth potential (7.0);
- Luxembourg places 4th for competitiveness with a score of 7.6;
- For fiscal sustainability, Luxembourg scores 9.4 and thus tops the rankings;
- Luxembourg scores 5.8 for resilience and thus ranks 11th.

a.2 European cities and regions of the future 2016[14]

In February 2016, *FDI Magazine* (part of the *Financial Times* group) published a new edition of its study aimed at measuring the attractiveness of European cities and regions for foreign investors. This attractiveness is measured on the basis of incoming foreign investments, economic development, and growth potential. The indicators that are being used to measure this attractiveness are split into 5 categories: economic potential, human resources and quality of living, costs, infrastructure, and business environment. A sixth category includes policies implemented to promote foreign investments. On the basis of the performances obtained, cities and regions are rated on a scale of 1 to 10 (maximum).

There are several ranking categories depending on the size of cities and regions analysed. A distinction is made between cities considered as 'major', 'large', 'mid-sized', 'small' (100,000-350,000) and 'micro' (less than 100,000 inhabitants). Regions are also split on the basis of their size into 'large', 'medium' and 'small' (less than 1.5 million inhabitants). In the rankings published in February 2016, Luxembourg City is among those cities belonging to the 'small' category, and 'Luxembourg region' is also classified in the 'small' category.

In the 2016 edition, Luxembourg City ranks overall 9th of European cities of the future.

[14] For more information: http://www.fdiintelligence.com/Rankings/European-Cities-and-Regions-of-the-Future-2016-17

Table 7
Top 25 of the rankings

Rank	City	Country
1	London	UK
2	Paris	France
3	Dublin	Germany
4	Frankfurt	Germany
5	Munich	Germany
6	Zurich	Switzerland
7	Amsterdam	Netherlands
8	Stockholm	Sweden
9	**Luxembourg**	**Luxembourg**
10	Cambridge	UK
11	Helsinki	Finland
12	Moscow	Russia
13	Geneva	Switzerland
14	Düsseldorf	Germany
15	Copenhagen	Denmark
16	Eindhoven	Netherlands
17	Stuttgart	Germany
18	Espoo	Finland
19	Basel	Switzerland
20	Berlin	Germany
21	Reading	UK
22	Istanbul	Turkey
23	Bucharest	Romania
24	Aberdeen	UK
25	Hamburg	Germany

Source: FDi magazine

Amongst Western European cities, Luxembourg City ranks 6th overall and boasts the highest average GDP increase. Luxembourg also places 1st overall amongst Europe's small cities and achieves the same placing in the economic potential category. The Luxembourg region ranks 4th amongst the regions classed as small.

b. Financial sector attractiveness and competitiveness indicators

b.1 Global Financial Centres Index[15]

The Z/Yen consultancy bureau has just published the 20th edition of the bi-annual competitiveness index of 87 c financial centres around the world, the 'Global financial centres index'. In a world that is becoming increasingly globalised and interdependent through information and communication technologies, financial centres are faced with a greater competition than other sectors. In fact, financial services are at the heart of the global economy, acting as facilitators of international trade and foreign investments.

The study is based on two types of sources to assess the competitiveness of financial centres (scale from 1 to 1,000). On the one hand the study uses 101 quantitative determinants and on the other hand it resorts to a barometer of appreciation on the basis of online surveys among professionals of the sector. As defined in this study, competitiveness consists of five categories of indicators: the business environment (taxes, regulation, etc.), development of the financial sector (volumes, capital availability, etc.), infrastructure (cost and availability of offices, etc.), human resources (training, flexibility, etc.) and global determinants of competitiveness (perception of cities as desirable places to live, etc.).

London (795), New York (794) and Singapore (752) occupy the top three places in the latest edition of the world rankings with Luxembourg (711) placing 12th, thus climbing two places in the standings. Luxembourg ranks 3rd amongst European cities with London and Zurich (716) leading the way. As regards EU cities, Luxembourg places 2nd and is 1st amongst cities in the euro area. The major financial centres in Luxembourg's vicinity scored as follows: Frankfurt 19th (695), Geneva 23rd (689), Paris 29th (672) and Brussels 62nd (614).

[15] For more information: http://www.longfinance.net/global-financial-centres-index-20/1037-gfci-20.html#.VNx7MS73jpI#.VNx7MS73jpI#.VNx7MS73jpI#.VNx7MS73jpI

Table 8
Top 20 of global financial centres

	GFCI 20		GFCI 19		CHANGES	
Centre	**Rank**	**Rating**	**Rank**	**Rating**	**Rank**	**Rating**
London	1	795	1	800	←→ 0	↓ 5
New York	2	794	2	792	←→ 0	↑ 2
Singapore	3	752	3	755	←→ 0	↓ 3
Hong Kong	4	748	4	753	←→ 0	↓ 5
Tokyo	5	734	5	728	←→ 0	↑ 6
San Francisco	6	720	8	711	↑ 2	↑ 9
Boston	7	719	9	709	↑ 2	↑ 10
Chicago	8	718	11	706	↑ 3	↑ 12
Zurich	9	716	6	714	↓ 3	↑ 2
Washington DC	10	713	7	712	↓ 3	↑ 1
Sydney	11	712	17	692	↑ 6	↑ 20
Luxembourg	**12**	**711**	**14**	**698**	**↑ 2**	**↑ 13**
Toronto	13	710	10	707	↓ 3	↑ 3
Seoul	14	704	12	705	↓ 2	↓ 1
Montreal	15	703	21	686	↑ 6	↑ 17
Shanghai	16	700	16	693	←→ 0	↑ 7
Osaka	17	699	20	687	↑ 3	↑ 12
Dubai	18	698	13	699	↓ 5	↓ 1
Frankfurt	19	695	18	689	↓ 1	↑ 6
Vancouver	20	694	22	684	↑ 2	↑ 10

Source: Long Finance & Z/Yen

The authors of the study rank Luxembourg in the 'global' and 'relatively deep specialist' financial centre category. Analysing the volatility of the performance of the financial centres, Luxembourg is considered to be a 'dynamic' financial centre, placed between 'stable' and 'unpredictable' financial centres. This means that Luxembourg as a financial centre has the potential to evolve in either direction. According to the survey of financial sector professionals around the world, Luxembourg ranks 8th worldwide, and even 1st in Europe, amongst the financial centres that respondents see as playing a more significant role in forthcoming years.

c. Innovation and technology indicators

c.1 Global innovation index[16]

In August 2016, Cornell University, INSEAD and the World Intellectual Property Organisation (WIPO) published the 9th edition of the Global Innovation Index (GII). The GII composite index has been published every year since 2007 and is a comparative tool enabling business leaders, decision makers and other interested parties to better understand the innovation state of play across the world.

The GII report contains a ranking of countries' innovation capacities and performance. Given the vital role that innovation plays in economic growth and prosperity, the GII index features indicators which go beyond those traditionally used to measure innovation, such as R&D expenditure. The 2016 edition assesses 128 countries and is based on a total of 82 indicators.

The GII is calculated on the basis of the average of the following sub-indices:

- Resources invested in innovation ('Inputs') evaluate national economic measures in favour of innovative business activities on the basis of five pillars: 1. institutions, 2. human capital and research, 3. infrastructure, 4. market sophistication, 5. business sophistication;
- 'Outputs' assesses tangible evidence of innovation on the basis of two pillars: 6. knowledge and technology outputs, 7. creative outputs.

The GII composite index is then calculated on the basis of these two sub-indices with scores ranging from 0 (poor) to 100 (excellent).

The 2016 GII world rankings are led by Switzerland (66.28/100) ahead of Sweden (63.57) and the United Kingdom (61.93). Luxembourg (57.11) ranks 12th with the Netherlands (58.29) placing 9th, Germany (57.94) 10th, France (54.04) 18th and Belgium (51.97) 23rd. Luxembourg is 9th in Europe and ranks 8th amongst the 28 EU Member States.

[16] For more information: https://www.globalinnovation-index.org/

Table 9
GII 2016 Top 20 rankings

Country/Economy	Score (1-100)	Rank	Income	Rank	Region	Rank
Switzerland	66.28	1	HI	1	EUR	1
Sweden	63.57	2	HI	2	EUR	2
United Kingdom	61.93	3	HI	3	EUR	3
United States of America	61.40	4	HI	4	NAC	1
Finland	59.90	5	HI	5	EUR	4
Singapore	59.16	6	HI	6	SEAO	1
Ireland	59.03	7	HI	7	EUR	5
Denmark	58.45	8	HI	8	EUR	6
Netherlands	58.29	9	HI	9	EUR	7
Germany	57.94	10	HI	10	EUR	8
Korea, Rep.	57.15	11	HI	11	SEAO	2
Luxembourg	**57.11**	**12**	**HI**	**12**	**EUR**	**9**
Iceland	55.99	13	HI	13	EUR	10
Hong Kong (China)	55.69	14	HI	14	SEAO	3
Canada	54.71	15	HI	15	NAC	2
Japan	54.52	16	HI	16	SEAO	4
New Zealand	54.23	17	HI	17	SEAO	5
France	54.04	18	HI	18	EUR	11
Australia	53.07	19	HI	19	SEAO	6
Austria	52.65	20	HI	20	EUR	12

Source: Cornell University/INSEAD/WIPO

As regards the two sub-indices, Luxembourg fared as follows:

- With a score of 56.54, Luxembourg places 23rd in the world rankings for inputs (19th for institutions, 33rd for human capital and research, 27th for infrastructure, 69th for market sophistication and 2nd for business sophistication). In this particular sub-index, Luxembourg trails the Netherlands (12th, 64.03), France (15th, 62.56), Germany (18th, 61.91) and Belgium (20th, 58.23);

- Scoring 57.57, Luxembourg obtains 3rd place in the outputs category (11th for knowledge and technology, 2nd for creative outputs). Luxembourg ranks higher than Germany (8th, 53.97), the Netherlands (9th, 52.54), Belgium (18th, 45.71) and France (19th, 45.51).

The two sub-index results were then used to calculate an innovation efficiency ratio (outputs/inputs) to assess the efficiency of innovation systems and policies. Luxembourg tops the world rankings, with a ratio of 1.02, ahead of Malta (0.98) and Iceland (0.98).

Finally, the authors note the following regarding Luxembourg: *'Luxembourg ranks 3rd in the Innovation Output Sub-Index in 2016 and 12th in the overall GII. On the output side, Luxembourg comes in 11th in Knowledge and technology outputs and 2nd in Creative outputs, improving and maintaining its position from 2015, respectively. Luxembourg ranks among the top five economies in four of the six output sub-pillars: Knowledge diffusion (5th), Intangible assets (1st), Creative goods and services (10th), and Online creativity (3rd); it ranks 1st in five indicators: PCT patent applications, FDI net outflows, cultural and creative services exports, national feature films, and generic top-level domains (TLDs). Luxembourg also achieves the top position in the Innovation Efficiency Ratio rankings (...)'*.

c.2 Global information technology report[17]

Over the last few years, the world has become more and more hyperconnected. The Internet and related services are becoming increasingly available and can often be accessed immediately. Therefore, it is vital that States improve their support for these technologies in order to obtain positive leverage and thus boost competitiveness and wellbeing.

In July 2016, the World Economic Forum (WEF) presented the latest edition of its Global Information Technology Report, which has been published annually since 2001. The main goal of the report is to measure the transformational impact of information and communication technologies (ICT) on the economy and society and to evaluate the economic effectiveness of investment in ICT.

The report features a composite index referred to as the 'Network Readiness Index' (NRI), which is based on 50 indicators divided into four pillars and ten sub-categories:

- 'Environment': assesses the market conditions and the regulatory framework for entrepreneurship, innovation and ICT development;
- 'Readiness': evaluates a country's infrastructure and other key determining factors for ICT uptake;
- 'Usage': assesses actual ICT uptake by citizens, companies and public administrations;
- 'Impact': evaluates the economic and social impact of ICT.

[17] For more information: http://reports.weforum.org/global-information-technology-report-2016/#.VNx7MS73jpI#.VNx7MS73jpI#.VNx7MS73jpI#.VNx7MS73jpI

A score of between 1 (poor) and 7 (best) is awarded to 139 countries worldwide. The report draws on quantitative and qualitative data from the WEF's annual Executive Opinion Survey.

In 2016, Singapore (6.0/7) tops the global NRI standings ahead of Finland (6.0) and Sweden (5.8) with Luxembourg (5.7) placing 9th, just as it did the previous year. The Netherlands (5.8) ranks 6th, Germany (5.6) 15th, Belgium (5.4) 23rd and France (5.3) 24th. In Europe, Luxembourg places 7th and is 5th in the EU.

Table 10
Top 25 of the rankings

Rank	Country/ Economy	Value	2015 rank (out of 143)	Income level	Group+
1	Singapore	6.0	1	HI	ADV
2	Finland	6.0	2	HI-OECD	ADV
3	Sweden	5.8	3	HI-OECD	ADV
4	Norway	5.8	5	HI-OECD	ADV
5	United States	5.8	7	HI-OECD	ADV
6	Netherlands	5.8	4	HI-OECD	ADV
7	Switzerland	5.8	6	HI-OECD	ADV
8	United Kingdom	5.7	8	HI-OECD	ADV
9	Luxembourg	5.7	9	HI-OECD	ADV
10	Japan	5.6	10	HI-OECD	ADV
11	Denmark	5.6	15	HI-OECD	ADV
12	Hong Kong SAR	5.6	14	HI	ADV
13	Korea, Rep.	5.6	12	HI-OECD	ADV
14	Canada	5.6	11	HI-OECD	ADV
15	Germany	5.6	13	HI-OECD	ADV
16	Iceland	5.5	19	HI-OECD	ADV
17	New Zealand	5.5	17	HI-OECD	ADV
18	Australia	5.5	16	HI-OECD	ADV
19	Chinese Taipei	5.5	18	HI	ADV
20	Austria	5.4	20	HI-OECD	ADV
21	Israel	5.4	21	HI-OECD	ADV
22	Estonia	5.4	22	HI-OECD	ADV
23	Belgium	5.4	24	HI-OECD	ADV
24	France	5.3	26	HI-OECD	ADV
25	Ireland	5.3	25	HI-OECD	ADV

Source: WEF

As for the 10 sub-categories, the performance is as follows:

- Political and regulatory environment: Luxembourg ranks 1st (5.9);
- Business and innovation environment: Luxembourg ranks 27th (5.0);
- Infrastructure: le Luxembourg ranks 26th (6.0);
- Affordability (prices/costs): Luxembourg ranks 36th (6.0);
- Skills: Luxembourg ranks 20th (5.9);
- Individual usage: Luxembourg ranks 2nd (6.8);
- Business usage: Luxembourg ranks 15th (5.4);
- Government usage: Luxembourg ranks 9th (5.4);
- Economic impacts: Luxembourg ranks 9th (5.4);
- Social impacts: Luxembourg ranks 23rd (5.3).

In conclusion the authors of the report make the following observation: *'Luxembourg's NRI rank stays the same as last year at 9th place, with its overall score continuing its steady upward trend. Improvements at the pillar level come in three areas: political and regulatory environment and individual usage, moving Luxembourg to 1st and 2nd place in these categories, respectively, and in the area where the country is most behind, affordability: here in particular, a large drop in mobile cellular tariffs moves the country up 14 places in the affordability pillar. Although performance in terms of innovation environment is mixed, good availability of venture capital (8th) and a strong government commitment to procuring advanced technologies (5th) bode well for the commercialization of new ideas. In general government is perceived to play an important role in supporting Luxembourg's digital economy, with business executives attesting to a high importance of ICTs in the government's vision (5th) and its success in ICT promotion (6th). Furthermore, strong framework conditions have been put in place, reflected in the top rank regarding the level of sophistication for ICT related laws (e.g., for e-commerce, digital signatures, and consumer protection). The country also boasts a top infrastructure with top ranks for international bandwidth (1st) and the number of secure servers per capita (3rd).'*

d. Globalization indicators

d.1 KOF Index of Globalization[18]

The Federal Institute of Technology in Zurich (ETH) released the 2016 edition of its KOF Index of globalization, which reflects the state of economic, social and political globalization in 187 countries around the world on the basis of 23 variables. The KOF index shows globalization development over a long period of time. It measures globalization on a scale of 1 (least globalized) to 100 (most globalized).

Overall, the Netherlands (91.70) is the most globalised country in the 2016 rankings, followed closely by Ireland (91.64) and Belgium (90.51). These three countries also occupied the top three places in 2015. Luxembourg (83.55) ranks 18th in the world standings with France (82.61) 19th and Germany (78.24) in 27th place. In Europe, Luxembourg places 16th and is 14th in the EU.

The 'economic dimension of globalisation' indicator considers, on the one hand, the extent of trade flows, investment and cross-border revenue as a share of gross domestic product (GDP) and, on the other, the impact of trade barriers and restrictions on capital movements. Singapore (96.06), Ireland (93.08) and Luxembourg (91.80) lead the rankings for this particular indicator of economic globalisation.

The social dimension of globalisation is measured on the basis of three categories. The first includes personal cross-border contacts, i.e. phone calls and correspondence. Tourism and the number of foreign residents are also taken into account. The second category looks at cross-border information flows via the Internet, television and the foreign press whilst the third assesses the uptake of globalised culture, e.g. the number of McDonald's and Ikea outlets, and book imports and exports as a share of GDP. For this particular indicator, Austria (91.30), Singapore (91.15) and Switzerland (91.10) lead the standings with Luxembourg (78.73) occupying 30th position.

The political dimension of globalisation is assessed on the basis of the number of foreign embassies located in the country, the number of international organisations of which the country is a member, the number of UN peace-keeping missions the country has participated in and the number of bi-lateral and multi-lateral agreements the country has signed since 1945. Italy (97.53) tops the rankings for this indicator ahead of France (97.29) and Belgium (96.51) with Luxembourg (79.44) placing 60th.

[18] For more information: http://globalization.kof.ethz.ch/

Table 11
The 20 most globalized countries in the world

	Country	Globalization Index
1	Netherlands	91.70
2	Ireland	91.64
3	Belgium	90.51
4	Austria	89.83
5	Switzerland	87.01
6	Singapore	86.93
7	Denmark	86.44
8	Sweden	85.92
9	Hungary	85.78
10	Canada	85.67
11	Finland	85.47
12	Portugal	85.08
13	Norway	84.24
14	Cyprus	84.07
15	Spain	83.73
16	Slovak Republic	83.62
17	Czech Republic	83.60
18	**Luxembourg**	**83.55**
19	France	82.61
20	United Kingdom	81.97

Source: ETH

e. Quality of life and cost of living indicators

e.1 Quality of living survey[19]

In February 2016 the consultancy firm MERCER published the 18th edition of its annual study on the quality of living for expatriates through their host cities around the world: the Quality of living survey. This survey is conducted to help multinational companies and governments to establish the amount of compensation for their staff abroad. In this new 2016 edition, 230 cities were analysed.

The survey is based on factors that expatriates consider as having a major impact on their quality of life abroad. Indicators used to assess the level of quality of living are grouped into ten categories: political and social environment, economic environment, sociocultural environment, health system, education system, public services and transport, leisure, consumer products, housing, and finally, the natural environment.

[19] For more information: http://www.mercer.be/newsroom/2016-classement-des-villes-les-plus-vivables-au-monde.html

In 2016, Vienna, Zurich and Auckland are deemed to be the three cities offering the best quality of life for expats. Luxembourg ranks 19th in the world rankings, on a par with Stockholm.

Vienna, Zurich and Munich top the European standings with Luxembourg ranking 12th (9th in the EU). In terms of quality of life for expats, Luxembourg ranks higher than neighbouring cities such as Brussels (21st), Stuttgart (24th) and Paris (37th) but below Düsseldorf (6th), Frankfurt (7th) and Amsterdam (11th).

Table 12
Top 20 of the rankings

	City	Country
1	Vienna	Austria
2	Zurich	Switzerland
3	Auckland	New Zealand
4	Munich	Germany
5	Vancouver	Canada
6	Dusseldorf	Germany
7	Frankfurt	Germany
8	Geneva	Switzerland
9	Copenhagen	Denmark
10	Sydney	Australia
11	Amsterdam	Netherlands
12	Wellington	New Zealand
13	Berlin	Germany
14	Bern	Switzerland
15	Toronto	Canada
15	Melbourne	Australia
17	Ottawa	Canada
18	Hamburg	Germany
19	**Luxembourg**	**Luxembourg**
19	Stockholm	Sweden

Source: Mercer

In the 2016 edition, MERCER compiles a ranking for a new indicator: personal security. The score is based on internal stability, crime figures, public order and a country's international relations. Luxembourg tops the rankings as the world's safest city with Bern, Helsinki and Zurich in 2nd position.

e.2 Expat insider[20]

In August 2016 InterNations, a worldwide expatriates network, published the 3rd edition of its annual report on host countries for expatriates. The report is based on a (qualitative) survey of around 14,000 expatriates who scored different aspects of expatriate life (e.g. quality of life, family life, cost of living abroad, etc.) in 67 destinations across the world on a scale of 1 to 7. A classification of the best destinations for expatriates was drawn up on the basis of the responses submitted.

The 2016 world rankings for the best destination for expatriates is led by Taiwan, Malta and Ecuador with Luxembourg placing 9th, Germany 17th, the Netherlands 30th, Belgium 39th and France 41st. In Europe, Luxembourg ranks 3rd overall behind Malta and Austria (8th in the world rankings).

Table 13
Top 10 of 2016 rankings

1	Taiwan
2	Malta
3	Ecuador
4	Mexico
5	New Zealand
6	Costa Rica
7	Australia
8	Austria
9	Luxembourg
10	Czech Republic

Source: InterNations

In the different sub-categories upon which the rankings are based, Luxembourg fared as follows:

- Quality of Life: Luxembourg ranks 17th overall and is thus below Germany (9th) and France (15th) but ahead of the Netherlands (24th) and Belgium (44th). As regards the sub-indices, Luxembourg places 56th for leisure options, 56th for personal happiness, 15th for travel and transport, 14th for health and wellbeing and 1st for safety and security;

- Ease of Settling in: Luxembourg occupies 40th position overall and is thus ahead of Belgium (44th), the Netherlands (46th), France (53rd) and Germany (57th). In the four sub-indices, Luxembourg ranks 43rd for feeling welcome, 41st for friendliness, 57th for finding friends and 27th for language;

- Working Abroad: Luxembourg is top of the world rankings ahead of Germany (3rd), the Netherlands (20th), Belgium (27th) and France (42nd). In the three sub-indices that make up this category, Luxembourg places 6th for job and career, 4th for work-life balance and 1st for job security;

[20] For more information: https://www.internations.org/expat-insider/2016/the-best-and-worst-places-for-expats

- Family Life: Luxembourg occupies 14th place in the world rankings and is thus below Belgium (9th), Germany (10th), France (11th) and the Netherlands (13th). As regards the four sub-indices, Luxembourg ranks 28th for availability of childcare and education, 25th for cost of childcare and education, 19th for quality of education and 8th for family wellbeing;

- Finances and Cost of Living: Luxembourg ranks 22nd for perceived financial situation and is thus ahead of Germany (33rd), Belgium (38th), the Netherlands (41st) and France (60th). However, Luxembourg can only manage 63rd place for cost of living and thus trails Germany (23rd), France (40th), the Netherlands (43rd) and Belgium (44th).

In conclusion the authors of the report mainly make the following observation regarding Luxembourg: *'A Stable Job Market - After featuring consistently in the top three of the Working Abroad Index (ranking second in 2014 and third in 2015), Luxembourg finally claims the top spot in 2016. Its finance industry appears to be the most popular sector, with more than three in ten expats (31%) choosing this option, as opposed to 8% worldwide. It is followed by the public sector presumably due to Luxembourg's status as a European capital and seat of EU institutions. In Luxembourg, expats are more likely to choose a traditional role as employee or manager as their main employment status than the global average (66% vs. 41%). Senior employees or experts also make up a large percentage of that group, with 32% in Luxembourg vs. 23% worldwide. In terms of overall job satisfaction, 76% of expats in Luxembourg are generally satisfied, compared to a global average of 64%. With regard to career prospects, 67% are overall pleased with their opportunities (global average: 55%). The work-life balance is rated highly by 79% of expats in Luxembourg (globally: 60%), with the country ranking fourth in the Work-Life Balance subcategory. As far as working hours are concerned, all working respondents spend on average 40.6 hours a week at their job (global: 41.4 hours). Only 7% work in part-time jobs, and the average work week for full-time employees thus isn't that much longer at 41.8 hours. Expats also feel their jobs are secure, according to 81% of the respondents, which might be explained by the country's strong economy. Luxembourg ranks first in terms of the state of the local economy, with not one respondent considering it very bad. Generally, a large proportion of expats decided to move to Luxembourg for job-specific reasons. More than seven in ten respondents (71%) saw the economy or the job market as a potential benefit when they considered relocating there. This is backed up by the results for the participant's main motivation for their move: 34% of expats came to Luxembourg because they found a job on their own, making this the most important reason for relocating to this destination at more than double the global average of 15%.'*

e.3 ECA International - cost of living[21]

In June 2016, ECA International, an information and solutions provider for international human resource professionals, published the latest edition of its report on the cost of living for expatriates worldwide, entitled 'Cost of Living Index 2016'. The study is based on an average basket of consumer goods and services commonly purchased by expatriates with prices in several hundred cities and places worldwide being compared. The data are used by human resource professionals to calculate cost of living allowances for expats.

ECA International assesses and compares the cost of living on the basis of an average basket of consumer goods and services, i.e. products and services typically purchased by consumers. Such products and services include foodstuffs, basic expenditure (household goods, leisure, a range of services, recreation) and general expenditure (clothing, electrical appliances, a meal at a restaurant, alcohol and cigarettes). The cost of living index thus reflects expatriates' daily expenditure but certain costs such as housing, utilities (electricity, gas, water), purchasing a vehicle and school fees are not included.

Kinshasa tops the 2016 world rankings ahead of Zurich and Geneva with Luxembourg achieving 122nd place.

In Europe, the rankings are led by Zurich, Geneva and Basel with Luxembourg ranking 25th just behind Marseille (24th) and ahead of Cardiff (26th). Paris occupies 12th place with Brussels 13th and Antwerp 18th.

Table 14
Top 20 of most expensive cities in Europe

Location	Regional rank			Global rank
	2016	2015	Difference	March 2016
Zurich	1	1	-	2
Geneva	2	2	-	3
Basel	3	4	↑ 1	4
Bern	4	3	↓ 1	5
Oslo	5	5	-	20
Copenhagen	6	7	↑ 1	25
Stavanger	7	6	↓ 1	26
Helsinki	8	8	-	35
Stockholm	9	10	↑ 1	45
Gothenburg	10	11	↑ 1	55
Central London	11	9	↓ 2	65
Paris	12	13	↑ 1	72
Brussels	13	18	↑ 5	86
Outer London	14	12	↓ 2	92
Berlin	15	15	-	94
Vienna	16	20	↑ 4	99
Edinburgh	17	14	↓ 3	102
Antwerp	18	22	↑ 4	111
Dublin	19	23	↑ 4	114
Munich	20	25	↑ 5	115

Source: ECA International

[21] For more information: https://www.eca-international.com/news/june-2016/zurich-tops-the-european-rankings-of-most-expensiv#.VNx7MS73jpI#.VNx7MS73jpI#.VNx7MS73jpI#.VNx7MS73jpI

e.4 MERCER - cost of living[22]

In June 2016, MERCER published the 22nd edition of its annual expatriate cost of living survey. The survey measures the cost of living in 209 cities on five different continents and uses 200 products and services to estimate the cost of living (housing, transport, food, clothing, etc.), which is then used to calculate allowances for expatriates during their time abroad.

Hong Kong, Luanda and Zurich are the three cities with the highest cost of living for expatriates in 2016. Luxembourg ranks 86th, on a par with Brussels, with other European cities placing as follows: London 17th, Paris 44th, Dublin 47th, Amsterdam 64th, Frankfurt 88th, Düsseldorf 107th.

Table 15
Excerpt of 2016 rankings
(The Mercer international basket, including rental accomodation costs)

Rank as of March			
2015	**2016**	**City**	**Country**
2	1	Hong Kong	Hong Kong
1	2	Luanda	Angola
3	3	Zurich	Switzerland
4	4	Singapore	Singapore
11	5	Tokyo	Japan
13	6	Kinshasa	Dem. Rep. of the Congo
6	7	Shanghai	China
5	8	Geneva	Switzerland
10	9	Ndjamena	Chad
7	10	Beijing	China

Source: MERCER

f. Human resources

f.1 Global talent competitiveness index[23]

In a globalised world, human capital is a key factor for national competitiveness as it is the origin of innovation and sustainable growth. Countries are competing in developing this human capital, but also in attracting and retaining it within their territory.

In this context, the business school INSEAD, in association with the Human Capital Leadership Institute and Adecco, published early 2016 the 3rd edition of the 'Global Talent Competitiveness Index' (GTCI) for 109 countries around the world. This annual study focuses on mobility, as it highlights the strong correlation between movements of talent and economic prosperity, and it recommends to countries a more strategic management of new dynamics in brain circulation.

[22] For more information: http://www.mercer.com/newsroom/continued-demand-for-mobility-in-the-global-workforce-challenged-by-cost-of-expatriate-packages.html#.VNx7MS73jpI#.VNx7MS73jpI#.VNx7MS73jpI#.VNx7MS73jpI

[23] For more information: http://global-indices.insead.edu/gtci/

In order to compare countries performance, the report includes a composite index based on an input-output model, allowing to evaluate those measures/policies/resources implemented to develop human capital (inputs), and the performance of the measures implemented (outputs) for two categories of competence (mid-level/technical skills of labour force - LV skills - and high-level skills - GK skills - needed for innovation and entrepreneurship). The GTCI composite index, based on these two categories and made up of 61 indicators in total, uses a score between 0 (worst performance) and 100 (best performance).

In the 2016 GTCI world rankings there is no change at the top with Switzerland (72.6), Singapore (71.4) and Luxembourg (68.9) retaining the top 3 places. The Netherlands (65.2) ranks 12th, Germany (63.8) 14th, Belgium (61.8) 18th and France (59.1) 22nd.

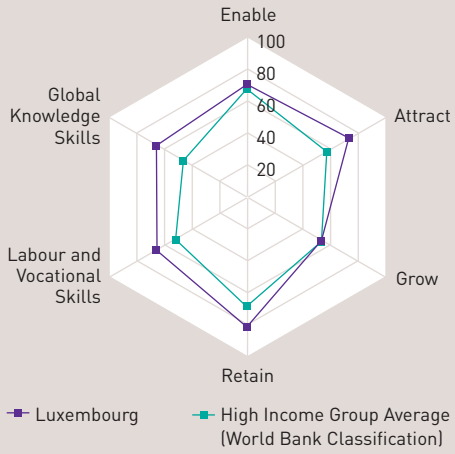
Table 16
Top 20 of the human capital rankings

Country	Score	Overall Rank
Switzerland	72.648	1
Singapore	71.456	2
Luxembourg	**68.978**	**3**
United States	67.902	4
Denmark	67.865	5
Sweden	66.621	6
United Kingdom	66.597	7
Norway	66.339	8
Canada	65.346	9
Finland	65.333	10
New Zealand	65.264	11
Netherlands	65.219	12
Australia	65.080	13
Germany	63.850	14
Austria	63.552	15
Ireland	63.137	16
Iceland	62.001	17
Belgium	61.849	18
Japan	60.978	19
Czech Republic	90.949	20

Source: INSEAD

In the inputs sub-category, Luxembourg ranks 23rd for enablers, 3rd for attraction, 19th for growth and 2nd for talent retention. In the outputs sub-category, Luxembourg ranks 5th for labour and vocational skills (LV) and 1st for global knowledge skills (GK). Luxembourg's performance is above the average score for high-income developed countries.

Chart 5
Performance of Luxembourg



Source: INSEAD

In conclusion the authors of the report make the following observation: *'Luxembourg (3rd) has the best pool of Global Knowledge skills (1st). As a small country that has a built an international reputation as a centre of finance and industry, it is part of the top three on the Retain (2nd) and Attract (3rd) pillars respectively, driven by high scores on the Sustainability (2nd) and External openness (3rd) sub-pillars. Despite the strong attraction of knowledge workers, the business environment shows ample room for improvement in terms of the business labour landscape (65th) – as labour markets are not the most flexible. As is often the case for a small country, Formal education (50th) does not figure at the top, particularly in terms of top global universities. Given its small size, Luxembourg prefers higher education abroad for its citizens, and to attract talent from outside.'*

f.2 Human capital index[24]

In the 21st century, expertise and talent are essential factors linking innovation, competitiveness and growth. The level and the quality of human capital available to a country are considered as key factors for long-term economic success in an increasingly digitalised world.

In late June 2016, the World Economic Forum (WEF) published the latest edition of its Human Capital Report, which assesses the ability of 130 countries to develop human capital during different stages of life, each of which has its own characteristics (age ranges: 0-14 years, 15-24 years, 25-54 years, 55-64 years and over 65 years). The analysis is based on 46 quantitative and qualitative indicators, divided into several sub-categories, which focus on the different stages of life. The WEF uses these indicators to calculate the Human Capital Index (HCI), an overall composite index, which measures the extent to which countries ensure development of their human capital (level of education, skills and accessible jobs) in a globalised and digitalised economy.

[24] For more information: http://reports.weforum.org/human-capital-report-2016/press-releases/#.VNx7MS73j-pI#.VNx7MS73jpI#.VNx7MS73j-pI#.VNx7MS73jpI

The world standings are led by Finland (85.86) ahead of Norway (84.64) and Switzerland (84.61) with Luxembourg (79.28) placing 22nd. The Netherlands (82.18) ranks 8th, Belgium (81.59) is 10th, Germany (81.55) 11th and France (80.32) 17th.

Table 17
Top 25 of the rankings

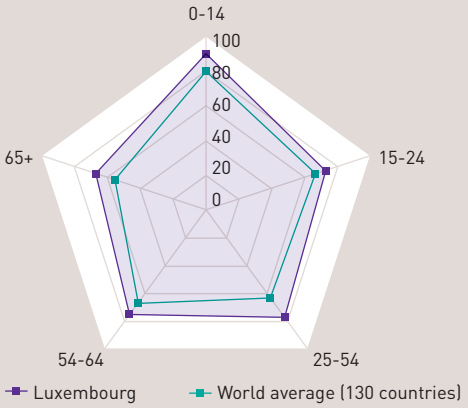
	Overall index		0-14 Age Group		15-24 Age Group		25-54 Age Group		55-64 Age Group		65 and Over Age Group	
Country	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**
Finland	85.86	1	98.17	1	85.35	1	81.24	1	83.90	7	72.95	9
Norway	84.64	2	94.69	11	84.72	2	80.11	4	85.34	3	74.53	2
Switzerland	84.61	3	96.76	7	83.34	4	80.51	2	83.54	8	73.28	7
Japan	83.44	4	96.78	6	77.26	19	79.13	5	85.72	1	75.61	1
Sweden	83.29	5	93.25	14	81.03	9	80.17	3	84.58	4	70.43	16
New Zealand	82.79	6	96.20	9	82.25	7	76.25	17	85.70	2	74.07	3
Denmark	82.47	7	91.77	22	81.89	8	78.17	8	83.99	6	74.04	4
Netherlands	82.18	8	92.81	17	83.70	3	77.58	10	81.06	13	69.59	18
Canada	81.95	9	93.46	13	77.74	16	77.61	9	84.22	5	73.05	8
Belgium	81.59	10	96.29	8	78.25	13	77.55	11	78.33	27	68.32	23
Germany	81.55	11	89.56	38	79.78	10	78.39	7	83.31	9	73.54	6
Austria	81.52	12	92.29	20	82.41	6	76.75	15	79.06	23	72.00	12
Singapore	80.94	13	96.81	5	76.12	25	78.70	6	75.17	39	60.59	52
Ireland	80.79	14	96.87	4	75.84	29	76.32	16	78.16	28	67.77	26
Estonia	80.63	15	96.09	10	77.35	18	74.02	24	82.98	10	71.77	13
Slovenia	80.33	16	92.90	16	79.13	12	75.30	20	77.04	32	71.39	14
France	80.32	17	93.07	15	76.00	26	77.32	12	77.59	30	66.32	31
Australia	80.08	18	91.36	24	82.56	5	74.33	22	80.85	15	67.27	27
United Kingdom	80.04	19	91.91	21	76.64	22	76.78	14	79.07	22	66.43	30
Iceland	79.74	20	93.85	12	79.63	11	75.78	18	74.62	40	60.30	54
Lithuania	79.34	21	92.38	19	75.87	28	74.25	23	81.24	12	68.30	24
Luxembourg	**79.28**	**22**	**91.33**	**26**	**73.46**	**36**	**77.24**	**13**	**75.74**	**36**	**66.45**	**29**
Israel	78.99	23	89.56	37	76.75	21	75.39	19	79.78	20	67.05	28
United States	78.86	24	88.97	39	75.99	27	74.91	21	80.62	16	70.32	17
Czech Republic	78.45	25	89.66	36	77.49	17	73.72	25	78.43	25	68.38	22

Source: WEF (2016)

In the different age ranges analysed in the study, Luxembourg fared as follows:

- 0-14 years: 26th (91.33);
- 15-24 years: 36th (73.46);
- 25-54 years: 13th (77.24);
- 55-64 years: 36th (75.74);
- > 65 years: 29th (66.45).

Chart 6
Performance of Luxembourg



Source: WEF (2016)
Note: The centre of the chart corresponds to the lowest possible score (0) whilst the bold line represents the world average (130 countries). The shaded area shows Luxembourg's performance.

g. Miscellaneous indicators

A multitude of other factors play an important role in the debate regarding territorial attractiveness and competitiveness: functioning and governance of public authorities, business environment, human resources, etc. There are regular publications on benchmarks and country rankings focusing on a multitude of these topics, some of which are reviewed below.

g.1 Corruption perceptions index[25]

The institutional and regulatory framework within which economic activities take place, impacts on the way resources are distributed, investment decisions are orientated and creativity and innovation are stimulated. Corruption thus weakens a country and harms the stability and security of the decisions economic agents make.

It is from this point of view that Transparency international, a non-governmental organisation, has just published a new edition of its annual composite index of corruption perception: the Corruption Perceptions Index (CPI). The index is established on the basis of the opinions of specialists on corruption in the sole public sector. Countries with a high score often have a transparent administration which enables citizens to hold their officials to account. A low score signifies systemic bribery, the absence of sanctions to combat corruption and a mismatch between the activities of the administration and the needs of the people. Countries are ranked on the basis of the extent of corruption present in the public sector. CPI scores range from 100 (very low corruption) to 0 (very corrupt) with 168 countries under scrutiny.

[25] For more information: https://www.transparency.org/cpi2015

In the 2015 edition, Denmark (91), Finland (90) and Sweden (89) top the rankings with Luxembourg (81) in 10th position alongside Germany and the United Kingdom whilst the Netherlands (87) is 5th, Belgium (77) 15th and France (70) in 23rd place.

Table 18
Top 10 of the rankings

Rank	Country/Economy	Score
1	Denmark	91
2	Finland	90
3	Sweden	89
4	New Zealand	88
5	Netherlands	87
5	Norway	87
7	Switzerland	86
8	Singapore	85
9	Canada	83
10	Germany	81
10	**Luxembourg**	**81**
10	United Kingdom	81
13	Australia	79
13	Iceland	79
15	Belgium	77
16	Austria	76
16	United States	76
18	Hong Kong	75
18	Ireland	75
18	Japan	75

Source: Transparency International

g.2 Global resilience index[26]

In 2016, FM Global, one of the world's largest commercial and industrial property insurers published the latest edition of its annual report on territorial resilience to corporate supply chain disruption. Resilience enables companies located in a country to more effectively protect themselves against possible supply chain disruption and to recover quicker if such an eventuality comes to pass. This is of particular importance to multinationals engaging in international trade who, consequently, are exposed to a multitude of risks such as geopolitical tensions, raw material price volatility, natural hazards, etc. The composite resilience index provides companies with a tool for more effective assessment of their operational integrity.

[26] For more information: http://newsroom.fmglobal.com/releases/fm-global-report:-lower-oil-prices-and-threat-of-terrorism-impacting-global-supply-chain-resilience

In the 2016 edition, 130 countries and territories were assessed, both quantitatively and qualitatively, on nine criteria broken down into three sub-categories:

- Economy (productivity, political risk, oil-intensity of the economy);
- Risks (exposure to natural hazards, potential to improve risk management if natural disaster occurs, fire risk management);
- Supply chain (control of corruption, infrastructure, quality of local suppliers).

Scores are awarded for each of the nine criteria (and three sub-categories) on a scale of 0 (poorest performance) to 100 (best performance).

The 2016 world rankings are led by Switzerland (100), Norway (99.6) and Ireland (98.4) with Luxembourg (94.5) occupying 5th place. Germany (94.6) ranks 4th, the Netherlands (94.3) 6th, Belgium (88.7) 17th and France (86.2) 19th.

Table 19
Top 20 of the rankings

Country/ Region	Composite		Factors					
			Economic		Risk quality		Supply chain	
	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Switzerland	1	100.0	2	94.9	73	57.2	1	100.0
Norway	2	99.6	3	89.6	10	80.3	12	82.4
Ireland	3	98.4	7	77.2	1	100.0	25	73.8
Germany	4	94.6	16	72.1	13	78.4	4	91.2
Luxembourg	**5**	**94.5**	**1**	**100.0**	**79**	**54.5**	**11**	**84.4**
Netherlands	6	94.3	20	68.9	9	80.5	3	92.0
United States 3	7	94.2	13	72.2	3	88.4	17	80.5
Canada	8	92.7	19	69.0	2	88.7	21	80.2
Australia	9	90.9	10	76.5	8	81.0	23	75.6
Denmark	10	90.8	5	77.8	70	64.0	6	90.3
United States 1	11	90.6	13	72.2	11	80.0	17	80.5
Hong Kong SAR	12	90.4	17	70.7	22	72.1	8	89.3
Finland	13	90.3	11	74.8	58	65.6	5	90.8
Qatar	14	90.1	4	84.4	24	71.6	24	74.6
New Zealand	15	89.9	12	74.1	17	75.1	15	81.6
Sweden	16	88.8	6	77.5	71	64.0	10	86.2
Belgium	17	88.7	23	64.5	5	81.8	13	82.4
Austria	18	87.2	9	76.7	72	57.9	7	89.3
France	19	86.2	22	65.0	14	77.4	20	80.4
United Kingdom	20	85.6	18	69.9	23	72.1	22	79.0

Source: FM Global

In the three sub-categories which make up the overall composite index, Luxembourg fared as follows:

- Economy – Luxembourg (100) tops the world rankings, scoring 100 for productivity, 97.4 for political risk and 84.9 for oil-intensity of the economy;

- Risk quality – Luxembourg (54.5) is 79th in the world rankings, scoring 37.0 for exposure to natural hazards, 89.2 for potential to improve risk management should a natural disaster occur and 23.2 for fire risk management;

- Supply chain – Luxembourg (84.4) occupies 11th place in the world ranking, scoring 95.1 for control of corruption, 78.8 for infrastructure and 77.5 for quality of local suppliers.

g.3 Global logistics performance index[27]

In late June 2016, the World Bank published the 5th edition of its bi-annual 'Connecting to Compete' report, which analyses commercial logistics, i.e. a country's ability to efficiently deliver goods and establish links between manufacturers and customers on international markets. The rationale behind this is that the countries with the best logistics can boost their growth potential, become more competitive and invest more. Efficient logistics chains improve market access and offer greater economic opportunities.

The report is based on an in-depth survey of international express forwarders and carriers in 160 countries across the world and on quantitative data linked to the performance of a series of key components of the logistics chain (infrastructure, service quality, reliability, efficiency of customs clearance procedures). On the basis of the data collected, the World Bank calculates a composite index known as the Logistics Performance Index, which measures performance in commercial logistics on a scale of 1 (worst) to 5 (best).

The LPI ranking is led by Germany (4.23/5) ahead of Luxembourg (4.22) and Sweden (4.20) with the Netherlands (4.19) placing 4th, Belgium (4.11) 6th and France (3.90) 16th.

[27] For more information: http://www.banquemondiale.org/fr/news/press-release/2016/06/28/germany-tops-2016-logistics-performance-index#.VNx7MS73jpI#.VNx7MS73jpI#.VNx7MS73jpI#.VNx7MS73jpI

Table 20
Top 20 of the rankings

	LPI rank			LPI score			% of highest performer	Customs		Infra-structure		International shipments		Logistics quality and competence		Tracking and tracing		Time-liness	
	Rank	Lower bound	Upper bound	Score	Lower bound	Upper bound		Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Germany	1	1	4	4.23	4.18	4.27	100.0	2	4.12	1	4.44	8	3.86	1	4.28	3	4.27	2	4.45
Luxembourg	**2**	**1**	**12**	**4.22**	**3.97**	**4.47**	**99.8**	**9**	**3.90**	**4**	**4.24**	**1**	**4.24**	**10**	**4.01**	**8**	**4.12**	**1**	**4.80**
Sweden	3	1	7	4.20	4.09	4.32	99.3	8	3.92	3	4.27	4	4.00	2	4.25	1	4.38	3	4.45
Netherlands	4	1	6	4.19	4.11	4.27	98.8	3	4.12	2	4.29	6	3.94	3	4.22	6	4.17	5	4.41
Singapore	5	2	9	4.14	4.06	4.22	97.4	1	4.18	6	4.20	5	3.96	5	4.09	10	4.05	6	4.40
Belgium	6	5	9	4.11	4.04	4.18	96.4	13	3.83	14	4.05	3	4.05	6	4.07	4	4.22	4	4.43
Austria	7	3	11	4.10	3.98	4.21	96.0	15	3.79	12	4.08	9	3.85	4	4.18	2	4.36	7	4.37
United Kingdom	8	6	9	4.07	4.03	4.11	95.2	5	3.98	5	4.21	11	3.77	7	4.05	7	4.13	8	4.33
Hong Kong SAR, China	9	6	9	4.07	4.00	4.14	95.1	7	3.94	10	4.10	2	4.05	11	4.00	14	4.03	9	4.29
United States	10	10	12	3.99	3.94	4.04	92.8	16	3.75	8	4.15	19	3.65	8	4.01	5	4.20	11	4.25
Switzerland	11	10	15	3.99	3.92	4.06	92.6	10	3.88	7	4.19	14	3.69	14	3.95	12	4.04	14	4.24
Japan	12	10	15	3.97	3.92	4.02	92.1	11	3.85	11	4.10	13	3.69	12	3.99	13	4.03	15	4.21
United Arab Emirates	13	10	16	3.94	3.88	4.00	91.2	12	3.84	13	4.07	7	3.89	18	3.82	18	3.91	18	4.13
Canada	14	10	16	3.93	3.83	4.03	90.8	6	3.95	9	4.14	29	3.56	15	3.90	9	4.10	25	4.01
Finland	15	9	20	3.92	3.77	4.07	90.5	4	4.01	16	4.01	30	3.51	16	3.88	11	4.04	16	4.14
France	16	13	16	3.90	3.84	3.96	89.9	17	3.71	15	4.01	20	3.64	19	3.82	15	4.02	13	4.25
Denmark	17	6	30	3.82	3.51	4.12	87.3	14	3.82	24	3.75	15	3.66	9	4.01	25	3.74	30	3.92
Ireland	18	11	30	3.79	3.60	3.99	86.6	25	3.47	22	3.77	10	3.83	20	3.79	16	3.98	29	3.94
Australia	19	10	30	3.79	3.58	4.00	86.6	22	3.54	18	3.82	21	3.63	17	3.87	19	3.87	21	4.04
South Africa	20	17	24	3.78	3.70	3.85	86.0	18	3.60	21	3.78	23	3.62	22	3.75	17	3.92	24	4.02

Source: World Bank

In the six sub-categories of the LPI international rankings, Luxembourg fared as follows:

- Efficiency of customs and border clearance: 9th (3.90);
- Quality of trade and transport infrastructure: 4th (4.24);
- Ease of arranging competitively priced international shipments: 1st (4.24);
- Competence and quality of logistics services: 10th (4.01);
- Ability to track and trace consignments: 8th (4.12);
- Frequency with which shipments reach consignees within scheduled or expected delivery times: 1st (4.80).

2.3 Conclusions

Many reports are published each year on the several aspects of competitiveness and territorial attractiveness. Country rankings are undoubtedly the most mediatised sections of reports by far. However, those reports tell a more complex tale which belies the apparent simplicity of overall rankings. When analysing benchmarks and rankings, one should not lose sight of the intrinsic limitations of such an exercise:

1. A rise or fall in the rankings does not mean that the performance of Luxembourg has improved or deteriorated. Such a development may also stem from the fact that other territories have experienced the effects of a shock more or less severely than Luxembourg. It is essential to take this relativity into account in international comparisons.

2. It is worth noting that there is a time lag between the time of publication of the rankings and many statistics used therein. The composite indices analysed in this 2016 edition of the Report still often use statistics dating back to 2012, 2013, 2014 and 2015. Therefore, these rankings should not be considered as short-term predicting tools.

3. Many rankings assume methodological differences. While the WEF attempts for example to measure the ability of countries to achieve sustainable economic growth, the IMD analyses the ability of countries to create and maintain a supporting environment for company competitiveness, as wealth creation is supposed to happen at the level of companies that operate within a national environment which either facilitates or hampers their competitiveness. Luxembourg's positions therefore vary from one ranking to another, even if they try to measure 'territorial competitiveness'.

4. The different rankings are criticized over suffering from methodological weaknesses, especially in three areas: the quality of sources (primary and secondary data), the core indicators used and the method for calculating the composite index (formulas, weights, etc.). For example, the 'one size fits all' indicators used in the same way for all countries analysed, often prove to be inadequate to the specificities of Luxembourg, which is a very small economy that is widely open. The best-known example is the 'GDP per capita' which, by its statistical construction, does not take into account the large flow of incoming cross-border workers in Luxembourg.[28] Thus, it strongly overestimates Luxembourg's performance. Another example is the indicator concerning the number of Luxembourg students in higher education, for which the data used often ignores the fact that a majority of Luxembourg students are studying abroad. Hence this indicator considerably underestimates Luxembourg's performance.

[28] Nearly 45% of the labour force in Luxembourg is currently border-workers.

5. The detail of which countries are analysed has an impact on comparability. For example, the WEF compares 138 countries, the IMD only 61 and the Heritage Foundation 186. This affects the relative position of countries in the rankings. For example, a decision could be made to only compare the EU. Luxembourg would then climb from the 20th world position to the 9th position (WEF), from the 11th to the 5th position (IMD) and from the 19th to the 8th position (Heritage Foundation).

6. There are countries or groups of countries in these rankings for which the performance is close, i.e. whose numerical values of the calculated composite indices are very close to each other. The mere country rankings can usually not show this. All things being equal, a slight increase (or decrease) in the value of the composite index could therefore lead to a significant rise (or fall) in the rankings. The rankings should therefore not be looked at separately from the value of the composite index. Significant differences in the rankings of countries may sometimes be related to small differences in the index.

Considering the above remarks, what should one think of these rankings and how should they be interpreted? Even if they trigger numerous concerns, these reports provide a useful performance calibration tool worthy to monitor. On one hand, these benchmarks summarize complex issues down to one single value and are thus extremely efficient communication tools that favour political debate and allow public authorities to evaluate their policies by comparing them to best practice. On the other hand, due to press coverage, these benchmarks and rankings also have a significant impact on the brand image of a territory and can influence the investors' perception (nation branding perspective).

Consequently, it is important to avoid caving into the syndrome of ranking for the sake of ranking. The indications provided in the final rankings are often of a character too general to be used and should help to focalise attention and lead to a more rigorous analysis. There is, indeed, no unique recipe. Different policies may be compared, but each country needs to adapt them to its own socio-economic environment. The strategies implemented succeed when economic imperatives and national social cohesion are in perfect balance.

To this end, in 2003 the Tripartite Coordination Committee in Luxembourg had identified the need for an enlarged indicator scoreboard in order to gain a better insight into the competitiveness of the country, through indicators that better reflect the specificities of the country. The Committee entrusted Professor Fontagné (University Paris I - Sorbonne) the task of elaborating proposals (November 2004)[29]. Since then the *Observatoire de la compétitivité* updates this national scoreboard[30].

[29] FONTAGNÉ L., Compétitivité du Luxembourg : une paille dans l'acier, Rapport pour le ministère de l'Économie et du Commerce extérieur, Luxembourg, November 2004, pp.102-120 For more information: http://www.odc.public.lu/publications/perspectives/PPE_003.pdf

[30] See Chapter 3 of this report for the most recent results of the scoreboard, which was initially compiled in 2003-2004. A review of the national scoreboard has been prepared over the last few years by the Economic and Social Council which, in July 2016, unanimously adopted its opinion on the national indicators system which will constitute the new, modernised and structured scoreboard. This new scoreboard should become operational ahead of the next edition of the report, scheduled for Autumn 2017.

2.4 Bibliography

GARELLI S.
World competitiveness – an overview of the fundamentals of our theory and the history of our research, IMD's World Competitiveness Center

HATEM F.
Les indicateurs comparatifs de compétitivité, in Problèmes économiques No. 2865, Paris, 22 December 2004

OCHEL W., ROEHN O.
Ranking of countries - the WEF, IMD, Fraser and Heritage indices, CESifo dice report, Journal for institutional comparisons, volume 4, No. 2, Summer 2006

THE ECONOMIST
How to lie with indices - Learn the ruses of international country rankings, November 2014

THE ECONOMIST
International comparisons are popular, influential - and sometimes flawed, November 2014

WEBSITES

http://composite-indicators.jrc.ec.europa.eu/

http://www.odc.public.lu/indicateurs/benchmarks_internationaux/index.html

http://www.swissinfo.ch/eng/business/How_competitive_are_competitiveness_rankings.html?cid=36258206

3 The Competitiveness Scoreboard

3.1 Introduction

To respond to the criticisms over some structural indicators and limitations of the composite indicators published by different international organisations, which are discussed in detail in chapter 2 of this report, the Tripartite Coordination Committee asked Professor Fontagné (University of Paris I - Sorbonne) in 2003 to draw up a national scoreboard to evaluate Luxembourg's competitiveness (known as the TBCO or Competitiveness Scoreboard). The initial version of the Scoreboard included 88 indicators divided into 10 categories. Over the years, the various contributors stopped updating several of the indicators from this initial version. This explains why the updated version of the national Scoreboard now includes just 77 indicators in this text, which serves as the annual update of the national Scoreboard. However, the Scoreboard still includes certain indicators which no longer provide relevant information or which have been replaced by new indicators of better statistical quality, making it necessary to revise the national Scoreboard.

In 2015 and 2016, the Economic and Social Council (ESC) has been reviewing the scoreboard. As this revision is not finalised yet, the *Observatoire de la compétitivité* is updating the scoreboard as it currently exists. The progress of the work on the review is explained in detail at the end of this chapter.

However, the revision of the Scoreboard indicators does not mean that the definition of competitiveness itself is under question. The *Observatoire de la compétitivité* recalls the broad definition of competitiveness, a definition which has been upheld by the Tripartite Committee and which was initially established by the Economic and Social Council. The latter sets the following targets for the government: '... the main role of the State is to contribute to achieving and maintaining a sustainable and high quality of life of the population of the country'. According to the ESC, competitiveness is a means to achieve these goals. Also according to the ESC, a country can be considered as being competitive if: 'its productivity increases at a similar or higher rate than that of its major trading partners having a comparable level of development, it manages to maintain a balance within an open market economy context, it has a high level of employment'.

The notion of competitiveness being rather complex, the Scoreboard aims to shed light on the different aspects of it and to simplify the global picture so that policy-makers, employees and employers strike the right balance in the formulation of future policies.

Table 1
Competitiveness Scoreboard Indicators

Category 1: Macroeconomic Performance (12 indicators)

- **A1**: Gross National Income per capita PPS
- **A2**: Real growth rate of GDP
- **A3**: Growth in domestic employment as a %
- **A4**: Unemployment rate as a %
- **A5**: Inflation rate as a %
- **A6**: Public balance as a % of GDP
- **A7**: Public debt as a % of GDP
- **A8**: Gross fixed capital formation of the public administration
- **A9**: Terms of trade
- **A10**: Real effective exchange rate 2000=1000
- **A11**: Diversification – Entropy coefficient
- **A12**: Foreign Direct Investment inflows and outflows

Category 2: Employment (9 indicators)

- **B1**: Employment rate as a % (Total)
- **B2**: Employment rate as a % (Men)
- **B3**: Employment rate as a % (Women)
- **B4**: Employment rate of persons aged 55-64 (Total)
- **B5**: Employment rate of persons aged 55-64 (Men)
- **B6**: Employment rate of persons aged 55-64 (Women)
- **B7**: Unemployment rate of persons under 25
- **B8**: Long-term unemployment rate as a %
- **B9**: Persons holding a part-time job

Category 3: Productivity and Labour Costs (4 indicators)

- **C1**: Trends in total factor productivity
- **C2**: Trends in apparent work productivity
- **C3**: Productivity per hour worked as a percentage of U.S. Charts
- **C4**: Changes in unit labour costs
- Costs / Revenue ratio in the banking sector*

Category 4: Market Operations (8 indicators)

- Percentage of full-time employees on minimum wage[1]*[2]
- **D2**: Price of electricity (excl. taxes and levies) – industrial users
- **D3**: Price of gas (excl. taxes and levies) – industrial users
- **D4**: Market share of the primary operator in cellular telephones
- Composite basket of fixed and cellular telecommunications (ex-VAT)*
- **D6**: Composite basket of cellular telephone rates (ex-VAT)
- **D7**: Broadband Internet access rates
- **D8**: Basket of domestic royalties for 2 Mbits leased lines
- **D9**: Value of public tenders using open procedure procurement
- **D10**: Total State aid as a % of GDP (except horizontal objectives)
- Market share of the primary operator in fixed telecommunications[3]*

Category 5: Institutional and Regulatory Framework (10 indicators)

- **E1**: Corporate tax rate
- **E2**: Income tax rate
- **E3**: Standard VAT rate
- **E4**: Tax wedge – Single, without children
- **E5**: Tax wedge – Married, with 2 children, one-wage-earner
- **E6**: Administration efficiency index
- **E7**: Law compliance index
- **E8**: Regulation quality index
- **E9**: Degree of sophistication of online public services
- **E10**: Full online availability of public services
- Public sector wage costs*

1 'Eurostat would like to inform countries that the table 'Full-time employees on the minimum wage' has been deleted on Eurostat's website as the methodological concept needs to be developed.'

2 Indicators signalled on a lighter background could not be updated for years and are therefore not taken into account for the analysis of the Scoreboard nor for the calculation of the composite indicator.

3 Indicators marked with an asterisk have not been updated.

Table 1
Continued

Category 6: Entrepreneurship (4 indicators)

- **F1**: Propensity for entrepreneurship
- **F2**: Self-employed jobs as a percentage of total employment
- **F3**: Net change in number of companies – start-up rate minus wind-up rate
- **F4**: Volatility amongst companies – start-up rate plus wind-up rate of disappearance

Category 7: Education and Training (5 indicators)

- **G1**: Annual cost per student in public educational facilities
- **G2**: Part of the population aged 25 to 64 with at least a secondary education
- Share of population aged 25 to 34 with university education*[4]
- **G4**: Share of human resources in scientific and technological fields as a % of total employment
- **G5**: Lifelong learning (participation of adults in training and teaching programmes)
- **G6**: Secondary school drop-outs
- Relative share of foreign nationals employment in science and technology human resources*
- Share of highly qualified workers (ICT) in total employment*

Category 8: Knowledge Economy (13 indicators)

- **H1**: Internal R&D expenditure
- **H2**: Public R&D budget credits
- **H3**: Portion of public research financed by the private sector
- Percentage of sales allocated to the introduction of new products on the market (new or significantly improved products)*
- **H5**: Number of researchers per 1,000 employed persons
- Scientific publications per million inhabitants*
- **H7**: Number of USPTO patents per million inhabitants
- **H8**: Number of OEB patents per million inhabitants
- **H9**: Use of broadband connections by companies
- **H10**: Investment in public telecommunications as a percentage of gross fixed capital formation
- **H11**: Percentage of households that have Internet access at home
- **H12**: Number of cell and fixed phones per 100 inhabitants
- **H13**: Percentage of households that have broadband Internet access
- **H14**: Number of secure web servers per 100,000 inhabitants
- **H15**: Percentage of total employment in medium or high technology sectors

Category 9: Social Cohesion (5 indicators)

- **I1**: Gini coefficient
- **I2**: At-risk-of-poverty rate after social transfers
- **I3**: At persistent risk of poverty rate
- **I4**: Life expectancy at birth
- **I5**: Gender wage gap
- Serious work-related accidents*

Category 10: Environment (7 indicators)

- **J1**: Number of ISO 14001 certifications
- **J2**: Number of ISO 9001 certifications
- **J3**: Total greenhouse gas emissions
- **J4**: Share of renewable energy
- **J5**: Volume of municipal waste generated
- **J6**: Energy intensity of the economy
- **J7**: Modal breakdown in transportation choice for passenger – Percentage of car users

Source: Fontagné (2004)

[4] For these indicators, indicators for Luxembourg are not available.

Since the 2004 Fontagné report, indicators of Luxembourg's Competitiveness Scoreboard are analysed in detail from two points of view. First, Luxembourg's position compared to the European average is highlighted.

- If Luxembourg shows a value that is 20% better (or equal) than the EU-x average, then the indicator is classified as 'green' (favourable position).

- If Luxembourg shows a value that is between +20% and -20% in relation to the EU-x average, then the indicator is classified as 'orange' (neutral position).

- If Luxembourg shows a value that is 20% lower (or equal) than the EU-x average, then the indicator is classified as 'red' (unfavourable position).

This ranking is a purely visual tool to quickly see where Luxembourg is in comparison with the EU average.

Secondly, Luxembourg's absolute performance is analysed over time by comparing the most recent data values with those from previous years. The arrows will indicate in which direction each indicator has recently changed (improvement or deterioration).

- ↑ If Luxembourg's performance has improved since the last edition of the Scoreboard, an arrow pointing upward will signal the indicator in question.

- → If Luxembourg's performance has remained stable since the last edition of the Scoreboard, a horizontal arrow will signal the indicator in question.

- ↓ If Luxembourg's performance has deteriorated since the last edition of the Scoreboard, an arrow pointing downward will signal the indicator in question.

Apart from the comparison with the European average, Luxembourg is also compared to the best and worst countries from the EU-x. As a reminder, the following acronyms are used:

Table 2
Acronyms

DE	Germany	**FR**	France	**PO**	Poland
AT	Austria	**GR**	Greece	**PT**	Portugal
BE	Belgium	**HU**	Hungary	**SK**	Slovak Republic
BU	Bulgaria	**IE**	Ireland	**CZ**	Czech Republic
CY	Cyprus	**IT**	Italy	**RO**	Romania
HR	Croatia	**LV**	Latvia	**UK**	United Kingdom
DK	Denmark	**LT**	Lithuania	**SL**	Slovenia
ES	Spain	**LU**	Luxembourg	**SE**	Sweden
EE	Estonia	**MT**	Malta		
FI	Finland	**NL**	Netherlands		

Source: Eurostat

Through the composite indicator, the indicators are summed up in a single number, with all the advantages and disadvantages this may imply. Often appreciated by the media, enjoying instantaneous compact information, this indicator cannot replace a serious and thorough analysis, by indicator, domain and sector of activity. On the contrary this composite indicator should encourage having a closer look at the Scoreboard.

The *Observatoire de la compétitivité* warns the reader against certain methodological aspects. The annual updating of data does not merely concern the previous year, but all the data from 2000 onwards is updated, depending on availability. This obviously has an influence on the outcome resulting from the current scoreboard, and especially on the ranking obtained from the composite indicator, as it is not stable in time and differences may appear from one edition of the report to the next for the same year. Thus, the yearly and quarterly data for the GDP are marked by two fundamental changes, namely the move to the new European System of Accounts ESA 2010 and the statistical revision of Charts for the period 2000-2013.

The missing data in the Scoreboard have a significant impact on the outcome of the Scoreboard, including on the composite indicator. As several EU countries are not OECD members (Bulgaria, Cyprus, Croatia, Latvia, Lithuania, Malta and Romania), the ranking provided by the composite indicator should be interpreted with caution, since some underlying indicators are not available for these countries. The same applies to the indicators of the Market Operations category, often derived from the OECD database that is only updated every two years. The following table provides information on the percentage of missing data in the Scoreboard for all countries. The indicators with at least 95% of data available are represented on darker background.

Table 3
Non-availability of data over time

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Macroeconomic Performance	2.1	1.5	0.3	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	16.7
Employment	4.0	3.2	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Productivity and Labour Costs	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
Market Operations	50.4	58.5	33.0	55.8	19.6	45.5	18.3	32.6	17.4	32.1	16.1	31.3	39.3	65.6	51.8	75.9
Institutional and Regulatory Framework	25.0	46.8	16.8	16.8	7.1	25.0	7.5	6.1	25.0	5.7	5.7	25.0	25.0	25.0	5.7	25.0
Entrepreneurship	15.2	15.2	15.2	15.2	15.2	28.6	28.6	6.3	31.3	5.4	28.6	29.5	6.3	50.0	75.0	75.0
Education and Training	22.9	15.7	2.9	4.3	2.9	0.7	2.1	1.4	2.9	2.1	2.9	1.4	20.0	20.0	20.0	20.0
Knowledge Economy	32.1	28.0	24.7	20.3	16.8	10.2	11.0	8.0	9.9	7.7	14.8	13.2	13.7	13.5	32.1	69.2
Social Cohesion	22.9	20.7	45.0	34.3	37.1	21.4	23.6	11.4	4.3	4.3	2.9	2.9	2.1	2.1	4.3	46.4
Environment	28.6	14.8	14.8	14.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	71.4

Source: *Observatoire de la compétitivité*

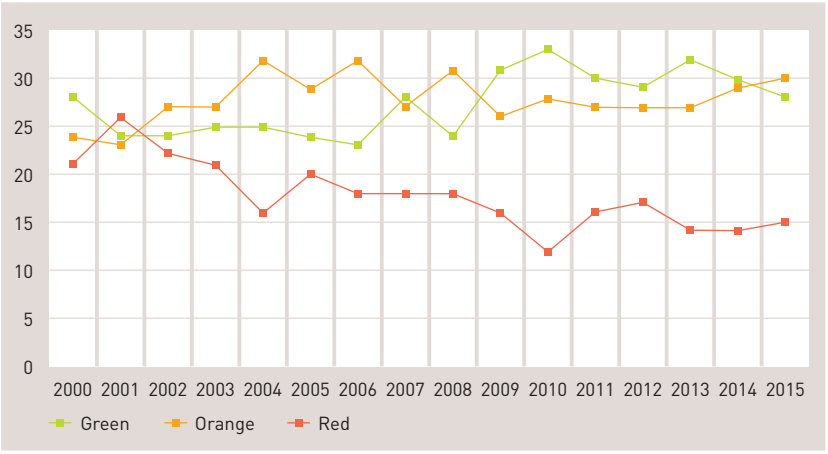
The Macroeconomic Performance, Employment, Productivity and Labour Costs, and Environment categories show the least missing data. Missing data are influenced by the source of the data. Actually, when it comes to OECD data, data concerning EU Member States which are not members of the OECD are automatically missing.

For the more 'structural' categories, data are published with some delay and a majority of 2015 data are not available for the Market Operations, Institutional and Regulatory Framework, Entrepreneurship, Knowledge Economy, Social Cohesion and Environment categories. From the moment they are available, this missing data obviously have a significant impact on the result of the ranking.

3.2 2016 Competitiveness Scoreboard

This sub-chapter analyses the indicators of the 10 categories. The green, orange and red colours inform on the position of Luxembourg in comparison with the EU average (EU-28 or OECD average). In 2015, for 28 of the 73[5] indicators Luxembourg recorded a performance above the Community average and for 15 indicators Luxembourg's performance was below the Community average, 30 indicators were average. Since 2001 the number of indicators in red has continuously decreased in favour of indicators in orange and green, which have slightly increased over the years.

Chart 1
Changes in indicators



Source: *Observatoire de la compétitivité*

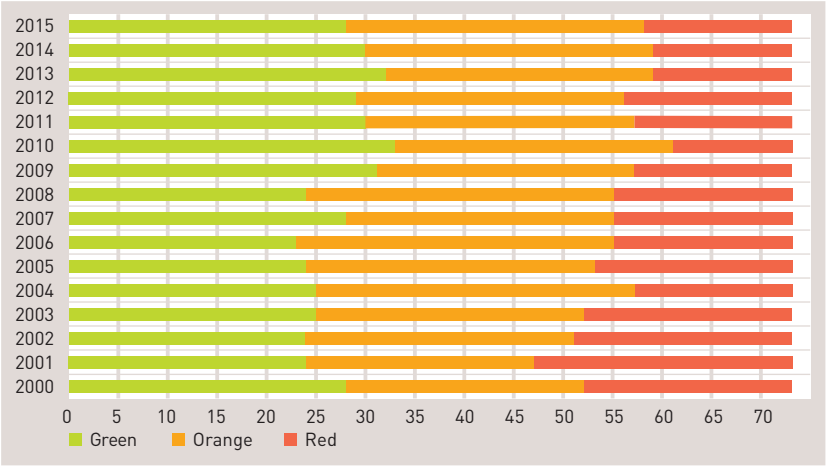
[5] For 4 of the 77 indicators a comparison with the other Member States doesn't make sense, as they are indices.

Table 4
Changes in colours since 2000

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Macroeconomic Performance		8	7	8	7	8	8	7	7	6	8	8	8	7	7	8	8
		1	2	2	3	2	2	2	3	3	1	2	2	2	3	2	1
		1	1	0	0	0	0	1	0	1	1	0	0	1	0	0	1
Employment		2	2	2	2	1	2	1	1	1	1	2	2	2	2	1	1
		3	3	3	4	5	4	6	5	5	7	7	6	7	6	7	5
		4	4	4	3	3	3	2	3	3	1	0	1	0	1	1	3
Productivity and Labour Costs		3	1	1	1	1	1	1	4	1	1	4	1	1	4	4	3
		1	0	0	0	2	0	1	0	0	0	0	0	0	0	0	1
		0	3	3	3	1	3	2	0	3	3	0	3	3	0	0	0
Market Operations		2	2	2	3	4	3	3	3	3	4	4	4	4	4	3	3
		4	4	4	3	4	4	3	3	3	2	1	1	1	1	2	3
		2	2	2	2	0	1	2	2	2	2	3	3	3	3	3	2
Institutional and Regulatory Framework		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
		3	2	3	3	4	2	3	3	4	4	4	4	4	4	4	4
		2	3	2	2	1	3	2	2	1	1	1	1	1	1	1	1
Entrepreneurship		1	1	0	0	0	0	0	0	1	1	1	1	1	1	1	1
		2	2	3	3	2	2	3	2	2	2	2	2	2	2	2	2
		1	1	1	1	2	2	1	2	1	1	1	1	1	1	1	1
Education and Training		0	0	0	1	1	0	0	0	0	3	3	3	3	3	3	2
		3	3	4	2	3	4	4	3	4	1	1	1	1	1	1	2
		2	2	1	2	1	1	1	2	1	1	1	1	1	1	1	1
Knowledge Economy		5	5	5	5	5	5	6	7	6	7	4	4	4	4	3	3
		2	2	2	3	3	4	4	3	5	4	7	7	6	6	7	7
		6	6	6	5	5	4	3	3	2	2	2	2	3	3	3	3
Social Cohesion		1	1	1	1	0	0	0	1	1	1	2	2	2	1	1	1
		4	4	4	4	5	5	5	4	4	4	3	3	3	4	4	4
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Environment		1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
		1	1	2	2	2	2	1	1	1	1	1	1	1	0	0	1
		3	4	3	3	3	3	4	4	4	4	4	4	4	4	4	3
Total		28	24	24	25	25	24	23	28	24	31	33	30	29	32	30	28
		24	23	27	27	32	29	32	27	31	26	28	27	27	27	29	30
		21	26	22	21	16	20	18	18	18	16	12	16	17	14	14	15
Total of indicators		73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73

Source: *Observatoire de la Compétitivité*

The Competitiveness Scoreboard



Note: For 4 indicators ('Terms of Trade', 'Real effective exchange rate', 'Total greenhouse gas emissions' and 'Modal breakdown in transportation choice for passenger') Luxembourg's performance over time is to be monitored through the base index 100. A comparison with the EU average does not make sense. The total of indicators amounts thus to 73 indicators.

Comparing Luxembourg against the EU average gives a relative dimension to the notion of competitiveness. Such a comparison pinpoints areas where Luxembourg is performing better than other Member States and areas where performance is rather mediocre and requires reform. It is also important to monitor Luxembourg's performance over time as an indicator being red does not mean that Luxembourg hasn't made an effort to improve on the previous year and a green indicator is not a sign of sudden improvement. In 2015, 39 of the 77 indicators showed signs of improvement whilst 34 indicators decreased in comparison with 2014 levels.

Table 5
LU indicator development compared to the previous year

		2009	2010	2011	2012	2013	2014	2015
Macroeconomic Performance	↑	4	5	7	4	4	8	8
	=	0	1	0	0	0	0	0
	↓	8	6	5	8	8	4	4
Employment	↑	8	5	1	7	4	7	2
	=	0	1	1	0	0	0	0
	↓	1	3	7	2	5	2	7
Productivity and Labour Costs	↑	0	4	0	0	4	1	3
	=	0	0	0	0	0	0	0
	↓	4	0	4	4	0	3	1
Market Operations	↑	5	6	2	3	4	4	5
	=	0	0	1	1	1	1	1
	↓	3	2	5	4	3	3	2
Institutional and Regulatory Framework	↑	7	4	2	2	2	2	2
	=	2	3	1	5	3	3	2
	↓	1	3	7	3	5	5	6
Entrepreneurship	↑	1	2	2	2	2	2	2
	=	0	0	0	0	1	0	0
	↓	3	2	2	2	1	2	2
Education and Training	↑	4	3	3	3	4	2	1
	=	0	0	0	0	0	1	0
	↓	1	2	2	2	1	2	4
Knowledge Economy	↑	8	6	7	6	8	6	6
	=	1	0	0	1	1	0	0
	↓	4	7	6	6	4	7	7
Social Cohesion	↑	2	4	4	1	2	4	4
	=	0	1	0	1	0	0	0
	↓	3	0	1	3	3	1	1
Environment	↑	5	1	6	6	7	4	6
	=	0	2	1	0	0	1	1
	↓	2	4	0	1	0	2	0
Total	↑	**44**	**40**	**34**	**34**	**41**	**40**	**39**
	=	**3**	**8**	**4**	**8**	**6**	**6**	**4**
	↓	**30**	**29**	**39**	**35**	**30**	**31**	**34**
Total of indicators		**77**	**77**	**77**	**77**	**77**	**77**	**77**

Source: *Observatoire de la compétitivité*

A more detailed analysis of each category, presented below in sections 3.2.1 - 3.2.10, is necessary to detect Luxembourg's strengths and weaknesses.

3.2.1 Macroeconomic Performance

Table 6
Category A Macroeconomic Performance

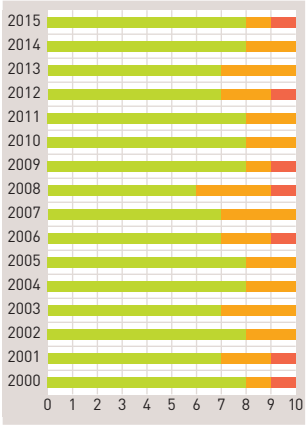
Code	Indicator		LU	Position of LU	EU-28	DE	FR	BE	MIN	MAX
A1	Gross national income at market prices, per capita in PPS (2015)	↓	177.6	1 / 28	100	127.7	107.8	119.5	BU 46	LU
A2	Growth rate of real GDP, as a % (2015)	↓	3.5	9 / 28	2.2	1.7	1.3	1.5	GR -0.2	IE 26.3
A3	Growth rate of domestic employment, as a % (2014)	↑	2.5	4 / 28	1.0	0.9	0.4	0.3	LV -1.3	MT 5.0
A4	Unemployment rate, as a % (2015)	↑	6.9	10 / 28	9.4	4.6	10.4	8.5	DE 4.6	GR 24.9
A5	Inflation rate, as a % (2015)*	↑	0.1	14 / 28	0.0	0.1	0.1	0.6	CY -1.60	MT 1.17
A6	Public balance, as a % of GDP (2015)	↑	1.6	1 / 28	-2.4	0.7	-3.5	-2.5	GR -7.5	LU
A7	Public debt, as a % of GDP (2015)	↑	22.1	2 / 28	85.0	71.2	96.2	105.8	EE 10.1	GR 177.4
A8	Gross fixed capital formation, as a % of GDP (2015)	↑	4.0	12 / 28	2.9	2.1	3.5	2.4	IE 1.7	HU 6.6
A9	Terms of trade (2015)	↑	104.35	11 / 28		103.14	102.75	96.9	SK 89.45	RO 145.4
A10	Real effective exchange rate (index 2000 =100) (2015)	↑	103.64	21 / 28	93.03	95.36	95.64	101.21	IE 89.25	SK 130.69
A11	Diversification – Entropy coefficient (2015)[6]	↓	0.863	25 / 28	0.903	0.875	0.898	0.878	LT 0.827	UK 0.924
A12	Market integration (2013)	↓	605.2	1 / 28	2.6	1.2	-0.1	-2.8	MT -11	LU

* LU inflation rate: IPCN, other IPCH; harmonized unemployment rate EUROSTAT/BIT LU: Adem

As regards Macroeconomic Performance, Luxembourg is a front-runner in most indicators. Only one indicator, the entropy coefficient (measuring the degree of diversification) is in orange. The inflation rate indicator is red, however the inflation differential vis-à-vis neighbouring countries is minimal, in spite of a VAT increase in 2015. In terms of year-on-year comparison, the situation in Luxembourg has worsened for 4 of the 12 indicators.

The real GDP growth rate stood at 3.5% in 2015 with Luxembourg placing 9th in the EU rankings. This level of growth is below pre-crisis levels as Luxembourg had an average annual growth rate of 4.7% between 2000 and 2007. It should be noted that the spectacular increase in Ireland's GDP (+26.3% in 2015) is due to the re-localisation of several economic operators and does not reflect an increase in gross fixed capital formation in Ireland.

Macroeconomic Performance



[6] The recent change of the NACE rev. 1.1 (6 branches) in Nace rev. 2 (10 branches) has a significant impact on the result of the entropy coefficient. In-depth analyses are necessary.

As regards the indicators measuring price competitiveness and cost competitiveness in Luxembourg, the real effective exchange rate (REER) has improved in 2015 in comparison with 2014. In the Macroeconomic Imbalance Procedure, a country is deemed to be potentially at risk if the REER is greater than 5% or below -5%[7].

Luxembourg continues to post mediocre results for diversification. However, this indicator is not a detailed reflection of the diversification efforts that the government has made over the last few years to develop its priority sectors such as ICT, eco-technologies, biotechnologies, logistics and space technologies with a view to preparing for the next growth cycle. Chapter 5 of this report provides more detailed information on initial developments in this area.

Please note that some of the information for this category has changed following the transition to the new European System of Accounts (ESA 2010) and the statistical revision of figures since the year 2000.

[7] See also chapter 4: 'Luxembourg in the European Semester' in the Competitiveness Report for more information.

3.2.2 Employment

Table 7
Category B Employment

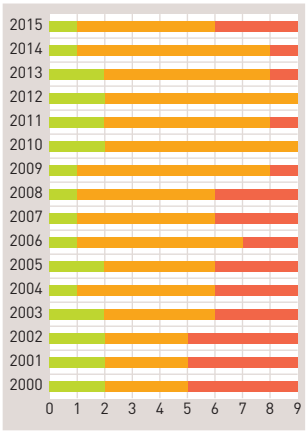
Code	Indicator		LU	Position of LU	EU-28	DE	FR	BE	MIN	MAX
B1	Employment rate, as a % (aged 15-64) (2015)	↓	66.1	12 / 28	65.6	74.0	64.2	61.8	GR 50.8	SE 75.5
B2	Employment rate – Men (aged 15-64) (2015)	↓	71.3	10 / 28	70.9	78.0	67.1	65.5	GR 59.3	NL 79
B3	Employment rate – Women (aged 15-64) (2015)	↑	60.8	14 / 28	60.4	69.9	60.6	58	GR 42.5	SE 74
B4	Employment rate of persons aged 55-64, as a % (2015)	↓	38.4	26 / 28	53.3	66.2	48.6	44	GR 34.3	SE 74.5
B5	Employment rate of persons aged 55-64 – Men (2015)	↓	43	27 / 28	60.1	71.3	50.6	48.9	SL 42.6	SE 76.8
B6	Employment rate of persons aged 55-64 – Women (2015)	↓	33.7	23 / 28	46.9	61.2	46.8	39.3	MT 21.9	SE 72.1
B7	Unemployment rate of persons under 25, as a % (2015)	↑	16.6	12 / 28	20.3	7.2	24.7	22.1	DE 7.2	GR 49.8
B8	Long-term unemployment rate, as a % (2015)	↓	1.9	5 / 28	4.5	2.0	4.3	4.4	SE 1.5	GR 18.2
B9	Persons holding a part-time job (2015)	↓	17.8	11 / 28	19	26.8	18.3	24.1	BU 2.2	NL 46.9

In the Employment category, Luxembourg's 2015 performance was below 2014 levels as the number of red indicators increased to three, whereas, since 2008, the number of red indicators was either zero or one. This time around, Luxembourg has only one green indicator, long-term unemployment, where Luxembourg is in 5th position.

In 2015, Luxembourg's employment rate dipped to 66.1%. It should be noted that the employment rate stated on the scoreboard refers to the 15-64-age bracket whereas the employment rate in the Europe 2020 strategy (national target: 73%) refers to an age range of 20-64 years so as to mitigate any possible mismatch between employment and education policies. For the 20-64-age range, the national employment rate stands at 70.9% in 2015. The employment rate falls when the population grows more rapidly than jobs are created and the Luxembourg population is currently growing rapidly, notably due to job-seeking immigrants from European countries affected by the crisis. The rise in the female employment rate has not been able to fully compensate for the fall in male employment in 2015. As regards older workers, the employment rate has fallen from 42.5% in 2014 to 38.4% in 2015 with a decline in both male and female employment rates for this age range.

The youth unemployment rate (<25 years) has been consistently on the rise in Luxembourg over the last few years.

Employment



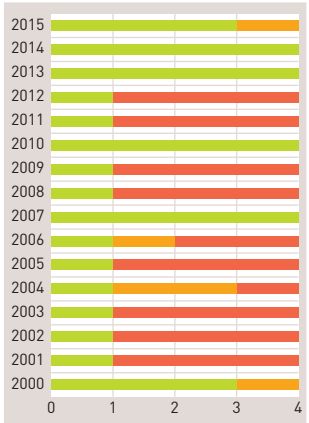
3.2.3 Productivity and Labour Costs

Table 8
Category C Productivity and Labour Costs

Code	Indicator		LU	Position of LU	EU-28	DE	FR	BE	MIN	MAX
C1	Trends in total factor productivity (2015)	↑	1.87	9 / 28	0.87	0.86	0.54	0.33	EE -1.79	IE 4.76
C2	Trends in apparent work productivity (2015)	↓	0.90	12 / 28	1.1	0.8	0.8	0.6	EE -1.4	IE 23.2
C3	Productivity per hour worked, as a % of US figures (2015)	↑	90	4 / 27	61.2	77.6	92.9	92.7	RO 19.1	IE 94.2
C4	Changes in unit labour costs (2015)	↑	0.1	12 / 28	1.9	1.6	0.3	-0.5	IE -16.5	EE 7.2

In the Productivity and Labour Costs category, three of the four indicators are green in 2015 with performance dipping only for trends in apparent work productivity. As regards productivity per hour worked as a % of US figures, Luxembourg has improved its score over the last three years but is still short of the figures posted before the 2008 crisis. The ULC is mostly used to ascertain price competitiveness as it establishes a direct link between costs and productivity. It measures the average labour cost per unit of output. An increase in labour costs corresponds with a greater reward for the contribution of labour to a unit of output Therefore, if there is a greater increase in labour costs than in productivity, this could potentially pose a threat to economic cost competitiveness if other costs, such as cost of capital, are not adjusted.

Productivity and Labour Costs



3.2.4 Market Operations

Table 9
Category D Market Operations

Code	Indicator		LU	Position of LU	EU-28	DE	FR	BE	MIN	MAX
D2	Price of electricity (excl. taxes and levies) – industrial users, in EUR per 100 kWh (2015)	↑	0.0842	16 / 28	0.089	0.0809	0.0757	0.0898	DK 0.0609	MT 0.1559
D3	Price of gas (excl. taxes and levies) – industrial users, in EUR per GJ (2015)	↑	11.72	25 / 26	10.03	11.35	10.23	8.42	RO 5.92	GR 12.11
D4	Market share of the primary operator in cellular telephones, as a % (2013)	↑	52.4	27 / 28	38	32.3	34.2	39.9	PO 29.8	CY 67.1
D6	OECD basket of mobile telephone rates for large consumers, VAT included – Total in USD (2014)	↑	562.46	11 / 20	618.07 *	789.30	321.25	723.17	FR	GR 1137.62
D7	Broadband Internet access rates in USD PPP/MB (VAT included) (2014)	↑	6.56	8 / 21	24.02 *	25.58	6.29	1.73	BE	PO 188.8
D8	OECD Basket of domestic royalties for 2 Mbits leased lines (excl. VAT) in USD (2014)	↓	9067	3 / 19	23623 *	14505	21529	16929	DK 1426	HO 3067549
D9	Value of public tenders using open procedure procurement, as % of GDP (2011)	↓	1.30	26 / 27	3.4	1.3	4.0	3.0	DE & LU	LV 17.6
D10	Total State aid as a % of GDP (except horizontal objectives) (2011)	→	0.24	2 / 27	0.51	0.53	0.62	0.43	BU 0.10	MT 1.60

*OCDE

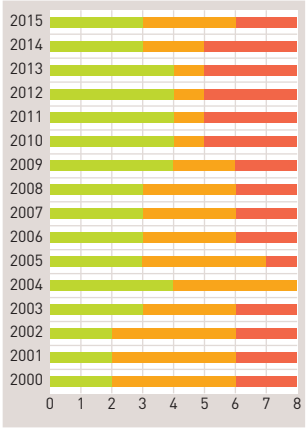
Luxembourg has rather mixed results in the Market Operations category. In 2015, three of the eight indicators are green whilst another three are orange and the remaining two red. Compared to the previous year, the number of red indicators has fallen by one and the number of orange ones has increased by the same margin. In comparison with 2014, Luxembourg improved its performance for five of the eight indicators in 2015.

Broadband Internet access charges have been progressively reduced in Luxembourg since 2007.

In comparison with 2014, 2015 saw a reduction in electricity and gas prices in Luxembourg. At first glance, Luxembourg does not seem to be competitive in these two indicators as electricity and natural gas prices for industrial users are above the European average. However, these indicators do not account for specific taxes (such as environmental taxes), VAT and recoverable taxes, which are significantly lower in Luxembourg than in other EU Member States. If the specific taxes had been factored into the calculation, Luxembourg would have scored higher for these two indicators.

It should be noted that the following indicators are no longer published by Eurostat and the latest available figures are from 2010 or 2011: Market share of the primary operator in cellular telephones, Total State aid as a % of GDP, Value of public tenders using open procedure procurement.

Market Operations



3.2.5 Institutional and Regulatory Framework

Table 10
Category E Institutional and Regulatory Framework

Code	Indicator		LU	Position of LU	EU-28	DE	FR	BE	MIN	MAX
E1	Corporate tax rate, as a % (2015)	→	29.22	22 / 28	22.8	29.7	33.33	34	BU 10	MT 35
E2	Income tax rate, as a % (2015)	→	43.6	11 / 28	39.3	47.5	50.3	53.8	BU 10	SE 57
E3	Standard VAT rate, as a % (2015)	↓	17	1 / 28	21.61	19	20	21	LU	HU 27
E4	Tax wedge – Single, without children, as a % (2015)	↓	38.3	6 / 21	36 **	49.4	48.5	55.3	IE 27.5	BE
E5	Tax wedge – Married, with 2 children, one wage-earner (2015)	↓	15.9	2 / 21	26.7**	34	40.5	40.4	IE 9.5	FR
E6	Administration efficiency index (2015)	↑	1.72	7 / 28	1.13	1.74	1.44	1.44	RO -0.04	DK 1.85
E7	Law compliance index (2015)	↓	1.86	5 / 28	1.14	1.78	1.41	1.42	BU -0.12	FI 2.07
E8	Regulation quality index (2015)	↑	1.67	7 / 28	1.17	1.67	1.15	1.28	HR 0.36	UK 1.86
E9	Degree of sophistication of online public services, as a % (2014)	↓	63	22 / 27	76.8	75	82	72	HU 43	MT / ES 100
E10	Full online availability of public services, as a % (2014)	↓	64	20 / 27	72.7	67	75	74	SK 44	MT 97

** OECD

Luxembourg has been unable to improve its performance against other Member States since 2000. Five indicators are green, four are orange and for only one indicator is Luxembourg's performance mediocre vis-à-vis the EU average.

Whilst Luxembourg has reduced its corporate tax rate from 37.5% in 2000 to 29.2% in 2015, this has not enabled it to gain ground on other Member States given that they too have decreased their corporate tax levels by roughly the same margin. Malta is the exception as it has kept its rate at a stable 35% since 2000 whilst Bulgaria has reduced its corporate tax rate to a mere 10%.

Despite increasing the standard VAT rate to 17% in 2015, Luxembourg still has the lowest standard VAT rate in the European Union. The intermediary VAT rates were increased from 12% to 14% and from 6% and 8% and the 'super-reduced' rate has remained unchanged at 3%. Luxembourg's *Observatoire de la formation des prix* says that "the real impact of the VAT rise on inflation is difficult to estimate as companies will react differently depending on their competitive situation. Some companies could prefer to lower pre-tax prices in order to mitigate the potential decline in demand. Other ones may opt to progressively adapt over the course of several months. Rate changes in Germany (2007), the Netherlands (2012) and France (2014) show that it is difficult to make an ex-post estimate of the impact of a change in VAT rates"[8].

As regards the tax wedges for single persons without children and for married couples with 2 children and one wage-earner, Luxembourg performs well in comparison with other Member States even though the scores are lower than in 2014.

In comparison with 2014 figures, there has been an improvement in two of the three World Bank indicators (administration efficiency and regulation quality) whilst one indicator (law compliance) has decreased.

Institutional and Regulatory Framework

[8] Impact assessment of the VAT increase in 2015 on consumer prices in Luxembourg, Ministry of the Economy, *Observatoire de la formation des prix*, 2016.

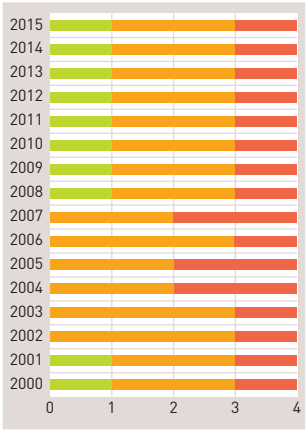
3.2.6 Entrepreneurship

Table 11
Category F Entrepreneurship

Code	Indicator		LU	Position of LU	EU-28	DE	FR	BE	MIN	MAX
F1	Propensity for entrepreneurship, as a % (2012)	↓	36	13 / 27	37	29	40	30	SE 22	LT 58
F2	Self-employed as a percentage of total employment (2015)	↓	5.1	27 / 28	15.4	10	10.3	16.8	SE 4.8	GR 31.7
F3	Net change in number of companies, as a % (2013)	↑	2.45	6 / 27	1.91	-1.07	3.44	0.89	IE –1.91	LT 6.40
F4	Volatility among companies, as a % (2013)	↑	17.61	17 / 27	20.24	15.47	16.42	7.85	BE	LT 42.60

Luxembourg's performance in the Entrepreneurship category is in line with the EU average as two indicators are orange, one is green and one is red. It should be noted that the figures for two of the indicators have dipped and that the other two have improved in comparison with the previous available figures. The OECD report entitled 'The Missing Entrepreneurs 2015 – Policies for Self-Employment and Entrepreneurship' reveals some interesting information about female entrepreneurship in Luxembourg. Female business ownership in Luxembourg is at a mere 2%, the lowest of all the OECD countries. However, it also transpires that self-employed women in Luxembourg earn much more than female salaried workers. In other OECD countries, self-employed women earn slightly less than salaried workers. Also, the perception of having the skills necessary to set up a business varies across the OECD countries with women in Austria, Greece, Slovenia and Spain being twice as likely to feel that they have entrepreneurial skills than women in Luxembourg.

Entrepreneurship



3.2.7 Education and Training

Table 12
Category G Education and Training

Code	Indicator		LU	Position of LU	EU-28	DE	FR	BE	MIN	MAX
G1	Annual cost per student in public educational facilities, in PPS (2011)	↓	13033	28 / 28	6914	7493	7716	9088	RO 2088	LU
G2	Part of the population having achieved at least the second cycle of secondary education, as a % (2015)	↓	76	21 / 28	76.5	86.8	77.5	74.7	MT 43.5	LT93.5
G4	Share of human resources in scientific and technological fields, as a % of total employment (2015)	↓	58.8	1 / 28	45.2	47.7	50	50.5	RO 27	LU
G5	Lifelong learning, as a % of the population aged between 25-64 (2015)	↑	18.0	6 / 28	10.7	8.1	18.6	6.9	RO 1.3	DK 31.3
G6	Secondary school drop-outs, as a % (2015)	↓	9.3	15 / 28	11	10.1	9.3	10.1	HR 2.8	ES 20

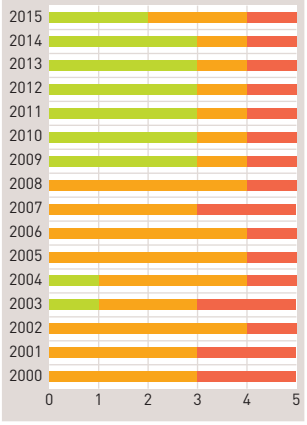
In 2015, only two of the five indicators in the Education and Training category are green whilst two are orange. One indicator is red: annual cost per student in public education facilities (indicator G1), with Luxembourg ranking last. In its report entitled 'Education at a Glance', the OECD compares this cost with national wealth (see Frame 1). It would be wise to pinpoint other indicators such as the efficiency of spending.

As regards the share of human resources in science and technology as a percentage of total employment, Luxembourg scores 58.8% in 2015, with the percentage dropping for the first time since 2000, when it stood at 37.7%

76% of the Luxembourg population aged between 25 and 64 have obtained secondary education qualifications, thus placing Luxembourg in 21st position in the EU. Germany and France fare better than Luxembourg with scores of 86.8% and 77.5% respectively. Belgium is slightly behind Luxembourg with a score of 74.7%.

In 2015, the school drop-out rate was 9.3% in Luxembourg, an increase on the 2014 figure.

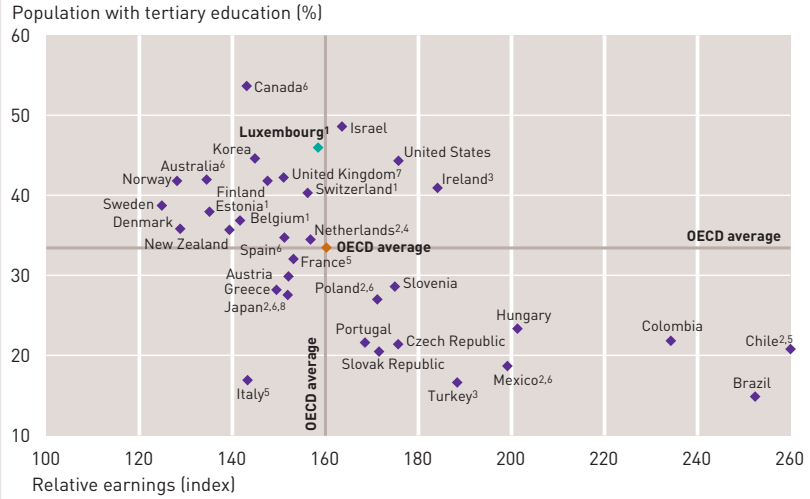
Education and Training



Frame 1
Education at a Glance, OECD (2015)

In its annual 'Education at a Glance' report, the OECD plotted the earnings of workers with tertiary education qualifications against the percentage of such individuals in the population. 'The chart provides some evidence of the influence of the supply-and-demand of tertiary-educated workers on relative earnings. The earnings advantages are largest in countries with a small share of tertiary-educated people, such as Brazil, Chile, Colombia, Hungary and Mexico, whereas earnings advantages are smallest in countries with a large share of tertiary-educated people, such as Norway and Sweden.' The percentage of tertiary-educated individuals in Luxembourg is higher than elsewhere and they have higher revenues, meaning that Luxembourg deviates slightly from the overall trend.

Relative earnings of tertiary-educated workers and their share in the population (2013)
25-64 year-olds with income from employment; upper secondary education = 100

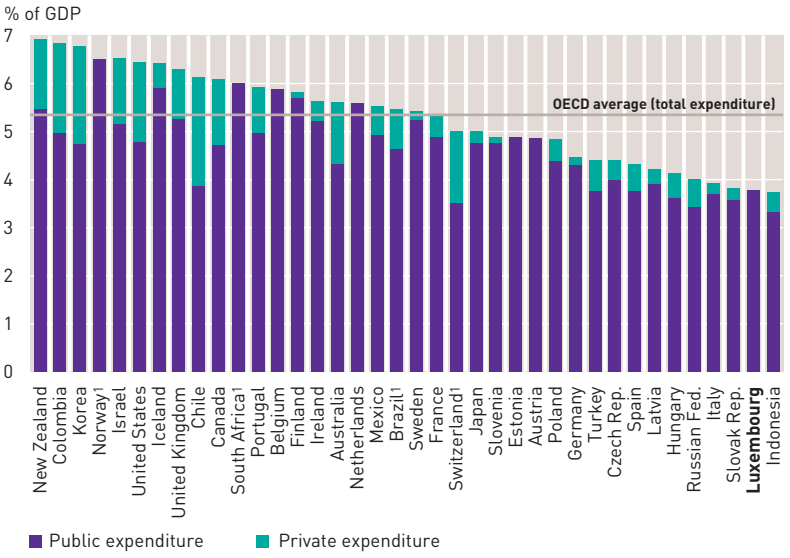


Note: All tertiary includes short cycle tertiary, bachelor's, master's, doctoral or equivalent degrees. Data on educational attainment refers to year 2014 or latest available year.
1. Belgium, Estonia, Luxembourg, Switzerland: Index 100 refers to the combined ISCED levels 3 and 4 of the educational attainment levels in the ISCED 2011 classification.
2. Chile, Japan, Mexico, the Netherlands, Poland: Index 100 refers to the combined ISCED levels 3 and 4 of the educational attainment levels in the ISCED-97 classification.
3. Ireland, Turkey: Earnings net of income tax.
4. The Netherlands: Year of reference 2010.
5. Chile, France, Italy: Year of reference 2011.
6. Australia, Canada, Finland, Japan, Mexico, Poland, Spain: Year of reference 2012.
7. The United Kingdom: Data for upper secondary attainment includes completion of a sufficient volume and standard of programmes that would be classified individually as partial level completion of upper secondary education.
8. Japan: Data on educational attainment exclude short-cycle tertiary education at the tertiary level.
Source: OECD. Tables A1.3a and A6.1a.

Frame 1
Continued

Another graph in the OECD publication put expenditure on primary to tertiary education institutions as a percentage of GDP into perspective. Luxembourg invests less than 4% of its GDP in education with investment in tertiary education totalling less than 0.5% of GDP.

Expenditure on primary to tertiary education institutions as a percentage of GDP (2012)
From public and private sources, including undistributed programmes



1. Public expenditure only (for Switzerland, in tertiary education only; for Norway, in primary, secondary and post-secondary non-tertiary education only).
Countries are ranked in descending order of expenditure from both public and private sources on educational institutions.
Source: OECD. Table B2.3.

3.2.8 Knowledge Economy

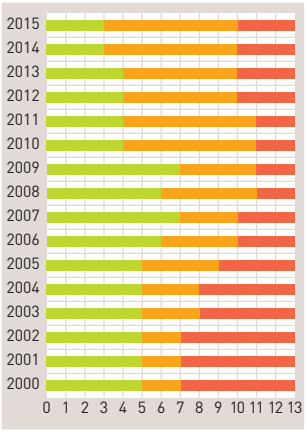
Table 13
Category H Knowledge Economy

Code	Indicator		LU	Position of LU	EU-28	DE	FR	BE	MIN	MAX
H1	Internal R&D Lisbon expenditure, as a % of GDP (2014)	↓	1.26	17 / 28	2.03	2.87	2.26	2.46	RO 0.38	FI 3.17
H2	Public R&D budget credits, as a % of GDP (2013)	↑	48.4	5 / 28	32.7	29.1	35.2	28.5	SL 21.8	CY 62.1
H3	Portion of public research financed by the private sector, as a % of GDP (2013)	↓	16.5	27 / 28	55.0	65.4	55.0	56.9	CY 12.1	SL 68.4
H5	Number of researchers per 1,000 employed persons (public and private sectors taken together) (2014)	↓	6.44	18 / 22	7.74	8.22	9.88	10.30	RO 2.10	FI 15.33
H7	Number of USPTO patents per million inhabitants (2015)	↑	90.59	11 / 28	86.79	203.81	98.85	100.64	LV 2.01	SE 270.12
H8	Number of OEB patents per million inhabitants (2014)	↓	109.32	9 / 28	111.59	255.95	138.48	137.3	HR 3.43	SE 349.36
H9	Use of broadband connections by companies, as a % (2013)	↑	98	6 / 28	93	88	99	98	RO 73	CY 100
H10	Investment in public telecommunications, as a % (2009)	↓	1.54	12 / 21	1.66*	1.16	1.33	1.91	AT 0.76	PT 2.75
H11	Percentage of households that have Internet access at home, as a % (2015)	↑	97	1 / 28	83	90	83	82	BU 59	LU
H12	Number of cell phones per 100 inhabitants (2013)	↓	217.2	1 / 21	166.3*	204.1	176.1	179.9	SK 143.3	LU
H13	Percentage of households that have broadband Internet access (2015)	↑	95	1 / 28	80	88	76	79	BU 59	LU
H14	Number of secure web servers per 100,000 inhabitants (2014)	↑	261.79	1 / 21	90.59*	138.35	64.66	84.18	GR 14.40	LU
H15	Percentage of total employment in medium or high technology sectors (2015)	↓	0.8	27 / 28	5.7	9.9	4.4	4.6	CY 0.8	CZ 11.2

* OECD

The colours on the graph above show that Luxembourg's performance in the Knowledge Economy stakes is identical to that of the previous year with only three of the 13 indicators in green, whilst there were seven in 2007 and 2009. However, it should also be noted that Luxembourg places 1st for two orange indicators, namely H11 and H13 (which measure Internet access), and that the EU average is so high that it is almost impossible to exceed the EU average by more than 20%. Luxembourg is a front-runner in four ICT indicators, thus reflecting Luxembourg's commitment to promoting this sector.

Knowledge Economy



However, there are some indicators in this category where Luxembourg's performance is mediocre, such as R&D expenditure as a percentage of GDP, which has decreased from 1.69% in 2006 to 1.30% in 2016. As the OECD has recommended on several occasions, an instrument should be sought out to measure *the efficiency of public R&D spending and cluster creation policies*. The 2016 NRP[9] includes a multitude of measures to be implemented with a view to strengthening RDI policy in both the public and private sectors, including the law of 27/08/2014 amending the National Research Fund (FNR), the law of 03/12/2014 on the organisation of public research centres, the FNR's CORE and INTER programmes, the Luxembourg Cluster Initiative, the creation of the Luxembourg Intellectual Property Institute (IPIL), etc.

The percentage of total employment in medium or high technology sectors (defined as sectors requiring a relatively high R&D intensity, such as aeronautics and space construction, pharmaceuticals, chemicals and the automotive industry) remains below the EU average. This can be explained by the fact that manufacturing jobs make up only a small share of total jobs in Luxembourg.

[9] 2016 National Reform Programme: http://www.gouvernement.lu/5693901/2016-pnr-luxembourg-fr.pdf

3.2.9 Social Cohesion

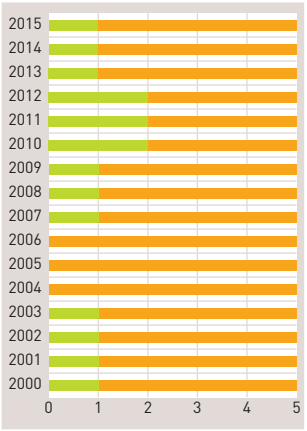
Table 14
Category I Social Cohesion

Code	Indicator		LU	Position du LU	EU-28	DE	FR	BE	MIN	MAX
I1	Gini coefficient (2014)	↑	28.5	12 / 28	31	30.1	29.2	26.2	SL 23.7	LT 37.9
I2	At-risk-of-poverty rate after social transfers, as a % (2014)	↑	15.3	12 / 28	17.3	16.7	13.6	14.9	CZ 9.7	RO 25.4
I3	At persistent risk-of-poverty rate, as a % (2014)	↓	12	19 / 28	10.3	9.5	8.5	9.8	DK 4.3	RO 20.2
I4	Life expectancy at birth in numbers of years (2014)	↑	82.3	5 / 28	80.9	81.2	82.8	81.4	LV 74.5	ES 83.3
I5	Gender wage gap, as a % of gross hourly wages of male employees (2014)	↑	13.2	6 / 28	17.2	25	13.5	14.9	SL 6.7	EE 27.4

Even though Luxembourg is in the average for most of the Social Cohesion indicators, four of the five indicators have shown signs of improvement in the last year, namely the Gini coefficient, the poverty rate, the gender wage gap and life expectancy at birth. Compared to its performance last year, Luxembourg's score has decreased for the at persistent risk-of-poverty rate but the at-risk-of-poverty rate has improved from 16.4% to 15.3% in 2015.

With a score of 28.0% in 2015, Luxembourg ranks 11th of the 28 EU Member States in the Gini coefficient indicator. A Gini coefficient of 0 means that the entire population has the same revenue (perfect equality) whilst a score of 1 means that just one individual accounts for the entirety of the income whilst everyone else's income is 0.

Social Cohesion



3.2.10 Environment

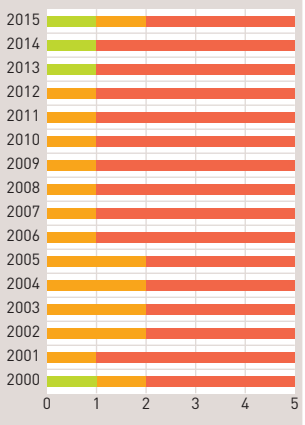
Table 15
Category J Environment

Code	Indicator		LU	Position of LU	EU-28	DE	FR	BE	MIN	MAX
J1	Number of ISO 9001 certifications per million inhabitants (2014) (2015)	↑	443	22 / 28	780	649	418	317	PO 278	IT 2188
J2	Number of ISO 14001 certifications per million inhabitants (2015)	↑	188	16 / 28	214	101	103	103	PO 73	RO 533
J3	Total greenhouse gas emissions (index 1990=100) (2014)	↑	90.56	21 / 28	77.05	73.5	85.37	79.07	LT 40.5	MT 150.88
J4	Share of renewable energy (2014)	↑	4.5	28 / 28	16	13.8	14.30	8	LU	SE 52.6
J5	Volume of municipal waste generated in kg per person, per year (2014)	→	616	25 / 28	474	618	509	435	RO 254	DK 758
J6	Energy intensity in kg of oil equivalent per thousand of euros (2014)	↑	94.8	3 / 28	121.6	114.1	120.1	141.2	DK 68.6	BU 445.2
J7	Modal breakdown in transportation choice for passenger method – Percentage of car users in passenger kilometres (pkm) (2014)	↑	90.3	11 / 27	93.1	94.9	97.7	95.4	SK 54.2	GR 140.6

Luxembourg posts reasonably mediocre results in the Environment category as, for almost all the indicators, it is over 20% adrift of the EU average in spite of the efforts that have been made to improve its position in six of the seven indicators. Unfortunately, these efforts have not enabled Luxembourg to bridge the gap.

Luxembourg has increased its share of renewable energies five-fold over the 2004-2014 period. Only Malta, Belgium and the United Kingdom were able to make fairly rapid progress in their share of renewable energies over the past years. The majority of countries have only been able to double at bet their share of renewable energies over a 10-year period.

Environment



3.3 Competitiveness composite indicator

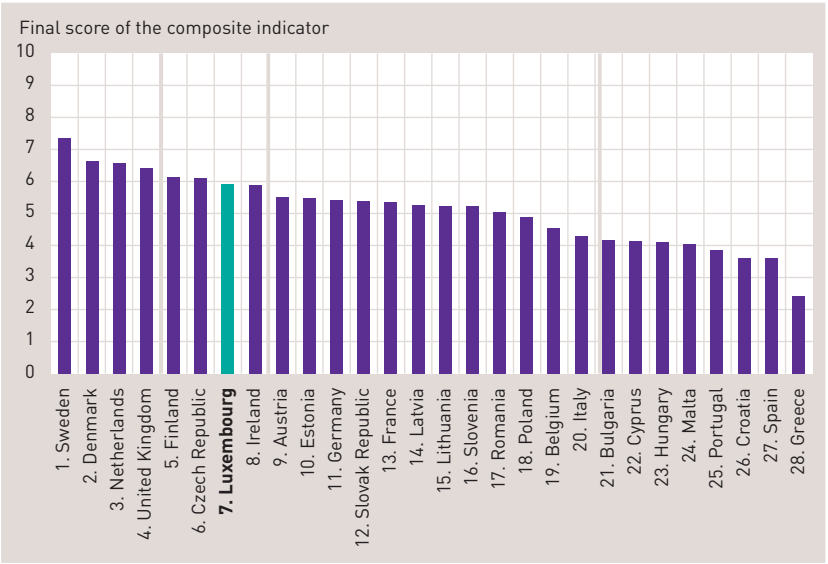
3.3.1 General result

In 2015, Luxembourg ranked in 7th place and moved down one position in comparison with last year. Sweden, Denmark and the Netherlands were the group leaders as usual. Germany (11th) moved up one position in comparison with 2014, France moved down two to 13th position, and Belgium (19th) moved down one position in comparison with last edition. Greece, Spain, Croatia and Portugal were at the other end of the rankings. The major winner in the overall rankings was Cyprus, which seems to have overcome the serious crisis of the past few years, rising from 27th to 22nd place.

Luxembourg is currently two places lower than its best rank, obtained in 2013. Analysis of the composite indicator results below shows that some countries are very evenly matched. Over the last four years, the top four places have been occupied by Sweden, Denmark, the Netherlands and the United Kingdom. Luxembourg is nestled in the chasing pack alongside Finland, the Czech Republic and Ireland.

The middle section of the rankings (from 9th to 20th position) can be divided into an upper group (from 9th to 16th) including Germany and France, and a group trailing behind which includes Poland, Belgium and Italy. Portugal, Malta, Croatia and Spain are among others bringing up the rear of the rankings, while Greece keeps sticking to the last position.

Chart 2
Final score of the composite indicator



Source: Calculation *Observatoire de la compétitivité*

The method for calculating the composite indicator remains unchanged. However, we remind the calculation method hereunder. Only the updating of data may have an impact on the rankings of previous years.

Frame 2

Methodology

Concerning the methodology for calculating the composite indicator, we take the recommendations made by the audit into account (2010 Competitiveness Report, Perspectives économiques No. 15).

For some indicators, there are outliers. In particular, the indicators[10] on direct investment (A12), broadband Internet access rates (D7), basket of domestic royalties for 2 Mbits leased lines (D8) and number of ISO 14001 certifications (J1). For each of these indicators, there is a country that has a value significantly higher than all other countries: Luxembourg (A12), Greece (D7), Hungary (D8) and Italy (J1). Given the dramatic increase in the Irish GDP in 2015, indicators A2, C2 and C4 have also been processed as outliers for Ireland. As all these indicators are likely to influence the result too much, extreme values were replaced by the value of the country in second position.

In order to address the problem of missing values, the 'hot-deck imputation' method is used. The idea is to estimate a country's missing values based on the values of a country that shows a similar performance for the other indicators in the same category.

For the composite indicator calculation, basic indicators are standardized first. Each indicator is processed by the following formula by country j at time t.

$$y_{ij}^{t} = \frac{x_{ij}^{t} - \min_{j} x_{ij}^{t}}{\max_{j} x_{ij}^{t} - \min_{j} x_{ij}^{t}}$$

The composite index C for a category k (k = 1, ..., 10) at time t is calculated by averaging the sub-indicators of this category in the new scale:

$$C_{k,j}^{t} = \frac{1}{m_k} \sum_{i=1}^{m_k} y_{ij}^{t}$$

The composite indices of the 10 categories are then standardized in order to balance the impact of the 10 categories in the final composite indicator.

$$\hat{C}_{k,j}^{t} = \frac{C_{k,j}^{t} - \min_{j} C_{k,j}^{t}}{\max_{j} C_{k,j}^{t} - \min_{j} C_{k,j}^{t}}$$

The final composite indicator CI is achieved by a simple arithmetic mean of these composite indicators, which means the 10 categories are equally weighted.

$$CI_{j}^{t} = \frac{1}{10} \sum_{k=1}^{10} \hat{C}_{k,j}^{t}$$

As every year, the *Observatoire* warns the reader that certain technical aspects have a considerable impact on the result of the rankings. Firstly, the positions of the seven countries that are not OECD members (Bulgaria, Cyprus, Croatia, Latvia, Lithuania, Malta and Romania) need to be put into perspective, as a number of the Scoreboard indicators do not exist for these countries.

[10] Technically, these indicators have been identified by the fact they have a very high skewness and kurtosis.

Secondly, the rankings are constructed relatively, which means that Luxembourg's ranking also depends on the performance of the other countries. Even if Luxembourg's performance is bad, it may be that other countries have deteriorated much more, so that the relative position of Luxembourg improves at the end. The rankings do not say anything about the absolute performance of Luxembourg.

In other words, an improvement of a country's ranking may be caused by a deterioration in the performance of other countries. That is why the *Observatoire de la compétitivité* always recommends interpreting the rankings by completing it with the additional information provided by the Scoreboard, i.e. basic indicators.

3.3.2 Results per category

Luxembourg has dropped one position in the overall standings and its performance in the 10 categories shows a certain degree of consistency. In seven of the ten categories, Luxembourg has retained its 2014 position whilst in the 'Entrepreneurship' category it has gained a position, jumping from 19th to 18th. However, it has dropped three places in the 'Employment' category and six in 'Education and Training'. Luxembourg ranks in the top 10 in five of the ten categories: 'Macroeconomic Performance', 'Productivity and Labour Costs', 'Institutional and Regulatory Framework', 'Knowledge Economy' and 'Social Cohesion'.

However, the 'Productivity and Labour Costs' score should be interpreted with caution, as the standings are very volatile due to the fact that the indicators are heavily dependent upon the economic conditions and can thus seesaw. Also, the indicators are regularly reviewed and can subsequently create further changes to the standings.

Luxembourg's environmental performance remains mediocre with only Greece and Cyprus scoring worse. It should be noted that the majority of the indicators in this category date back to 2014 as data are published with a certain time lag.

The aggregation formula gives equal weight to the 10 categories, regardless of the number of indicators within each category. Competitiveness in a broad sense is measured through the 10 categories of the Scoreboard. No dimension is prioritised by construction.

Table 16
Rankings by category in 2015

	Cat A	Cat B	Cat C	Cat D	Cat E	Cat F	Cat G	Cat H	Cat I	Cat J
Germany	13	3	12	17	14	27	17	4	18	19
Austria	19	8	19	4	12	21	13	6	12	16
Belgium	26	18	8	9	23	24	21	9	8	24
Bulgaria	4	17	21	13	21	4	22	28	26	17
Cyprus	23	21	14	23	13	15	19	20	17	27
Croatia	17	27	24	18	27	25	14	21	20	10
Denmark	9	4	18	2	8	26	3	3	4	21
Spain	24	26	17	22	16	17	27	19	23	12
Estonia	8	6	28	7	2	16	5	11	25	7
Finland	22	9	15	20	7	23	2	1	5	11
France	21	13	9	3	20	12	11	10	6	22
Greece	28	28	25	27	28	2	23	22	22	28
Hungary	5	16	26	26	25	22	20	16	13	13
Ireland	3	12	1	24	1	20	15	13	15	23
Italy	25	25	20	8	24	10	24	14	16	5
Latvia	20	11	23	5	9	6	12	26	24	3
Lithuania	18	10	27	12	6	1	4	25	27	8
Luxembourg	**1**	**15**	**4**	**16**	**5**	**18**	**16**	**7**	**10**	**26**
Malta	7	14	6	28	10	14	28	18	9	25
Netherlands	14	2	5	6	4	13	6	5	7	18
Poland	10	19	16	14	18	7	8	24	19	20
Portugal	27	20	22	21	15	8	26	17	21	15
Romania	2	24	3	1	26	3	25	27	28	1
United Kingdom	12	5	13	10	3	9	9	8	14	9
Slovak Republic	15	22	11	19	22	5	18	23	11	2
Czech Republic	11	7	7	15	17	19	10	15	3	4
Slovenia	16	23	10	25	19	11	7	12	1	14
Sweden	6	1	2	11	11	28	1	2	2	6

Note: Cat. A Macroeconomic Performance, Cat. B Employment, Cat. C Productivity and Labour Costs, Cat. D Market Operations, Cat. E Institutional and Regulatory Framework, Cat. F Entrepreneurship, Cat. G Education and Training, Cat. H Knowledge Economy, Cat. I Social Cohesion, Cat. J Environment

Luxembourg has been in 1st place in the 'Macroeconomic performance' category since 2000 (except in 2005 and 2006), and its performance in the 'Institutional and Regulatory Framework' and 'Knowledge Economy' categories has been relatively stable from 2000 to 2015.

Over recent years, Luxembourg has improved its performance in the 'Education and Training' category moving from 24th in 2007 to 10th in 2014 before dropping 6 places in 2015. Luxembourg's score in the 'Environment' category has been mediocre for several years. After a 4th place ranking for social cohesion in 2011, Luxembourg fell several places in 2013 and is currently in 10th position.

The 'Productivity and Cost of Labour' category is highly volatile given that the indicators are largely dependent upon the economic situation. The transition to the new European System of Accounting (ESA 2010) led to a thorough revision of productivity data, which explains these latest changes in the standings for this category. However, Luxembourg has a good performance in this category for 3 years.

Table 17
Rankings of Luxembourg by category between 2000 and 2015

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Macroeconomic Performance	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1
Employment	13	14	13	14	17	16	16	17	19	11	9	11	11	12	12	15
Productivity and Labour Costs	6	25	11	20	9	17	12	2	25	19	5	21	27	1	4	4
Market Operations	19	13	14	14	12	15	11	18	16	8	11	11	15	16	16	16
Institutional and Regulatory Framework	6	6	2	2	3	3	5	3	4	3	3	2	2	3	5	5
Entrepreneurship	13	16	21	17	18	23	20	27	24	22	21	20	22	22	19	18
Education and Training	23	24	23	24	22	22	23	24	24	13	12	11	13	11	10	16
Knowledge Economy	7	9	8	8	6	6	6	6	6	6	7	6	10	9	7	7
Social Cohesion	6	12	12	11	11	10	11	10	6	10	5	4	6	11	10	10
Environment	24	26	25	24	25	24	26	24	25	25	27	27	26	25	26	26

Source: *Observatoire de la compétitivité*

3.3.3 The composite indicator stress test

The *Observatoire de la compétitivité* has undertaken a stress test of its composite indicator. The test consists in excluding one by one the 77 indicators and recalculating the rankings. Other scenarios include not imputing missing values or not treating outliers. This gives 84 different scenarios.

The table below shows that Luxembourg places 7th in 54% of the scenarios, in 8th place in 44% of the eventualities and in 6th position in 2% of the 84 scenarios. Therefore, the predominant range is positions 7 to 8. The stress test also shows that Sweden ranks 1st in all of the alternative scenarios and that there is virtually no change in position for Denmark, the Netherlands and the United Kingdom. The chasing pack, i.e. Finland, Czech Republic and Ireland, rank between 5th and 8th. The group of mid-rank countries, from 9th downwards, is characterised by volatility with, for example, Slovakia's position ranging from 9th to 16th. The countries ranked 21st to 25th form a separate group with significant internal variations and features Croatia and Spain, whose scores are almost identical. Greece ranks in last position in 99% of the alternative scenarios.

Table 18
The 2015 stress test, as a %

Country	Main Scenario	Average of 84 alternative scenarios	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Sweden	1	1.0	100																											
Denmark	2	2.1		87	13																									
Netherlands	3	2.9		13	86	1																								
United Kingdom	4	4.0			1	98	1																							
Finland	5	5.3				1	73	24	2																					
Czech Republic	6	5.8					24	70	6																					
Luxembourg	**7**	**7.4**						**2**	**54**	**44**																				
Ireland	8	7.5					2	4	38	56																				
Austria	9	9.6									52	36	11	1																
Estonia	10	10.0									39	42	11	4	2	1		1												
Germany	11	11.3									2	12	46	33	5	1														
Slovak Republic	12	12.0									6	7	19	29	29	7	2	1												
France	13	12.6										2	12	27	45	10	2		1											
Latvia	14	14.4										1	1	2	11	37	32	15												
Lithuania	15	15.2												1	1	18	38	40	1											
Slovenia	16	14.9												2	7	26	25	39												
Romania	17	17.2																2	81	12	4	1								
Poland	18	17.8																	17	83										
Belgium	19	19.0																		5	95									
Italy	20	20.1																			1	88	10	1						
Bulgaria	21	21.4																				6	57	26	10	1				
Cyprus	22	22.3																				1	25	35	23	12	4	1		
Hungary	23	22.6																				4	6	29	51	11				
Malta	24	23.6																					2	10	14	69	5			
Portugal	25	24.9																							2	7	90			
Croatia	26	26.5																										50	49	1
Spain	27	26.5																									1	49	50	
Greece	28	28.0																											1	99

Source: *Observatoire de la compétitivité*

3.3.4 Evolution of the final position of Luxembourg in the Competitiveness Scoreboard over time

The Competitiveness Scoreboard rankings are not fixed over time. In fact, the data are reviewed regularly by the various organizations that serve as major sources, such as Eurostat, OECD and the World Bank. In particular, national accounts are regularly updated, which has a significant influence on some of the indicators. Another factor is the non-availability of certain data when publishing the Competitiveness Report: part of the data, especially for the Social Cohesion and Environment categories, are published with some delay, and other data are only issued every two years (e.g. several indicators of the Market Operations category).

These factors explain the 2015 rankings do not remain fixed. Once all the data is available, the final rankings can change more or less dramatically. The following table shows the ranking variation of Luxembourg over time, depending on the publication of the Competitiveness Report.

Table 19
Change in the position of Luxembourg in the Competitiveness Scoreboard over time

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2007 Report	2	7	7	8	6	5	5									
2008 Report	5	7	5	8	6	7	6	9								
2009 Report	7	9	9	9	7	8	8	10	13							
2010 Report	6	11	9	9	8	6	8	9	11	9						
2011 Report	8	11	9	10	6	6	9	8	10	9	10					
2012 Report	6	10	10	9	6	6	11	9	9	6	8	11				
2013 Report	7	10	8	9	6	6	11	9	9	8	8	9	13			
2014 Report	6	9	7	7	6	7	11	9	10	8	6	10	13	6		
2015 Report	6	11	8	7	6	7	7	7	9	6	6	7	12	6	6	
2016 Report	6	11	9	7	6	7	7	7	9	7	6	9	13	5	6	7

Source: *Observatoire de la compétitivité*

In the 2012 Competitiveness Report, Luxembourg was ranked 11th for the year 2011, and after reviewing several indicators and receiving other data not yet available at the time of its release, Luxembourg gained two positions in the 2013 edition. After the review of several indicators, Luxembourg is currently ranked 9th for this year 2011.

In general, we can say that changes in Luxembourg's position were small in the latest editions of the Competitiveness Report. Other countries, especially non-OECD countries, vary more, as part of the data is not available. A revision of the indicators has therefore a greater effect on their final score. Finally, it should be noted this is a relative ranking and Luxembourg's position depends not only on its own performance but also on the performance of other countries.

In 2010 the *Observatoire de la compétitivité* had commissioned an audit with the Joint Research Centre (JRC)[11] of the European Commission[12]. This JRC is the centre of excellence in quantitative analysis that has collaborated, among other things, in drafting the OECD manual on the construction of mathematical indicators. This audit was performed in order to carry out a thorough statistical analysis and a critical assessment of the Scoreboard and of the competitiveness composite indicator while providing suggestions for possible improvements. Following the recommendations of the external audit, the *Observatoire de la compétitivité* took into account some changes in the imputation of missing values, the processing of outliers and of strongly correlated indicators[13]. These recommendations have been implemented since the 2010 Competitiveness Report.

In general, the external audit by Michaela Saisana was very positive about the *Observatoire de la compétitivité*'s Competitiveness Scoreboard composite indicator. She emphasized the transparency in the calculation of the indicator and the precise definition of competitiveness, the phenomenon to be measured. The Competitiveness Scoreboard is based on the definition from the Economic and Social Council (ESC), which is *'the ability of a nation to sustainably improve the standard of living of its inhabitants and to provide them with a high level of employment and of social cohesion while preserving the environment'*. The indicator also does not simply reflect the size of the country. Indeed, the result of the composite indicator is not correlated with a country's population or the gross domestic product (GDP). A simple correlation with GDP would portray the competitiveness of Luxembourg as simply productivity, but for the *Observatoire de la compétitivité* the competitiveness definition of the ESC prevails and is much broader.

The *Observatoire de la compétitivité* has always advocated an analysis on multiple levels, i.e. not simply establishing a mere country ranking. On the contrary, a detailed analysis of indicators is essential, as it was done in this chapter.

[11] For further information: http://composite-indicators.jrc.ec.europa.eu/

[12] Perspectives de politique économique No. 15: The Luxembourg Competitiveness Index: Analysis & Recommendations: http://www.odc.public.lu/publications/perspectives/PPE_015.pdf

[13] Details of the changes are explained in point 3.4 of the 2010 Competitiveness Report.

3.4 Competitiveness Scoreboard 2.0

In the preface of the 2013 Competitiveness Report, the Minister of Economy and Foreign Trade, Mr Etienne SCHNEIDER, expressed the following wish: *"...In order to ensure better operational and integrated monitoring of this competitiveness, I suggest to introduce a new system of indicators at the national level, based on the European Union's macro-economic imbalances' procedure scoreboard, called 'MIP'. This new system should allow us to better detect any significant internal and external deterioration in our competitiveness. But I also want this new system of indicators to be further enriched by the ongoing discussions in the Economic and Social Council and in the Higher Council for Sustainable Development within a long-term perspective of the PIBien-être project and, after consulting the Tripartite Coordination Committee, I hope this new system will be enshrined in a new 'Law on competitiveness'. This law would replace the set of obsolete indicators mentioned in the Grand-Ducal Regulation of 4 April 1985 adopted in application of the amended law of 24 December 1977, that is to say, the law establishing the Tripartite Coordination Committee."*

In response to this request, the Economic and Social Council (ESC) set up a working committee in 2014 to revise the Scoreboard, together with STATEC and the *Observatoire de la compétitivité*. The working committee held several meetings in 2014 and 2015 to try to come to an agreement with the stakeholders on a structure which reflects as efficiently as possible all of the aspects of competitiveness.

The new ESC scoreboard's architecture will offer two complementary views: an aspect-by-aspect view which will show each of Luxembourg's individual economic, social and environmental strengths and weaknesses as well as a general overview in which the economic, social and environmental aspects are intertwined.

The choice of indicators is based on the work carried out by the *Observatoire de la compétitivité* and the Economic and Social Council in its PIBien-être project as well as on the work of European and international institutions such as Eurostat and the OECD. The ESC decided on several criteria for making their choice: ensuring spatial and temporal comparison, relevance, statistical quality, indicator frequency, coverage of the Europe 2020 and MIP indicators, elimination of obsolete and duplicate indicators. The ESC also decided not to reopen the debate on the PIBien-être indicators and opted instead to flesh out or refine education, entrepreneurship and R&D statistics.

The ESC believes that it is important to clearly structure the indicators and ensure a balance between the different aspects of sustainable development. For each dimension of sustainable development, 'meta' indicators, i.e. the essentials, are retained to enable Luxembourg to be compared with the rest of the EU. The new scoreboard will also feature secondary indicators which reflect Luxembourg's specificities. The list of secondary indicators is merely indicative and is not exhaustive.

The current indicators for entrepreneurship and education are unsatisfactory given that they do not fairly reflect the situation in Luxembourg or have analytic limitations. The ESC proposes that indicators based on work carried out by the OECD and the European Union be factored in at a later stage.

The new scoreboard features three main categories: Economy, Social and Environment.

The 'Economy' category is divided into three sub-categories: stability and attractiveness, cost competitiveness and non-cost competitiveness.

The 'Social' category looks at living standards and quality of life, well-being and social cohesion, i.e. the labour market, education, income, property and indebtedness, inequality and poverty, living conditions, housing, health.

The 'Environment' category covers energy efficiency and raw materials, renewable energy, harmful emissions, waste treatment, nature and ecosystems, biodiversity and the transition towards a green economy.

The new system of indicators is envisaged as a reference tool for the political debate, shedding light on areas where Luxembourg's performance is insufficient. Furthermore, it will feed into discussions between the government and social partners, a requirement under the European Semester. The new scoreboard may end up replacing the criteria stipulated in the national regulation of 05/04/1985, which do not consider the social and environmental dimensions.

The ESC tasked the *Observatoire de la compétitivité* with analysing the availability and reliability of the indicators chosen. An 'ESC indicators' Working Committee will discuss and approve the results on the basis of the stress test results.

4 Luxembourg in the European semester

This chapter is monitoring Luxembourg's indicators and targets within the framework of the European Union strategy for growth and jobs (Europe 2020 strategy) and the macroeconomic imbalance procedure (MIP)[1]. These two pillars of the new European economic governance were implemented by the REGULATION (EU) No. 1175/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 November 2011 amending Council Regulation (EC) No. 1466/97 on the strengthening of the surveillance of budgetary positions and the surveillance and coordination of economic policies[2]. This chapter focuses mainly on Luxembourg performances and national targets. Consequently, it doesn't aim to assess European indicators and objectives at EU level.

4.1 Thematic coordination of structural policies

4.1.1 Implementation of thematic coordination under the Europe 2020 strategy

The Europe 2020 strategy[3], which is a central element of the EU's response to the global economic crisis, has been designed to update and replace the Lisbon strategy[4] that was launched in March 2000 and renewed in 2005 as a European strategy for growth and jobs. This new strategy involves closer coordination of economic policies and focuses on the key areas where action must be taken to boost the potential of sustainable and inclusive growth and competitiveness in Europe. It was considered that the end of the crisis should be the entry point into a social market economy, a greener and smarter economy, in which prosperity will be the result of the capacity to innovate and of a better use of resources, and where knowledge will be a key element. In early 2010, the Commission made proposals to implement this new Europe 2020 strategy[5]. In March 2010, on the basis of a communication from the Commission, the European Council discussed and approved the strategy's main elements, including key objectives which will guide its implementation, as well as provisions to improve monitoring. The European Council agreed on a series of elements[6]. The June European Council[7] finally completed the development of the new Europe 2020 strategy.

1 However, the analysis of the situation of Luxembourg in the coordination of budgetary policies (SGP) is not the subject of this section. With regards to the economic policy measures implemented by Luxembourg to achieve the objectives of the Europe 2020 strategy, reference is made to the 2016 NRP, submitted in April 2016 by the government to the European Commission within the framework of the European Semester.

2 For additional details: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:306:0012:0024:FR:PDF

3 For additional details: http://ec.europa.eu/eu2020/index_fr.htm

4 For additional details: http://ec.europa.eu/archives/growthandjobs_2009/

5 EUROPEAN COMMISSION, EUROPE 2020 - A strategy for smart, sustainable and inclusive growth, COM (2010) 2020, Brussels, le 3.3.2010

6 EUROPEAN COUNCIL, Conclusions, Brussels, March 2010
For additional information: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/fr/ec/113602.pdf

7 EUROPEAN COUNCIL, Conclusions, Brussels, June 2010
For additional information: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/fr/ec/115348.pdf

The European Council confirmed in particular five major EU objectives, which are shared objectives guiding the action of Member States and of the EU in terms of promoting employment, improving the conditions for innovation and R&D, achieving the objectives in the field of climate change and energy, improving education levels and promoting social inclusion, in particular by reducing poverty:

- *aiming to raise to 75% the employment rate for women and men aged 20-64, including through the greater participation of young people, older workers and low-skilled workers and the better integration of legal migrants;*

- *improving the conditions for research and development, in particular with the aim of raising combined public and private investment levels in this sector to 3% of GDP; the Commission will elaborate an indicator reflecting R&D and innovation intensity;*

- *reducing greenhouse gas emissions by 20% compared to 1990 levels; increasing the share of renewables in final energy consumption to 20%; and moving towards a 20% increase in energy efficiency; the EU is committed to taking a decision to move to a 30% reduction by 2020 compared to 1990 levels as its conditional offer with a view to a global and comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities;*

- *improving education levels, in particular by aiming to reduce school dropout rates to less than 10% and by increasing the share of 30-34 years old having completed tertiary or equivalent education to at least 40%;*

- *promoting social inclusion, in particular through the reduction of poverty, by aiming to lift at least 20 million people out of the risk of poverty and exclusion. The population is defined as the number of persons who are at risk-of-poverty and exclusion according to three indicators (at-risk-of poverty; material deprivation; jobless household), leaving Member States free to set their national targets on the basis of the most appropriate indicators.*

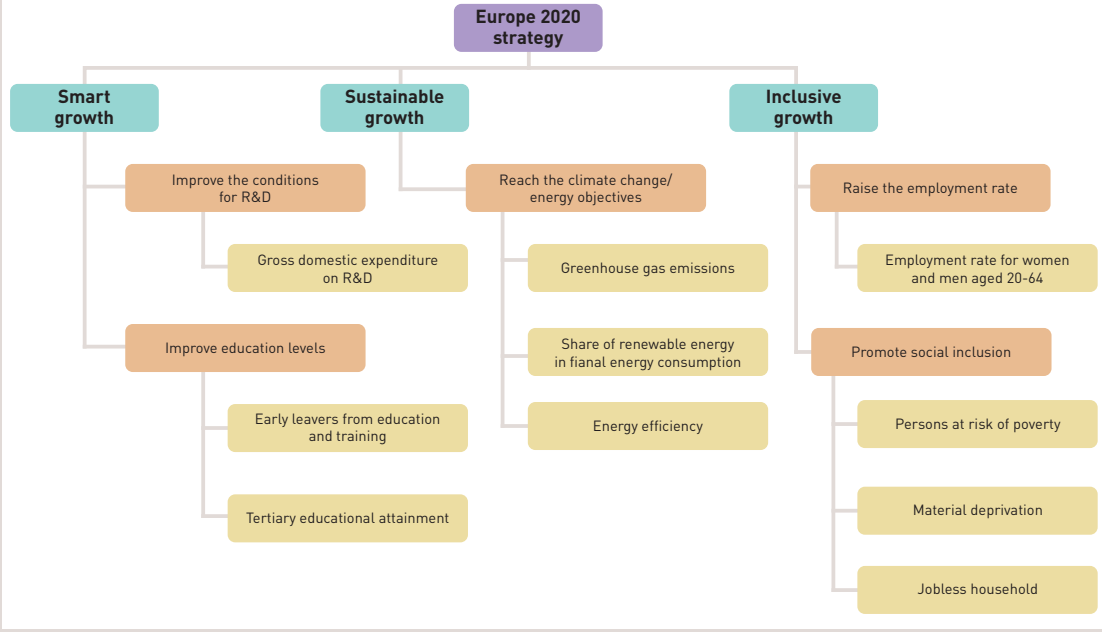
4.1.2 Priorities, objectives and indicators

Obviously the new governance of the Europe 2020 strategy, including main European objectives and monitoring indicators, will not alone create growth, jobs and prosperity. It should nevertheless ensure that major emphasis on quantitative targets and indicators. Implementing policies without measurable goals and without monitoring indicators is not the way forward because the assessment would then be totally subjective. Despite the many limitations of the indicators (data availability, comparability, etc.) such a tool for decision support is the best way to measure the performance of policies. Past experience has shown that for a successful monitoring the system must meet certain initial conditions. It is not enough to base the monitoring mechanism only on territory rankings resulting from a list of indicators selected during painstaking negotiations and based on compromise (and which is therefore likely to please everyone); to discuss objectives and indicators only amongst experts, without ensuring an adequate involvement of the general public; to be restricted to ex-ante indicators (input) measuring the resources invested, without resorting to indicators measuring ex-post performance and the efficiency of the resources involved (output).

The 'thematic coordination of structural policies' component of the Europe 2020 strategy is based on three priorities, five goals and ten indicators:

- Three mutually reinforcing priorities - smart growth, sustainable growth and inclusive growth;
- Five major European goals to reach by 2020 - to improve the conditions for R&D, to improve education levels, to reach the climate change and energy objectives, to promote employment and to reduce poverty;
- Ten indicators to measure the progress in achieving the objectives - gross domestic expenditure on R&D, early school leaving rate, proportion of higher education graduates or with an equivalent level of education, greenhouse gas emissions, share of renewable energy sources in final energy consumption, energy efficiency, employment rate for women and men aged 20-64, risk of poverty, material deprivation and jobless household.

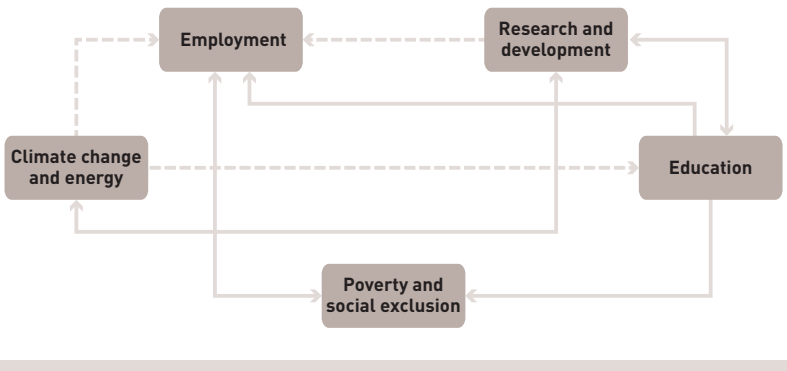
Chart 1
Priorities, objectives and indicators of the 'thematic coordination' in Europe 2020



Note: Diagram drafted by the *Observatoire de la compétitivité* based on the communication from the European Commission (March 2010) and the conclusions of the European Council (June 2010)

These priorities and objectives are closely linked. For example, higher education levels improve employability and help increase the employment rate, which helps reduce poverty, and a greater R&D and innovation capacity combined with increased resource efficiency improves competitiveness and promotes job creation; investing in cleaner and low carbon technologies improves the environment, contributes to fight against climate change and creates new business and job opportunities.

Chart 2
Links between the 5 objectives of the Europe 2020 strategy



Source: Eurostat

Given the diversity of EU Member States and their varying levels of development, applying the same objectives and criteria to all Member States as it had been originally done in the context of the Lisbon Agenda, has not proven to be the right approach. The major European objectives therefore no longer apply uniformly to all Member States in the context of Europe 2020. They are European objectives to be broken down into national targets, according to the initial conditions and specificities of each Member State, in dialogue with the European Commission.

Table 1
National targets set by Luxembourg (April 2016)

		European objective 2020	**Luxembourg target 2020**
Priority 1 *'smart growth'*	Objective 1	*'(...) raising combined public and private investment levels to **3%** of GDP'*	**2.3 to 2.6% interval**
	Objective 2	*'(...) reduce the early school leaving rate to **less than 10%**'*	sustainably less than **10%** [a]
		*'(...) increasing the share of people aged 30-34 who graduated from higher education or reached an equivalent level to **at least 40%**'*	**66%** [b]
Priority 2 *'sustainable growth'*	Objective 3	*'(...) **reducing** greenhouse gas emissions **by 20%** (...)'*	reducing non-ETS greenhouse gas emissions by **-20%** compared to 2005 (emissions of approximately 8,145 Mt CO_2 in 2020) [c]
		*'(...) increasing the share of renewable energy sources in final energy consumption to **20%**'*	**11%** [c] (2015/2016 average 5,45%)
		*'(...) moving towards a **20%** increase in energy efficiency'*	Final energy consumption: **49,292 GWh,** being **4,239.2 ktoe**
Priority 3 *'inclusive growth'*	Objective 4	*'(...) raise to **75%** the employment rate for women and men aged 20-64'*	**73%** (71.5% for 2015)
	Objective 5	*'(...) lift at least **20 million people** out of the risk of poverty and exclusion.'*	reduce the number of people at risk of poverty or social exclusion **by 6,000 people** by 2020 [d]

Sources: European Council, Eurostat
Notes:
[a] National data will also be used as a measuring instrument, since the indicator calculated by Eurostat, from the Labour force survey, is not fully representative for Luxembourg. Attention should be paid to producing statistics that better distinguish people who attended schools in Luxembourg, in order to measure the quality of the national education system (national resident population) and assess the ability of the Luxembourg school system to train young people.
[b] Luxembourg would like this indicator to provide information on the ability of the national education system to make young people able to successfully complete tertiary education, rather than it being a reflection of the skills needed within the higher education labour market. In Luxembourg there is a strong disparity by country of birth (according to Eurostat, the foreigner resident rate is close to 60% and the national resident rate is somewhat above 40%), while in neighbouring countries, the differences between these two populations are much less pronounced and the proportion of graduates in these countries is higher among indigenous people than among non-indigenous people.
[c] For greenhouse gas emissions and renewable energy binding national targets already existed before the launch of the Europe 2020 strategy. For the 2013-2020 post-Kyoto period only non-ETS sectors are subject to targets set at Member State level. The 2020 non-ETS emissions reduction objective is compared to the level of 2005.
[d] As regards the methodology, the indicator used in the Europe 2020 strategy does not sufficiently take into account national demographics. Luxembourg has very dynamic demographics, even in times of crisis, and thus the relative nature of the indicator used, i.e. a % of the population, inevitably leads to an increase in the absolute number of people concerned.

European objectives can only be achieved if, on the one hand the sum of national targets leads to the fulfilment of European objectives and on the other hand, the first condition being fulfilled, if each Member State meets its national commitments for 2020. This type of governance therefore includes a *de facto* system of 'peer pressure', which should ensure that countries that do not adequately implement their national commitments are called to order by their peers as they may cause the failure of major European objectives, and therefore also the efforts of those countries that have fulfilled their commitments.

Eurostat publishes periodically monitoring indicators for each Member State[8] in order to be able to annually take stock of the state and determine if performances are going in the right direction.

The following pages will analyse the updated indicators for Luxembourg in more detail and a descriptive overview[9] will be presented[10]. Reference is made to the 2016 NRP for Luxembourg for more details on the measures implemented, in order to explain the evolution of the indicators[11].

A. Smart growth

a.1 Improving conditions for innovation and R&D

Investment in R&D, along with human capital, is essential for the development of knowledge and new technologies. The Barcelona European Council set the spending target of 3% of GDP on R&D in March 2002. This was one of the two key objectives of the former Lisbon strategy. The logic underlying the setting of this objective was that knowledge-based economies allocated a significant portion of their resources to R&D when the Lisbon strategy was launched (e.g. in 2000 2.7% in the United States and 3% in Japan). For the Europe 2020 strategy, it was proposed that this 3% European objective be maintained as a symbol, to focus political attention on the importance of R&D. The evolution of this indicator will largely depend on structural factors and public policies promoting R&D.

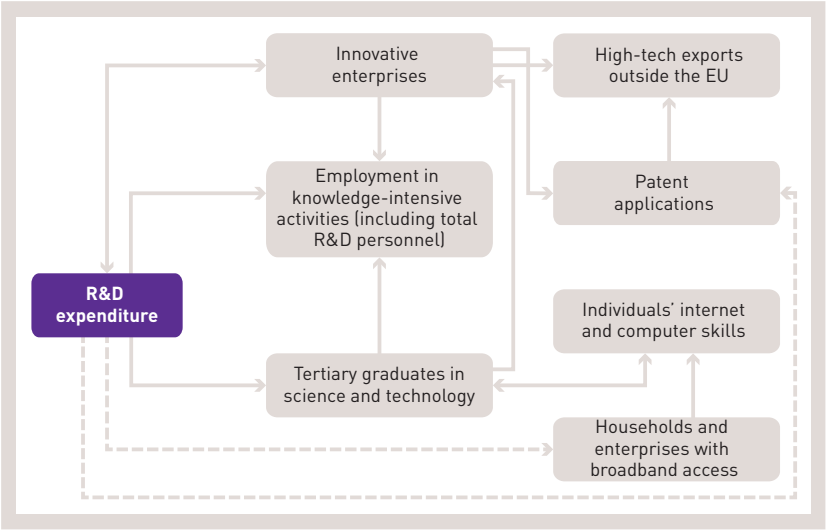
[8] For additional information: http://ec.europa.eu/eurostat/web/europe-2020-indicators/statistics-illustrated The new Europe 2020 indicators will replace in the future the Lisbon structural indicators used in the *Observatoire de la compétitivité*'s Competitiveness Scoreboard.

[9] On its website Eurostat provides comments regarding the quality of the statistics for the different Member States (series breaks, projections, uncertain data, etc.), which will not be repeated here.

[10] For more details about other EU Member States: EUROSTAT, Europe 2020 Strategy - towards a smarter, greener and more inclusive EU economy?, 2016

[11] For additional details: http://www.gouvernement.lu/5693901/2016-pnr-luxembourg-fr.pdf

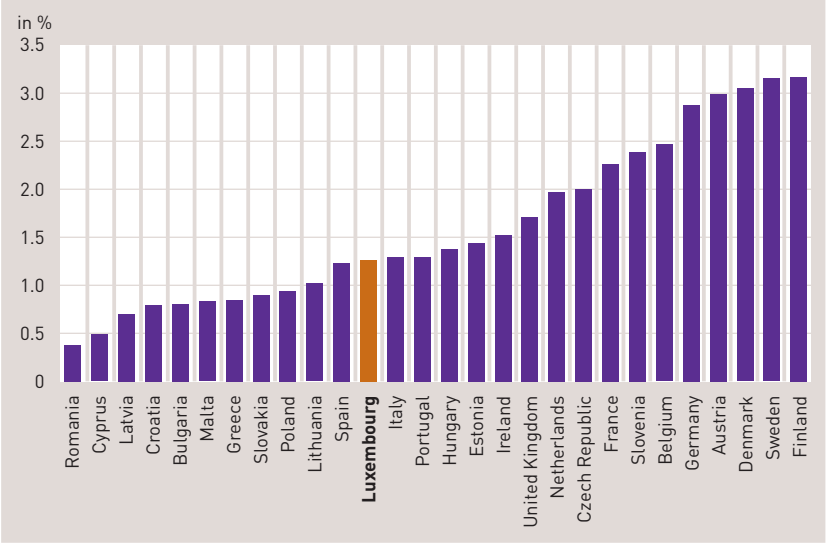
Chart 3
R&D objectives



Source: Eurostat

In 2014, the EU average for R&D expenditure was around 2% with Luxembourg (1.26%) scoring significantly below this average[12].

Chart 4
Gross domestic expenditure on R&D, as a % of GDP (2014)



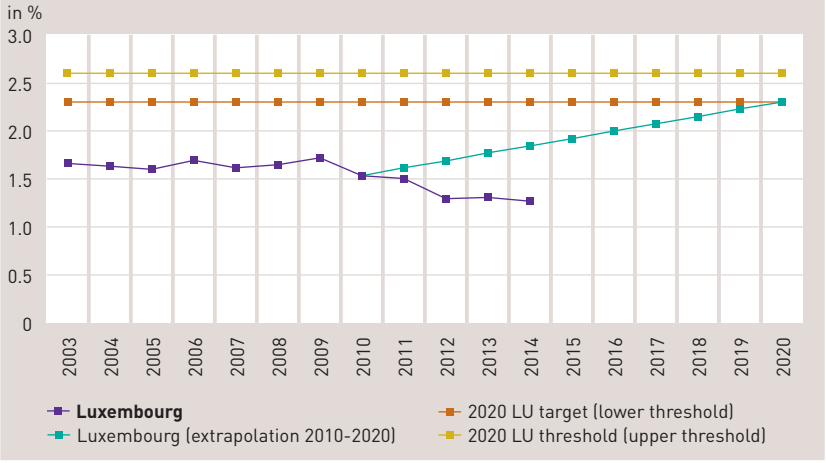
Source: Eurostat

[12] For additional details:
http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_R%26D_and_innovation

http://ec.europa.eu/europe2020/pdf/themes/2016/research_innovation_201605.pdf

As part of its NRP, Luxembourg set a national target of spending 2.3-2.6% of GDP by 2020, with 1.5-1.9% being contributed by the private sector and 0.7-0.8% by the public sector. In 2014 Luxembourg is still far from achieving its national target for 2020, as well as being significantly below the upward trend which needs to materialise if it is to achieve this national 2020 target.

Chart 5
Gross domestic expenditure on R&D (GERD), as a % of GDP[13]



Source: Eurostat, NRP 2016
Note: The green line connecting the years 2010-2020 is an example to illustrate the linear trend Luxembourg's performance should display after 2010 in order to achieve national target set for 2020, i.e. 2.3%.

Every year since 2000 has seen an increase in public expenditure on R&D and innovation whilst private R&D expenditure[14] (expressed in EUR millions) fell between 2007 and 2012 but rose slightly in 2013 and 2014. The public research share rose from 7.5% of total R&D expenditure in Luxembourg in 2000 to almost 48% at the present time (2014). Private sector corporate R&D currently accounts for around 52% of total R&D expenditure.

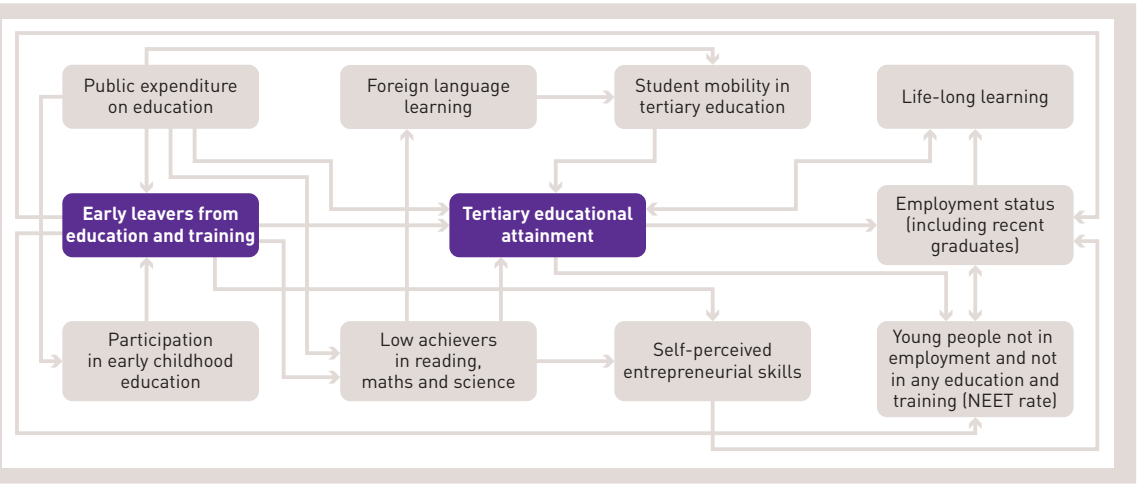
[13] Definition: R&D comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications. (Frascati Manual, 2002 edition, § 63). R&D is an activity where there are significant transfers of resources between units, organizations and sectors and it is important to trace the flow of R&D funds.

[14] The R&D expenditure (in millions of euros) of companies with commercial economic activity employing at least 10 people.

a.2 Improving education levels

Investments in human resources alongside those in R&D are essential to ensure the development of knowledge and new technologies. The objective of the Europe 2020 strategy is smart and inclusive growth, two objectives are fixed for education and training. The trajectory of these two indicators is determined by demographic and social changes as well as political and institutional reforms, and should not therefore be influenced by cyclic fluctuations.

Chart 6
Objectives regarding levels of education



Source: Eurostat

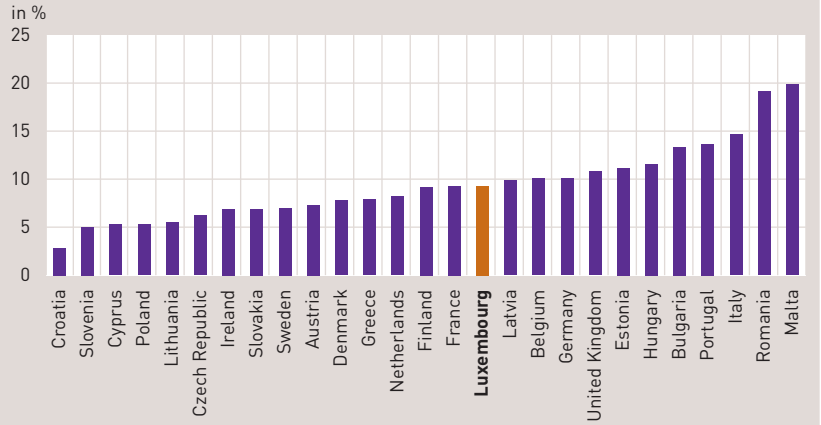
a.2.1 Early school leavers

The EU-28 average for early school leavers[15] is 11% in 2015. Luxembourg's score is 9.3% and is thus below the EU average[16].

[15] Definition: From 20 November 2009, this indicator is based on annual averages of quarterly data instead of one unique reference quarter in spring. The term 'early school leavers' refers to persons aged 18 to 24 fulfilling the following two conditions: first, the highest level of education or training attained is ISCED 0, 1, 2 or 3c short, second, respondents declared not having received any education or training in the four weeks preceding the survey (numerator). The denominator consists of the total population of the same age group, excluding no answers to the questions 'highest level of education or training attained' and 'participation to education and training'. Both the numerators and the denominators come from the EU Labour Force Survey.

[16] For additional details: http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_education

Chart 7
Young people having left education and training prematurely, % of 18-24 year olds not in education or training with up to lower secondary education (2015)



Source: Eurostat

In 2015, the school drop-out rate was higher amongst males (10.5%) than females (8.1%). As regards the employment status of early school leavers, more of them are employed (5.6%) than unemployed (3.7%) and the majority of the latter are seeking work[17]. According to EFT, the rate of school drop-outs amongst Luxembourg nationals (6.9%) is significantly lower than the rate amongst foreigners residing in Luxembourg (15.6%)[18].

The underlying statistics of this indicator calculated by Eurostat result from the Labour Force Survey (LFS) and are prone to yearly variations for Luxembourg, due to the limited size of the survey sample. The Ministry of National Education in Luxembourg has therefore set up its own national survey on early school leaving, and levels of early school leaving calculated are different from LFS ones.

[17] For additional details: http://ec.europa.eu/eurostat/statistics-explained/index.php/Early_leavers_from_education_and_training

[18] For additional details: http://ec.europa.eu/eurostat/statistics-explained/index.php/Migrant_integration_statistics_-_education

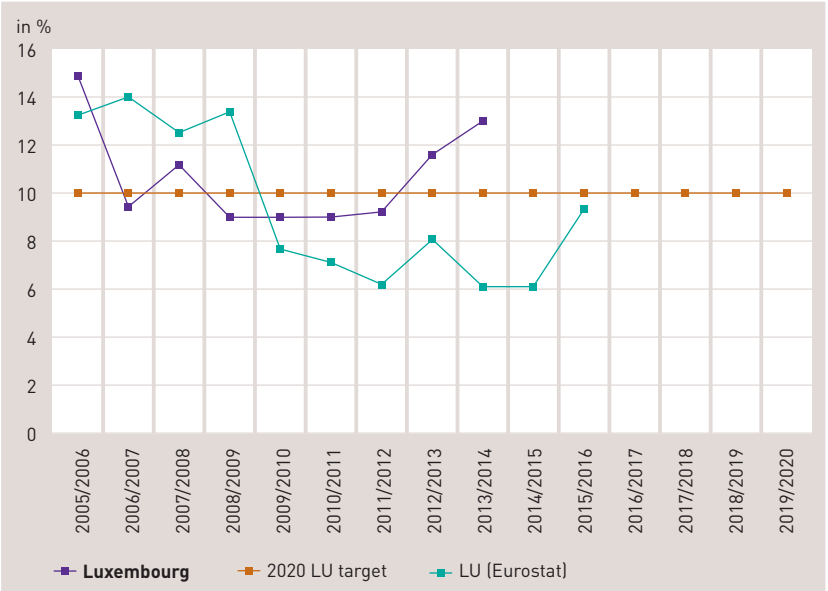
Table 2
Statistics on early school-leaving rate according to the national study on early school leaving (national figures)

Study		Early school-leaving rate
1	2003-2004	17.20%
2	2005-2006	14.90%
3	2006-2007	9.40%
4	2007-2008	11.20%
5	2008-2009	9.00%
6	2009-2010	9.00%
7	2010-2011	9.00%
8	2011-2012	9.20%
9	2012-2013	11.60%
10	2013-2014	13.00%

Source: Ministry of National Education, Childhood and Youth (MENEJ)
Definition: The notion of 'early school leavers' refers to young people who permanently left school without a diploma and who joined the labour market, benefiting from a professional integration measure or not having a specific occupation. It also includes young people who, after an initial leaving, have re-registered in a school, and then left again during the same period of observation, and for whose any additional information on their current situation is not available.
Comment: National early school-leaving rate not available for 2004/2005.

The EU has set an objective for an early school leaving rate of under 10% by 2020. Luxembourg has rallied behind this European objective and has set a national target to keep the early school leaving rate under the 10% mark in the long-term. According to Eurostat, Luxembourg is therefore well within its national target of 10%. However, according to national government statistics (MENEJ, Luxembourg Ministry of Education), Luxembourg exceeded this symbolic threshold in 2012/2013 and again in 2013/2014.

Chart 8
People having left education and training prematurely

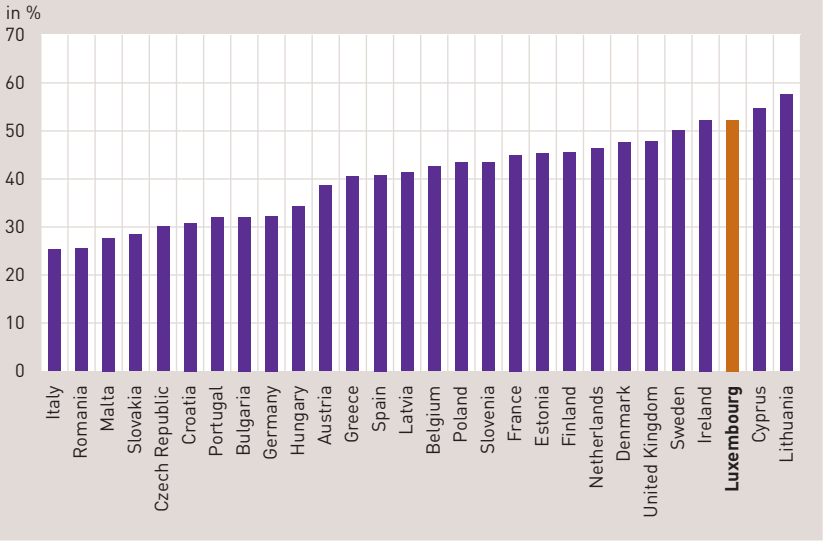


Source: Eurostat, 2016 NRP
Note: There is a time gap between MENEJ and Eurostat data.

a.2.2 Share of higher education graduates

In 2015, the EU-28 average for the percentage of 30-34 year olds with a tertiary education qualification is 38.7%. Luxembourg is amongst one of the top performers[19] with a score of over 50% in 2015.

Chart 9
Level of higher education graduates in the age group 30-34 (%), 2015



Source: Eurostat

In 2015, the percentage of women with tertiary education qualifications (57.7%) was higher than the percentage of men (46.8%). The figure is lower for Luxembourg nationals (>40%) than for foreign-born Luxembourg residents (almost 60%)[20] .

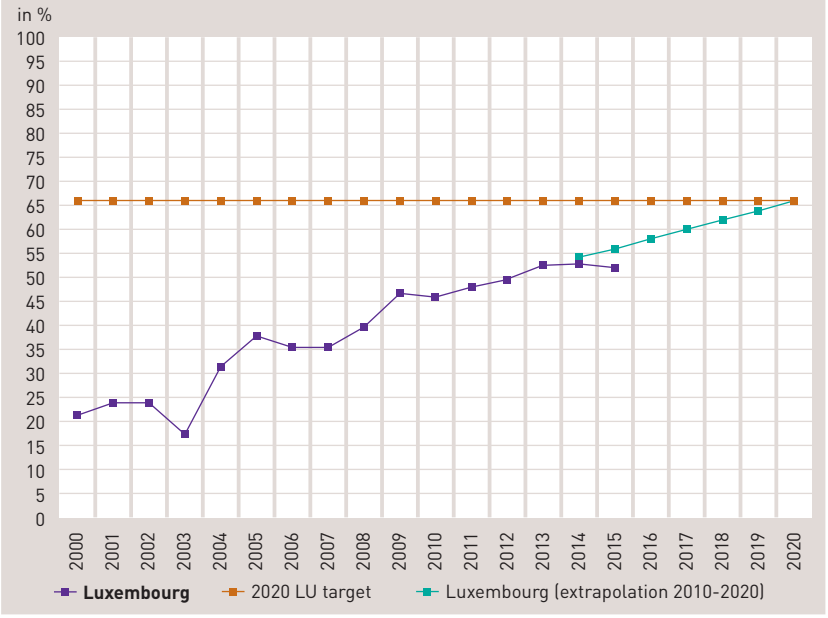
The overall EU objective is to achieve a rate of 40% of people aged 30-34 graduated in higher education by 2020. Luxembourg set a much higher objective in its NRP (66%). Luxembourg has experienced a significant increase in this indicator, which rose from 21.2% in 2000 to 52.3% in 2015. Luxembourg thus already exceeds by now the European objective and shows a positive mid- and long-term trend.

[19] For additional details: http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_education

http://ec.europa.eu/europe2020/pdf/themes/2016/tertiary_education_attainment_201605.pdf

[20] For additional details: http://ec.europa.eu/eurostat/statistics-explained/index.php/Migrant_integration_statistics_-_education

Chart 10
Level of higher education graduates in the age group 30-34[21]



Source: Eurostat, NRP 2016
Note: The green line connecting the years 2010-2020 is an example to illustrate the linear trend Luxembourg's performance should display after 2010 in order to achieve national target set for 2020.

As the indicator for early school leaving, this indicator results from the Labour Force Survey (LFS). It is not fully representative for Luxembourg, because on the one hand it includes foreign graduates living and working in Luxembourg (around 45% of residents in Luxembourg do not have Luxembourg nationality), and on the other hand this indicator can neither capture national from Luxembourg who graduated and work abroad, nor the numerous cross-border workers coming to Luxembourg (around 45% of the total workforce in Luxembourg).

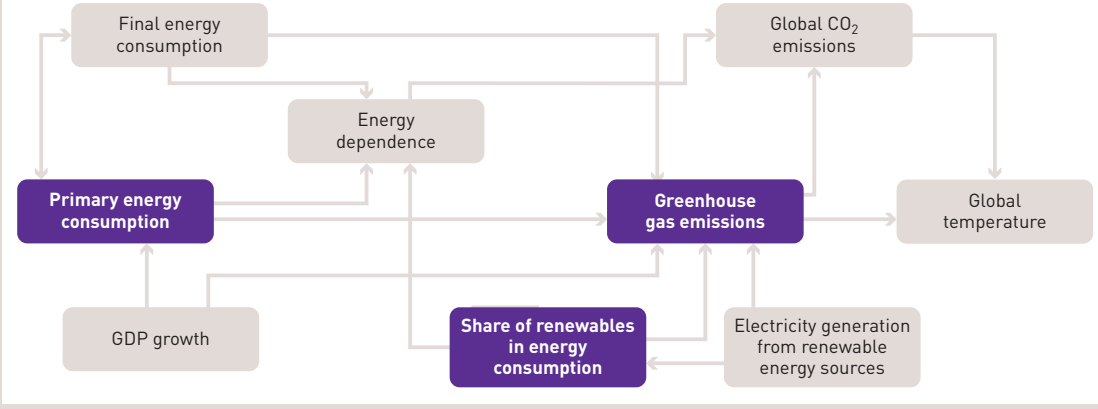
[21] Definition: The share of the population aged 30-34 years who have successfully completed university or university-like (tertiary-level) education with an education level ISCED 1997 (International Standard Classification of Education) of 5-6.

B. Sustainable growth

b.1 Reaching the climate change and energy objectives

In order to reach the climate change and energy objectives, the objectives set at the European Council in March 2007 were kept within the framework of the Europe 2020 strategy. The greenhouse gas emissions reduction targets and the share of renewable energy in the total energy consumption are legally binding[22,23].

Chart 11
Objectives regarding climate change and energy



Source: Eurostat

b.1.1 Greenhouse gas emissions

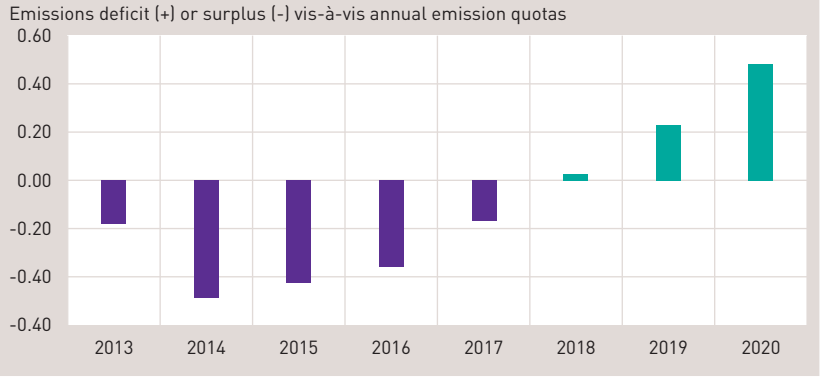
In the 2013-2020 post-Kyoto period, only the non-ETS sectors have objectives which are set at Member State level. In Luxembourg, the 2020 target for non-ETS emissions is a 20% reduction on the 2005 reference level. This target is to be acieved following a linear path with the 2013 starting point consisting of the average rate of emissions between 2008 and 2010. The effects of the economic crisis have certainly not been favourable to Luxembourg as there has been a reduction in the emissions budget post-2013. The annual budget is based on annual emission allocations. In 2020, non-ETS emissions[24] will be limited to 8.145 Mt CO_2. According to the latest forecast sent by Luxembourg to the European Commission (March 2016), featured in the 2016 NRP, the government predicts in its primary scenario that, for the 2013-2020 period, Luxembourg could generate an emissions surplus of around 0.9 Mt CO_2e by using existing measures. Over this eight-year period, stock-taking (2013-2014) and forecasts (2015-2020) show that Luxembourg will begin to have an emissions deficit vis-à-vis its annual emissions quota in 2018. However, these calculations are heavily dependent on the expected developments in one particular sector, namely road transport, which alone represents almost two thirds of total non-ETS emissions.

22 See EU Directive 2006/32/CE. The reduction in energy consumption is a policy objective endorsed by the Member States in their Energy efficiency action plan.

23 For additional details: http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_climate_change_and_energy

24 Accounting for the adjustment stipulated in Article 10 of Decision (EC) 406/2009, as published in Commission Implementing Act 2013/634/EU of 31/10/2013. Amounts expressed on the basis of the existing GWPs featured in the 4th IPCC report, based on 2015 inventory submissions.

Chart 12
Projected GHG emissions, non-LULUCF & ETS (2013-2020)



Source: NRP 2016

b.1.2 Share of renewable energy in energy consumption

In 2014 the share of renewable energy in final, gross energy consumption stood at an average of 16% in the EU-28. Luxembourg recorded a rate of 4,5% and is therefore one of the lowest-performing EU Member States in this area.

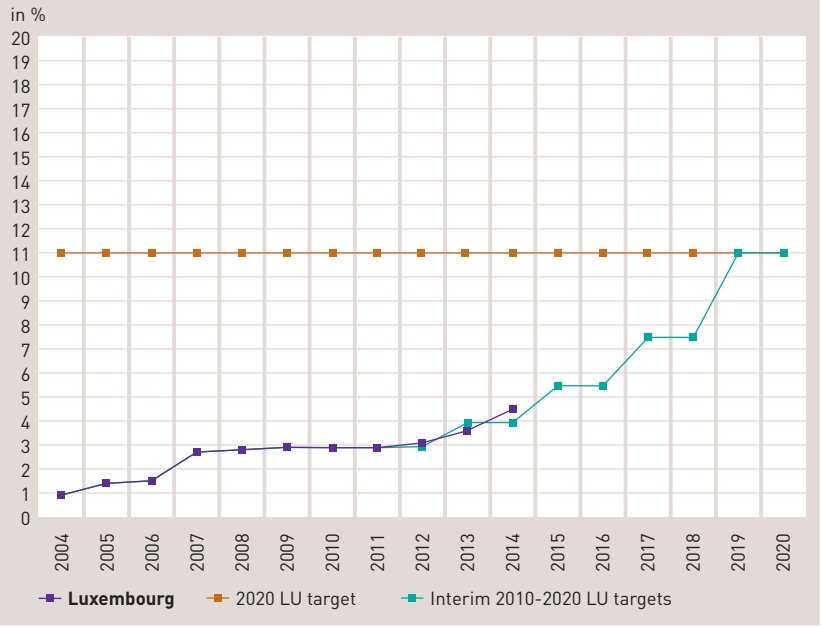
Chart 13
Renewable energy in gross final energy consumption, 2014

Source: Eurostat

In 2014, the lion's share of Luxembourg's renewable energy came from biomass and waste (77.2% of the total) with other sources being solar energy (9.3%), hydroelectric energy (7.7%) and wind turbines (5.7%)[25]. As regards consumption, the greatest share of renewable energy consumption was for heating and cooling (7.4%) followed by electricity (5.9%) and transport (5.2%).

As an objective, the EU has set the share of renewable energy to 20% by 2020. In this context, Luxembourg has set an overall target of 11% share of renewable energy in final energy consumption, with a series of interim targets. Luxembourg is in this interim development but will have to make significant efforts in the coming years to achieve its 2020 national target.

Chart 14
Share of renewable energy in gross final energy consumption[26]



Source: Eurostat, 2016 NRP
Note: The green line is the interim development set by the government after 2010 in order to achieve the national target set for 2020.

[25] For additional details: http://ec.europa.eu/eurostat/statistics-explained/index.php/Renewable_energy_statistics

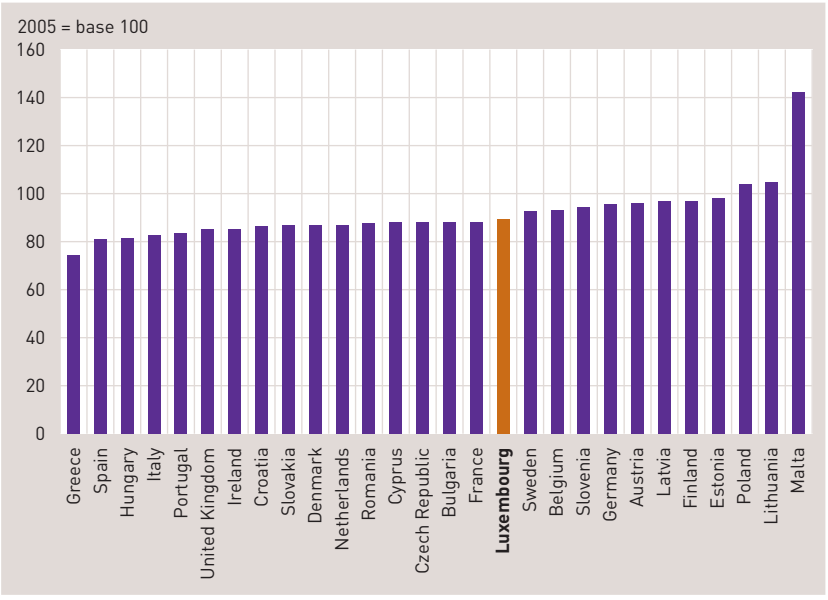
[26] Definition: This indicator is calculated on the basis of energy statistics covered by the Energy Statistics Regulation. It may be considered an estimate of the indicator described in Directive 2009/28/EC, as the statistical system for some renewable energy technologies is not yet fully developed to meet the requirements of this Directive. However, the contribution of these technologies is rather marginal for the time being. More information about the renewable energy shares calculation methodology and Eurostat's annual energy statistics can be found in the Renewable Energy Directive 2009/28/EC, the Energy Statistics Regulation 1099/2008 and in DG ENERGY transparency platform.

b.1.3 Energy efficiency

The Energy Efficiency Directive has set an energy efficiency objective for the whole of Europe by 2020. The EU has set an objective of a 20% increase in energy efficiency by that date. Although it applies to the EU as a whole, the Europe 2020 indicator does not provide practical information about national energy efficiency rates in the Member States. In fact, the Europe 2020 indicator only takes into account the energy savings of the EU in comparison to a scenario whereby policies remained unchanged, and based on economic predictions dating from 2007. Member States were obliged to set indicative national targets for primary and/or final energy consumption levels. In order to draw comparisons on the basis of this information regarding energy consumption, Eurostat subsequently calculates the primary and final energy consumption in million tonnes oil equivalent[27] in order to assess the progress made in energy efficiency at national level. It is worth noting that the economic and financial crisis which began in 2008, and the resulting downturn in economic activity, had a significant impact on energy consumption during the period of time taken into consideration. Therefore, the reduction in the volume of energy recorded in recent years, both in the EU as a whole and in the Member States, may not necessarily only signal an increase in energy efficiency, but may also be the result of declining activity.

Overall, final energy consumption in Luxembourg (89.3) fell between 2005 and 2014 at roughly the same rate as the EU average (89). This means that final energy consumption fell by around 10.7% in 2014 compared to the 2005 consumption level.

Chart 15
Final energy consumption in Luxembourg (2005 = base 100)



Source: Eurostat

[27] Definition: The term 'primary energy consumption' means gross inland consumption with the exception of any non-energy use of energy products (e.g. natural gas used not for combustion but for the production of chemicals). This quantity is relevant to measure the actual energy consumption. 'Percentage of savings' is calculated using 2005 values and their forecasts for 2020. The Europe 2020 target will be achieved when this value reaches the level of 20%.

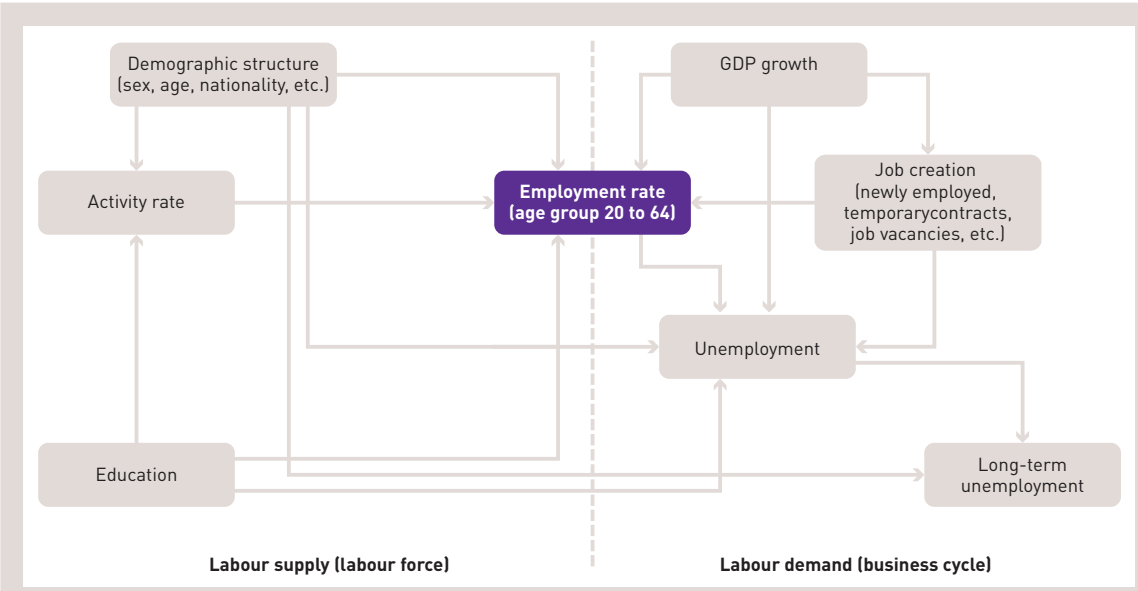
Luxembourg set a national target for 2020 with the aim being for annual consumption to be less than 49,292 GWh (4,239.2 ktoe). In addition to the energy efficiency target, Luxembourg also set itself the goal of saving 5,993 GWh by the end of 2020. Luxembourg intends to achieve all of its energy saving targets via a system of energy efficiency obligations, which were established in 2015. Even though the energy saving target is not linked to the energy efficiency target given that the latter is completely independent of the variation in final annual energy consumption, the energy efficiency obligations are one of the primary instruments in the bid to meet the energy efficiency target.

C. Inclusive growth

c.1 Promoting employment

The Lisbon strategy (2000-2010) included a target related to employment policies, namely the employment rate. The new Europe 2020 target shows two major changes compared to the former Lisbon objective: firstly, the age range considered (20-64 for 2020 instead of 15-64 for 2010) in order to reduce potential conflicts between employment policies and education policies, and secondly the reference value to be achieved (75% by 2020 instead of 70% by 2010). Developments in the employment rate depend on many uncertainties, which must be considered when setting quantified targets for the Europe 2020 strategy. Indeed, the employment rate indicator is a very cyclical indicator. For example, the actual exit date of the 2008/2009 crisis plays a key role in the development of this indicator.

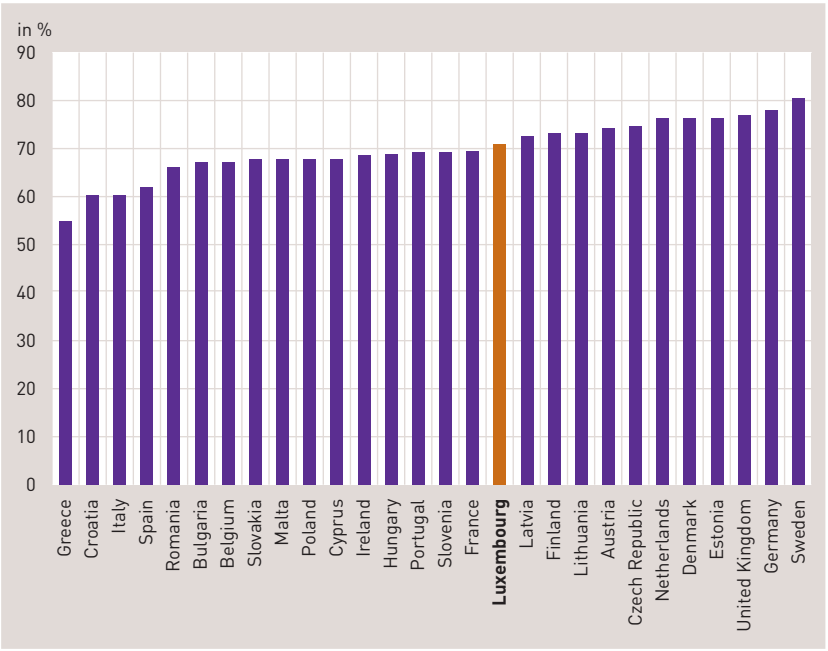
Chart 16
Employment objective



Source: Eurostat

The average EU-28 employment rate is 70.1%in 2015. With an employment rate of 70.9% in 2015, Luxembourg ranks above the EU average[28].

Chart 17
Employment rate of people aged 20-64



Source: Eurostat

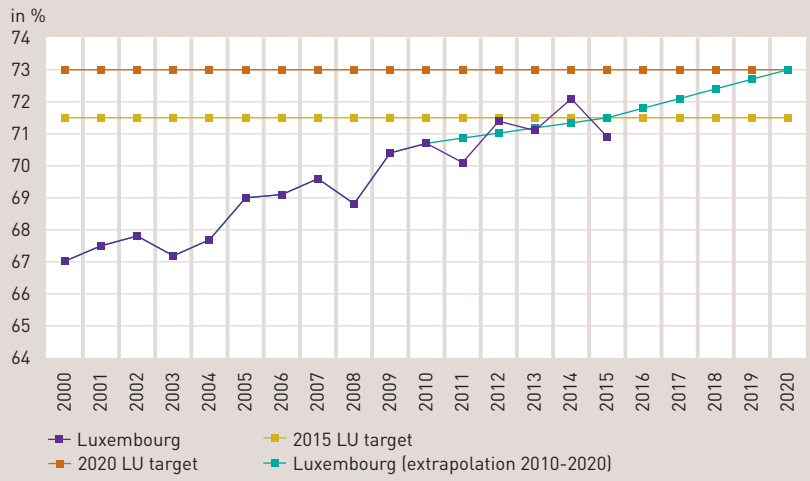
The employment rate, which is an average of the resident workforce, does however hide considerable differences in the employment rate per socio-economic category observed. Proceeding to a narrower segmentation of the employment rate, for example according to gender or age of the worker, reveals important fluctuations in the employment rate. For example, in 2015, the male employment rate is around 76.7% whilst the female employment rate is close to 65%, revealing that Luxembourg has a gender employment gap which is slightly above the EU average[29]. The employment rate for 55-64 year olds is around 38.4% whilst the employment rate for 25-54 year olds stands at 82.6%.

Luxembourg set a national target of employment rate of 73% to be achieved by 2020, with an interim target of 71.5% in 2015. Since 2000 Luxembourg shows a positive trend regarding the employment rate.

[28] For additional details: http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_employment

[29] For additional details: http://ec.europa.eu/europe2020/pdf/themes/2016/labour_market_participation_women_201605.pdf

Chart 18
Employment rate of people aged 20-64[30]



Source: Eurostat
Note: The green line connecting the years 2010-2015 and 2015-2020 is an example to illustrate the linear trend Luxembourg's performance should display after 2010 in order to achieve national target set for 2020.

The rise in the overall employment rate in Luxembourg is primarily due to a rise in the employment of women and older people. For example, over the last ten years (between 2005 and 2015), the female employment rate has risen from 58.4% to 65% and the corresponding rate for older people (60-64 years) has risen from 12.7% to around 16.5%.

Finally, although a higher employment rate generally allows increasing the supply of domestic labour, boosting growth and relieving social spending and public spending, these statements must be put in perspective in the case of Luxembourg. Labour supply in Luxembourg consists of three components: the indigenous, cross-border and the immigrant offers. However cross-border workers are not considered in the definition of the employment rate. This is a purely national concept, related to the place of residence of the worker. Yet cross-border workers in Luxembourg make up more than 45% of domestic employment. As noted by the Economic and Social Council (ESC)[31], this indicator *'is not representative of macroeconomic reality in Luxembourg and is even less suitable for a macroeconomic employment target, on which employment policy should be defined'*. In contrast, the employment rate for young people, women and older workers is useful for understanding the use of human resources in the economy.

30 Definition: The employment rate is calculated by dividing the number of persons aged 20 to 64 in employment by the total population of the same age group. The indicator is based on the EU Labour Force Survey. The survey covers the entire population living in private households and excludes those in collective households such as boarding houses, halls of residence and hospitals. Employed population consists of those persons who during the reference week did any work for pay or profit for at least one hour, or were not working but had jobs from which they were temporarily absent.

31 ESC, Deuxième avis sur les Grandes Orientations des Politiques Économiques des États membres et de la Communauté (GOPE), Luxembourg, 2003.
For more information: http://www.ces.public.lu/fr/avis/index.html

c.2 Reducing poverty

The European objective that was initially proposed by the European Commission for social inclusion focused on reducing poverty by 20 million people at risk of poverty. However, in order to meet the Europe 2020 strategy objective of promoting inclusive growth, the European Council in March 2010 had asked the Commission to work further on social inclusion indicators, including also non-monetary indicators. In June 2010 the European Council decided to ensure that 20 million people at least no longer be faced with the risk of poverty and exclusion, and defined this population as the number of people at risk of poverty and exclusion according to three indicators, Member States being free to set their national targets on the basis of indicators they consider most appropriate among these:

- At-risk-of-poverty rate: people living on less than 60% of the national median income. The at-risk-of-poverty rate is the key indicator to measure and monitor poverty in the EU. This is a relative measure of poverty, linked to the income distribution, which takes into account all sources of monetary income, including market revenues and social transfers. It reflects the role of employment and social protection in the prevention and reduction of poverty;

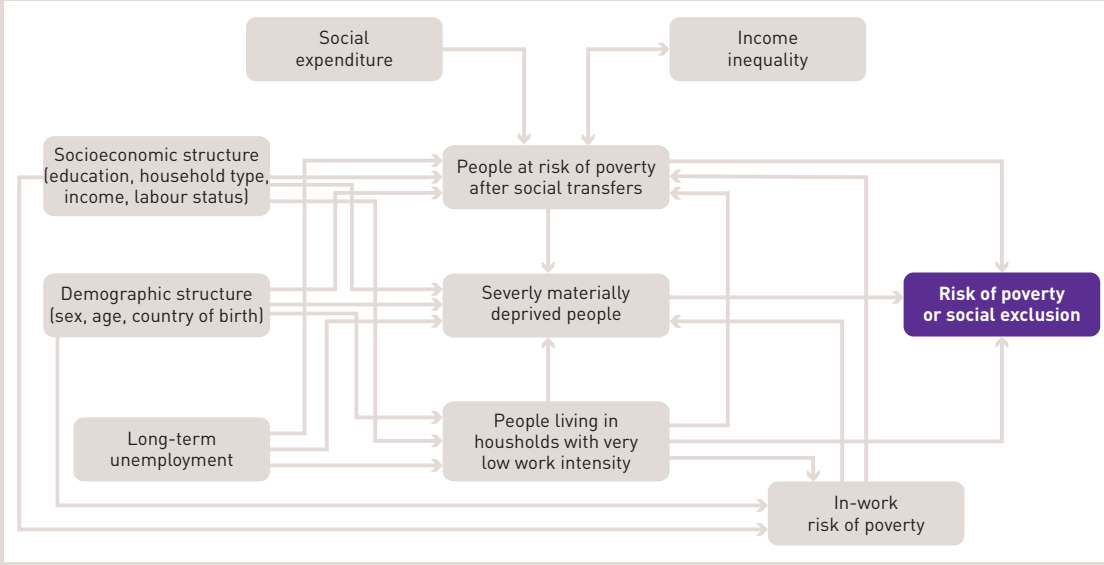
- Material deprivation rate: people whose lives are severely limited by a lack of resources[32]. The material deprivation rate is a non-monetary measure of poverty, which also reflects the different levels of prosperity and quality of life in the EU, as it is based on a single European level;

- People living in jobless households: this population is defined relative to zero or very low work intensity over an entire year, in order to properly reflect the situations of prolonged exclusion from the labour market. These are people living in families in a situation of long-term exclusion from the labour market. The long-term exclusion from the labour market is one of the main factors of poverty and increases the risk of transmission of disadvantage from one generation to another.

The risks that have an impact on the evolution of poverty indicators are related to macroeconomic developments, but also to the ability of employment policies to promote an inclusive labour market and employment opportunities for all and to the welfare system's capacity to improve efficiency and effectiveness because of the constraints on public finances. Note that monetary indicators of poverty, such as the poverty rate, are significantly limited. They do not take into account the many non-monetary public services that are available to citizens. In Luxembourg, among other things, we can mention in this context the service vouchers that are not taken into account.

[32] Definition: Currently the agreed EU material deprivation indicator is defined as the share of people are concerned with at least 3 out of the 9 following situations: people cannot afford i) to pay their rent or utility bills, ii) keep their home adequately warm, iii) face unexpected expenses, iv) eat meat, fish, or a protein equivalent every second day, v) a week of holiday away from home once a year, vi) a car, vii) a washing machine, viii) a colour tv, or ix) a telephone.

Chart 19
Risk of poverty and social exclusion objective



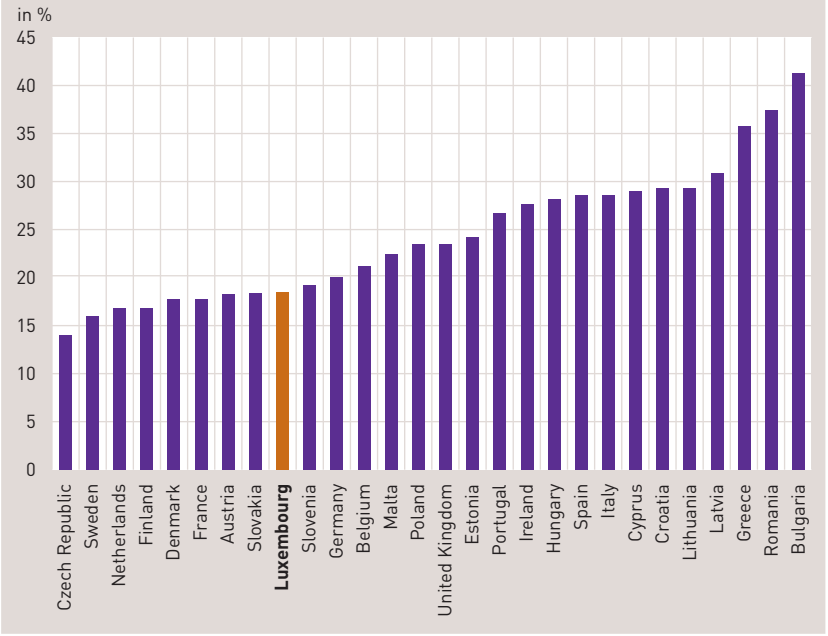
Source: Eurostat

For a more comprehensive view of people experiencing poverty or exclusion, Eurostat has developed an indicator to better quantify the percentage of the population facing the risk of poverty or exclusion, by combining the three individual indicators mentioned above.

In 2015, an average of 23.7% of the population of the EU-28 is considered to be at risk of poverty or social exclusion. According to the latest data published by STATEC in October 2016[33], 18.5% of the population of Luxembourg (i.e. 95,000 people) are at risk of poverty or social exclusion, a lower figure than the 19% (96,000 people) reported in 2014.

[33] For additional details: http://www.statistiques.public.lu/catalogue-publications/cahiers-economiques/2016/PDF-Cahier-121-2016.pdf

Chart 20
People at risk of poverty or social exclusion (2015)



Note: Croatia, Ireland (2014)
Source: Eurostat

In 2015, the people considered to be at risk of poverty or social exclusion in Luxembourg are[34, 35]:

- Primarily people at risk of poverty following social transfers (15.3%);
- To a much lesser extent, people living in a family with a very low work intensity (5.7%);
- To an even lesser extent, people living in severe material deprivation (2.0%).

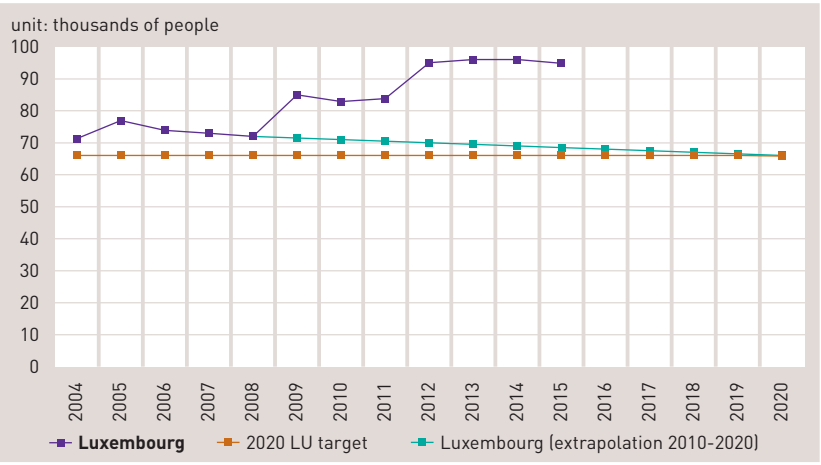
In its NRP Luxembourg has adopted a national target for 2020, which is 'to reduce by 6,000 the number of people at risk of poverty or social exclusion'. As is the case for the vast majority of Member States, Luxembourg is far from reaching its national 2020 target. In fact, since the recent economic and financial crisis, the number of people at risk of poverty or social exclusion has been steadily rising in Luxembourg. With about 96,000 people in 2014, Luxembourg is way above the downward trend necessary to reach its national target by 2020, according to the methodology used by the European Commission in its assessment[36] half way to the Europe 2020 strategy (taking 2008 as the reference year). The national target would need Luxembourg to display 6,000 people less in 2020 as compared to 2008 (72,000 people). This would imply that in 2020 only 66,000 people should be at risk of poverty or social exclusion in Luxembourg.

[34] For additional details: http://ec.europa.eu/eurostat/statistics-explained/index.php/Migration_integration_statistics_-_at_risk_of_poverty_and_social_exclusion

[35] For additional details, see also: http://ec.europa.eu/europe2020/pdf/themes/2016/poverty_social_exclusion_201605.pdf

[36] EUROPEAN COMMISSION, État des lieux de la stratégie Europe 2020 pour une croissance intelligente, durable et inclusive - ANNEXE 1, Brussels, March 2014

Chart 21
Development of the at-risk-of-poverty or of social exclusion rate (2004-2015)



Source: Eurostat, 2016 NRP
Note: The green line connecting the years 2008-2020 is an example to illustrate the linear trend Luxembourg's performance should display after 2008 in order to achieve national target set for 2020. 2020 target corresponds thus to 2008 figure minus the 6,000 people Luxembourg intends to lift out of poverty or social exclusion.

4.1.3 Conclusions – Taking stock of the situation in Luxembourg

In the Luxembourg country report published in February 2016 as part of the European Semester[37], the European Commission made the following comments on Luxembourg's range of national targets under the Europe 2020 strategy:

- R&D: Luxembourg is not at all on track to reach its R&D intensity target for 2020, due to a sharp decrease in business R&D intensity (although puvlic sector R&D intensity steadily increased);
- Early school leavers: the number of early leavers from education and training is below the 10% target;
- Higher education: the number of tertiary education students has risen significantly over the last few years and is currently above the European objective of 40% but below the national target of 66%;
- Greenhouse gas emissions: ccording to the latest national projections submitted to the Commission and taking into account existing measures, it is expected that the target will be missed[38];
- Renewable energy: Luxembourg risks failing to reach its 2020 renewable energy target. Between 2005 and 2012, the consumption doubled, this is above the indicative trajectory of 3.9% for 2013-2014. However, the target trajectory becomes steeper in the coming years. Thus, strong and continued effort is important for Luxembourg to reach its 11% renewable energy target in 2020. Given limited capabilities and geographical constraints, the achievement of the 2020 target solely by domestic measures seems challenging;

[37] For additional details: http://ec.europa.eu/europe2020/pdf/csr2016/cr2016_luxembourg_fr.pdf

[38] The conclusion drawn by the European Commission in February 2016 is based on old assumptions and does not factor in the new simulations contained in the 2016 Luxembourg NRP.

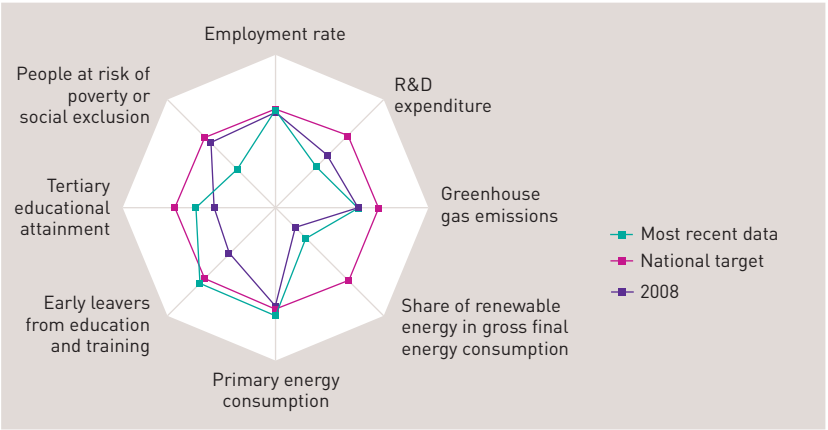
- Energy efficiency: the 2020 energy efficiency target will be met if efforts as in previous years are continued. The introduction of the energy savings obligation scheme on all electricity and gas suppliers is expected to contribute to the reduction of energy consumption in the industrial, household and services sectors;

- Employment: the employment rate of the resident population increased and is getting closer to the national target;

- Risk of poverty or social exclusion: the number of people at risk of poverty or social exclusion is on the rise.

In a report published in July 2016 on achievements in implementing the Europe 2020 strategy, Eurostat made the following observation concerning Luxembourg[39]: *'Luxembourg has the most ambitious target on tertiary education across the EU, envisioning 66% of the population aged 30 to 34 to have attained tertiary education by 2020. Despite a notable increase of 12.5 percentage points between 2008 and 2015, Luxembourg still has the largest gap to its national target in the EU. In contrast, the country has continuously exceeded its target on early leavers from education and training since 2009 and in 2015 was closer to reaching its employment target than the EU as a whole. In 2014, Luxembourg was below the EU as a whole in terms of R&D expenditure and the gap to the national target has widened since 2009. The number of people at risk of poverty or social exclusion increased by one-third between 2008 and 2014, pushing Luxembourg further from its national poverty alleviation target. In the area of climate change and energy, Luxembourg has remained within its target on primary energy consumption since 2011 but did not reach its national target and lagged behind the EU as a whole in the extension of renewable energy. In 2012, it also faced the largest gap to its non-ETS GHG emissions target across the EU.'*

Chart 22
Luxembourg profile: 2008, most recent data and national targets 2020



Source: Eurostat (July 2016)

[39] For additional details: http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_Luxembourg

On the basis of the Europe 2020 strategy indicators, updated by Luxembourg in August 2016 as part of the preparatory work for the drawing up of this chapter, and the analysis undertaken in 2016 by the European Commission and Eurostat, it can be observed that for the national targets to be met in 2020, Luxembourg should:

- Intensify efforts in R&D, especially in terms of R&D spending by companies;
- Closely monitor the school drop-out rate and the percentage of people with tertiary education qualifications amongst Luxembourg nationals resident in the country;
- Continue working intensely on climate change and energy change, especially by closely monitoring greenhouse gas emissions and the share of renewable energies;
- Try to reduce the existing gap between the average employment rate and the employment rates for women, young people and older people;
- Work to reduce the number of people at risk of poverty or social exclusion, especially the number of people at risk of poverty following social transfers.

Table 3
Summary table of the Europe 2020 strategy objectives (August 2016)

Priorities	**Smart growth**			**Sustainable growth**			**Inclusive growth**	
Objectives	Improving conditions for innovation and R&D	Improving education levels		Reaching the climate change/ energy objectives			Promoting employment	Reducing poverty
Indicators	R&D	Early school leaving rate	Higher education	GHG emissions	Renewable energy	Energy efficiency	Employment rate	Poverty
Unit	% of GDP	%	% of 30-34 year olds	Mtoe	%	Mtoe	% of 20-64 year olds	People
LU*	1.24	9.3**	52.3	9.36	4.5	4.0	70.9%	95,000
National target 2020	2.3-2.6%	<10%	66%	8.14***	11%	4.2****	73.0%	66,000

Source: Eurostat / 2016 NRP
Comments: * Update according to the most recent data available
** National data (MENEJ): 13% (2013/2014)
*** -20% in relation to 2005
**** Final energy consumption

4.1.4 Mid-term review of the Europe 2020 strategy

Launched in 2010, the Europe 2020 strategy has reached its mid-term in 2015. The European Commission suggested so taking stock of the Europe 2020 strategy. Subsequently, in March 2014, the Commission adopted a communication entitled 'Taking stock of the Europe 2020 strategy for smart, sustainable and inclusive growth', drawing several preliminary lessons from the first years of implementation of the strategy[40]. The European Commission considers that the reasons for the implementation of the Europe 2020 strategy are just as important in 2014 than they were in 2010. Moving out of the worst economic and financial crisis of its history, the EU needs to strengthen its strategy for smart, sustainable and inclusive growth in order to ensure its position on the global stage. The analysis of the European Commission gives a mixed picture of the headline objectives and flagship initiatives. Although in terms of education, climate and energy, the EU is close to reach the objectives it adopted, this is not the case for employment, R&D or the reduction of poverty. The transposition of these objectives into national level targets has also pointed out several worrying trends, such as an increase in the differences between the best and worst performing Member States. In many ways, the 2010-2014 period served to lay the foundation for the results that should be obtained in years to come.

At this stage, the European Commission has not drawn any conclusion on policies being led, nor has it made any recommendation on policies to be led. The Commission considers that it is necessary to first launch, at EU level, a public consultation with all stakeholders on lessons to be learnt and on the main elements that should define the next stages of the EU post-crisis growth strategy. The Commission launched this public consultation[41] end of May 2014. After this consultation, the Commission has presented its preliminary conclusions in the first term[42]. In its Annual Growth Survey 2016, published in November 2015 and which is the starting point for the launch of the European semester, the European Commission indicated it wanted to start in 2016 *'(...) a process for developing a longer term vision going beyond the horizon of the year 2020, also in the light of the new Sustainable Development Goals agreed by the United Nations for 2030. The lessons of the Europe 2020 review (...) will be taken into account in this exercise.'*[43]

[40] For additional details: http://ec.europa.eu/europe2020/pdf/europe-2020stocktaking_fr.pdf

[41] For additional details: http://ec.europa.eu/europe2020/public-consultation/index_fr.htm

[42] For additional details: http://ec.europa.eu/europe2020/pdf/europe2020_consultation_results_en.pdf

[43] For additional details: http://ec.europa.eu/europe2020/pdf/2016/ags2016_annual_growth_survey.pdf

4.2 Macroeconomic surveillance

4.2.1 Implementation of the monitoring of macroeconomic imbalances

Macroeconomic imbalances can cause economic crises, particularly in a monetary union because of the limited number of tools available to policy makers. The years before the financial and economic crisis were characterized in the euro area by divergent macroeconomic developments that have created imbalances among Member States. However, before the onset of the global economic and financial crisis, little attention was paid to these imbalances within the EU, in particular within the euro area. For example, public and private debt rose sharply in Greece, real estate bubbles were created in Spain and Ireland, and Italy, Spain, Portugal and Greece experienced significant losses in cost competitiveness[44]. Public attention only started to focus on this unhealthy situation after the crisis began. As a result, new challenges have arisen in monetary policy and coordination of economic and fiscal policies because of the interdependence of the European economies and because the existing mechanisms were insufficient. It was therefore important to reinforce and further coordinate economic policy.

So, the Commission proposed to further strengthen the coordination of economic policy. In its May 2010 communication 'Reinforcing Economic Policy Coordination', the Commission highlighted a persistent accumulation of macroeconomic imbalances, which is able to destabilize the euro area and the functioning of the European Monetary Union. Based on this communication, in June 2010 the European Council decided to establish a European stabilization mechanism. The Commission subsequently developed its ideas in its 'Enhancing economic policy coordination for stability, growth and jobs – Tools for stronger EU economic governance' communication on the governance of economic policy and proposed to develop a new structured mechanism to detect and to correct macroeconomic imbalances. In order to better detect these imbalances, the Commission along with the Member States established a first scoreboard with economic and financial indicators. On 29 September 2010, the Commission finally proposed a legislative package ('Six Pack'), which includes the monitoring of internal and external macroeconomic imbalances in the Member States, such as housing and increasing differences in cost competitiveness between Member States[45]. The European Parliament finally voted this legislative package on economic governance on 28 September 2011 and the European regulation entered into force in late 2011.

[44] MONETARY POLICY & THE ECONOMY, Prevention and Correction of Macroeconomic Imbalances: The Excessive Imbalances Procedure, Q4/2011

[45] Based on the two European regulations1176/2011 and 1174/2011.
For additional details:
http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32011R1176
http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32011R1174

4.2.2 Macroeconomic imbalance procedure

The monitoring procedure includes a preventive and a corrective arm.

a. The preventive arm

In the preventive component of the procedure, a scoreboard was established and is published annually by the Commission. The first edition of this scoreboard was published in the Alert Mechanism Report (AMR)[46] in February 2012. For each Member State this mechanism analyses several indicators compared with 'alert thresholds' and is accompanied by an economic reading of the indicators, so as to not limit the interpretation to a 'mechanical' reading. This procedure allows the Commission to identify a potential risk. If this initial scoreboard reveals the existence of a potential macroeconomic imbalance within a Member State, in a second step the Commission calls for an in-depth analysis. This further analysis examines the origin, nature and severity of a potential imbalance.

In the analytical work carried out within the context of the implementation of this scoreboard, it proved to be very difficult to agree on 'one size fits all' indicators for all Member States, which can take into account both the specificities of each Member State and the potential methodological problems. It was thus agreed that the results should not be limited to a 'mechanical' interpretation but to accompany the reading by an economic analysis. The selection of indicators is mainly based on four guidelines: indicators should detect the major macroeconomic imbalances and signs of loss of competitiveness; indicators should enable the analysis of both the level and flows; indicators should serve as an important communication tool; the statistical quality of data should be high and suitable to make international comparisons.

[46] EUROPEAN COMMISSION, Alert Mechanism Report, Report prepared in accordance with Articles 3 and 4 of the Regulation on the prevention and correction of macro-economic imbalances, Brussels, 14.2.2012 COM (2012)68 final

The initially adopted scoreboard includes eleven indicators divided into two categories: external and internal imbalances. The analysis of external imbalances includes indicators such as the current account balance (foreign exchange of a country), or factors having a direct impact on this aggregate such as cost competitiveness. In terms of internal imbalances, the experience gained through the crises in the past has allowed identifying various key indicators such as unusual developments in the financial sector; extreme changes in credit with a high increase in house prices. Statistics that are used annually in the scoreboard are updated periodically by Eurostat[47].

For each of these indicators, the Commission - in collaboration with Member States - also defined the thresholds at which performances can be regarded as potentially 'at risk' based on the historical statistical distribution of each indicator[48]. This means that if a Member State exceeds a threshold, it could display a macroeconomic imbalance. It is important to stress that the defined thresholds are usually the same for all Member States, making a difference only in some cases between Member States being in or out the euro area. However, the thresholds should not be considered as political objectives to be reached, but should only be used to identify developments that may lead to imbalances[49].

Since late 2015, the European Commission has added three new employment indicators, bringing to 14 the total number of main scoreboard indicators relating to the alert mechanism:

- Activity rate - % of total population aged 15-64;
- Long-term unemployment rate - % of the active population aged 15-74;
- Youth unemployment rate - % of the active population aged 15-24.

47 For additional details: http://ec.europa.eu/eurostat/web/macroeconomic-imbalances-procedure/indicators

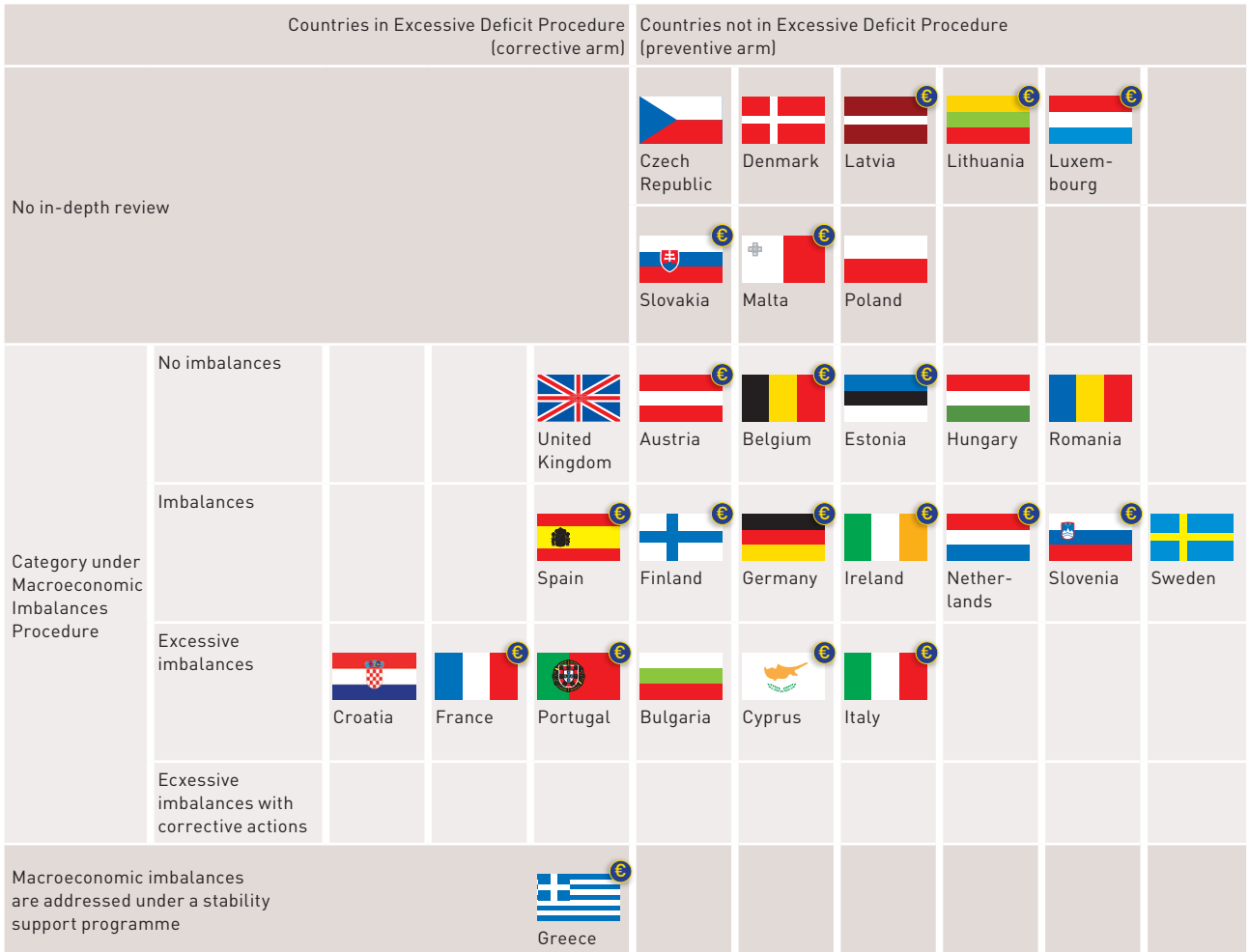
48 For more details about the implementation methodology of the AMR scoreboard: EUROPEAN COMMISSION, Scoreboard for the surveillance of macroeconomic imbalances, European Economy. Occasional Papers 92, Brussels, February 2012. Source: http://ec.europa.eu/economy_finance/publications/occasional_paper/2012/op92_en.htm

49 CENTRE FOR EUROPEAN POLICY STUDIES, Macroeconomic Imbalances in the Euro Area: symptom or cause of the crisis? Policy Brief No. 266, April 2012

b. The corrective arm

If in-depth examination, which is performed after the scoreboard-based analysis, finds that an excessive macroeconomic imbalance exists in a Member State, the corrective arm of the procedure is triggered. The Member State concerned is then placed in an excessive imbalances situation. In this case the Member State must submit a corrective action plan to the Council specifying concrete measures and a detailed implementation schedule. The Commission and the Council assess the corrective action plan that is either found to be satisfactory, which leads to the issuing of regular progress reports to the Council, or insufficient, and the Member State is requested to amend its action plan. If, after the amendments, the action plan remains insufficient, the Council adopts sanctions on the basis of recommendations of the Commission, unless the Council supports the arguments of exceptional economic circumstances by a reverse qualified majority.

Chart 23
Status of the macroeconomic imbalance procedure (June 2016)



€ = euro area
Source: European Commission

4.2.3 The 2016 edition of the macroeconomic imbalance procedure

The fifth edition of the scoreboard was published in the Alert Mechanism Report released in November 2015 as part of the European Semester.

In the November 2015 edition, the European Commission identified for Luxembourg a number of indicators that are beyond the indicative threshold, namely private sector debt, the growth rate of financial sector liabilities as well as the youth unemployment rate.

Luxembourg's substantial current account surplus was further reduced on the back of sharp increase of the deficit of primary income that more than offset the improvement of the balance of trade and services. Partially due to a positive contribution of productivity, unit labour cost growth abated in 2014, contributing to the sizeable gains of export market shares. Private sector indebtedness (consolidated figures but not for cross border intra company loans which are high) remained well above the threshold. The government debt is low. While financial sector liabilities grew substantially the leverage of the financial sector remains low and even if there are risks given the size of the sector they are limited. Real house prices growth continued to accelerate in 2014 where supply and demand mismatches on housing market remain which reduce the likelihood of a strong price correction. Youth unemployment increased although in a context of low unemployment.

In conclusion the European Commission made the following conclusion in its analysis of Luxembourg: *'Overall, the economic reading highlights a gradually improving economic environment with reduced risks. Therefore, the Commission will at this stage not carry out further in-depth analysis in the context of the MIP.'*

Table 4
AMR scoreboard indicator results (November 2015 edition)

	External imbalances and competitiveness					Internal imbalances						New employment indicators		
Year 2014	Current account balance - % of GDP (3-year average)	Net international investment position (% of GDP)	Real effective exchange rate - 42 trading partners, HICP deflator (3 years % change)	Export market share - % of world exports (5 years % change)	Nominal unit labour cost index (2010=100) (3 years % change)	House price index (2010=100), deflated (1 year % change)	Private sector credit flow, consolidated (% of GDP	Private sector debt, consolidated (% of GDP)	General government gross debt (% of GDP)	Unemployment rate (3-year average)	Total financial sector liabilities, non-consolidated (1 year % change)	Activity rate - % of total population aged 15-64 (3 years change in p.p.)	Long-term unemployment rate - % of active population aged 15-74 (3 years change in p.p.)	Youth unemployment rate - % of active population aged 15-24 (3 years change in p.p)
Thresh-olds	-4/+6%	-35%	±5% (EA) ±11% (Non-EA)	-6%	9% (EA) 12% (Non-EA)	6%	14%	133%	60%	10%	16.5%	-0.2%	0.5%	0.2%
BE	-0.1	57.2	-0.5	-10.7	5.6	-1.1p	1.0	181.4	106.7	8.2	4.9	1.0	0.8	4.5
BG	0.9	-73.4	-2.6	6.7	12.5p	1.5p	-0.3	124.3	27.0	12.2	7.2	3.1	0.6	-1.2
CZ	-0.5	-35.6	-10.0	-5.0	3.8	1.8	1.8	72.7	42.7	6.7	4.4	3.0	0.0	-2.2
DK	6.9	47.0	-1.2	-17.3	5.1	3.1	1.7	222.8	45.1	7.0	6.6	-1.2	-0.1	-1.6
DE	6.9	42.3	-0.3	-8.3	7.6	1.5p	1.1	100.4	74.9	5.2	4.2	0.4	-0.6	-0.8
EE	-0.5	-43.6	4.7	24.5	13.0	12.8	6.4	116.1	10.4	8.7	12.2	0.5	-3.8	-7.4
IE	1.8	-106.7	-3.5	-6.1	-2.2	11.1	13.7	263.3	107.5	13.0	16.0	0.6	-2.0	-5.2
EL	-2.6	-124.1	-5.6	-17.5	-11.6p	-4.9e	-2.7	130.5	178.6	26.2	-7.6	0.1	10.7	7.7
ES	0.7	-94.1	-1.0	-11.5	-4.1p	0.1	-7.1	165.8	99.3	25.1	-1.9	0.3	4.0	7.0
FR	-1.0	-19.5	-1.2	-13.1	4.8	-1.6	3.3	143.2	95.6	10.1	5.4	1.3	0.6	1.5
HR	0.5	-88.6	-0.9	-18.0	-5.9	-2.0p	0.3	120.6	85.1	16.9	0.9	2.0	1.7	8.8
IT	0.8	-27.9	0.2	-14.0	3.6	-4.6p	-0.9	119.3	132.3	11.8	-0.7	1.8	3.5	13.5
CY	-4.9	-139.8	-1.4	-26.7	-7.7p	0.3p	-8.5	348.3	108.2	14.6	0.7	0.8	6.1	13.6
LV	-2.5	-60.9	0.4	9.9	12.9	5.1	-11.9	96.4	40.6	12.6	10.4	1.8	-4.1	-11.4
LT	1.3	-46.4	1.4	35.3	8.3	6.3	-1.2	52.5	40.7	12.0	16.3	2.3	-3.2	-13.3
LU	**5.8**	**36.0**	**0.5**	**11.2**	**7.6**	**3.7**	**0.5**	**342.2**	**23.0**	**5.7**	**21.5**	**2.9**	**0.3**	**5.9**
HU	2.7	-73.8	-7.0	-14.9	6.7	3.1	-0.5	91.3	76.2	9.6	8.5	4.6	-1.5	-5.6
MT	2.6	39.5	0.0	-18.2	7.0	2.6	7.8	146.4	68.3	6.2	5.8	4.5	-0.4	-1.5
NL	10.9	60.8	0.8	-11.0	5.4p	-0.5	-1.6p	228.9p	68.2	6.8	8.2p	0.9	1.3	2.7
AT	1.8	2.2	1.9	-15.7	7.8	1.4	0.2	127.1	84.2	5.3	-1.5	0.8	0.3	1.4
PL	-2.3	-68.3	-1.3	4.8	2.5p	1.1	4.7	77.9	50.4	9.8	0.6	2.2	0.2	-1.9
PT	0.0	-112.3	-1.8	-4.7	-2.3e	3.6	-8.7	189.6	130.2	15.4	-6.1	-0.4	2.2	4.5
RO	-2.1	-57.2	-1.1	21.5	2.3p	-3.6p	-2.4	62.2	39.9	6.9	1.1	1.6	-0.1	0.1
SI	5.1	-43.7	1.2	-11.8	-0.2	-6.6	-4.6	100.1	80.8	9.6	-0.4	0.6	1.7	4.5
SK	1.0	-69.4	1.3	3.2	2.2	1.5	3.9	76.2	53.5	13.8	7.0	1.6	0.0	-4.0
FI	-1.5	-0.7	2.7	-24.0	8.0	-1.9	0.4	150.0	59.3	8.2	8.7	0.5	0.2	0.4
SE	6.5	-6.5	-3.7	-9.8	7.1	8.6	6.5	194.4	44.9	8.0	13.4	1.6	0.0	0.1
UK	-4.3	-25.3	10.2	-8.7	1.9	8.3	3.4	157.7	88.2	7.3	4.4	1.2	-0.5	-4.4

Flags: e: estimated. p: provisional.
Note: 1) See page 2 of the AMR 2016. 2) International investment position of LU has been revised downwards following the revised treatment of Euro banknotes in national Balance of payments/International investment position statistics. 3) House price index e = source NCB of EL.
Source: European Commission, November 2015

4.2.4 Updating alert mechanism scoreboard data

The data used in this chapter to illustrate the position of Luxembourg under the alert mechanism come from Eurostat database. This is an update of the data published in the last AMR scoreboard (November 2015). Therefore, differences can occur between the present results in the 2016 Competitiveness Report and those of the last alert mechanism scoreboard. The present data were downloaded mid-August 2016, and are thus an update halfway between the last alert mechanism report and the one that the Commission will publish in November 2016 in the context of its annual growth survey, which will launch the 2017 European semester.

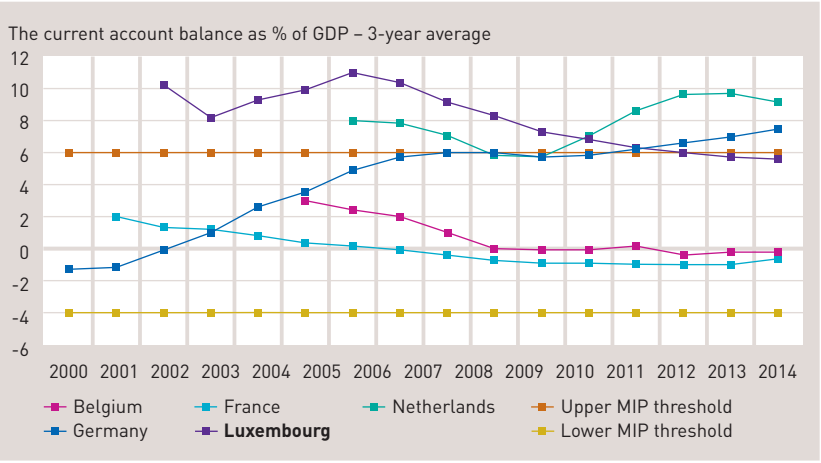
4.2.4.1 External and competitiveness imbalances

a. Current account balance[50]

Regarding the current account balance, unlike a country financing need (negative balance), a financing capacity (positive balance) does not seem an evidence of imbalance since it doesn't threaten the sustainability of its external debt. For this indicator, it has been agreed under the MIP that a country is potentially at risk if it has a current account balance with either a deficit higher than -4% of GDP or a surplus of over +6% of GDP.

Luxembourg exceeded the upper threshold limit between 2002 and 2012 but, over the last decade, its current account surplus has fallen and, since 2013, has been slightly below the upper threshold limit and is thus included in the interval defined as not posing a macroeconomic imbalance risk.

Chart 24
The current account balance, as % of GDP (3-year average)



Source: Eurostat, yellow and orange lines = thresholds of -4%/+6% set by MIP
Note: A Member State is considered to be at risk of imbalance if its balance surplus exceeds the +6% of GDP threshold or if the deficit of its balance is below -4% of GDP. If the current account balance is between those two thresholds (in the 'tunnel'), a Member State is not considered to be potentially at risk.

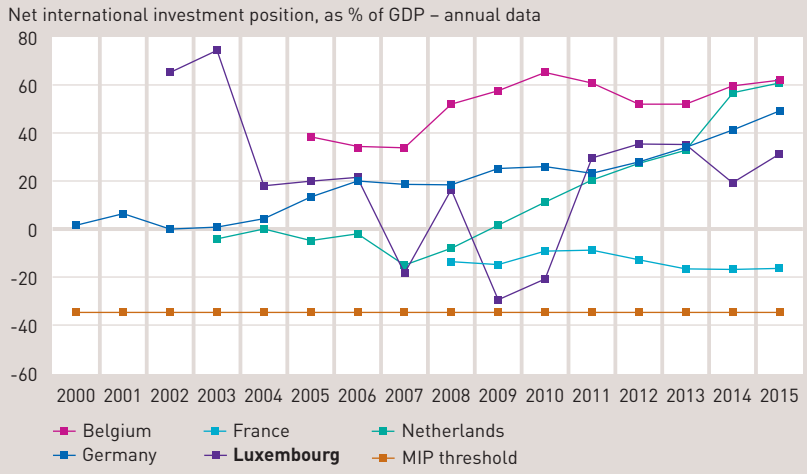
[50] The balance of payments is a statistical statement that systematically summarizes, for a specific period, the economic transactions of an economy with the rest of the world. It is divided into three main sub-balances: the current account, the capital account and the financial account. The current account is the main determinant of the financing capacity or need of an economy; it provides important information on the economic relations of a country with the rest of the world. It reports all transactions (other than those recorded under financial headings) in economic values that occur between resident and non-resident units.

b. Net international investment position[51]

The indicator of the net external position provides information on the relationship between foreign assets and the external debt of a country[52]. For this indicator, it has been agreed under the MIP that a country is potentially at risk if it has a negative balance over -35% of GDP.

Luxembourg's performance varies wildly. However, over the entire period for which data on Luxembourg are available, i.e. from 2002 to 2015, Luxembourg is above the threshold limit. In line with a large current account surplus, Luxembourg adheres to the criteria with regard to its net international position. Luxembourg's foreign assets far outweigh its foreign liabilities.

Chart 25
Net international investment position, as % of GDP



Source: Eurostat, orange line = threshold of -35% set by MIP
Note: A Member State is considered to be at risk of imbalance if its net international position is below -35% of GDP. If the indicator is above this threshold, a Member State is not considered to be at risk.

[51] The statistics of the international investment position (IIP) records the status of financial assets and liabilities of a country relative to the rest of the world. They are an important measure of the net position of the domestic economic sectors relative to the rest of the world. The net international investment position (NIIP) is calculated by the difference between assets and liabilities in the IIP. It allows a stock flow analysis of external positions.

[52] For additional details: http://ec.europa.eu/eurostat/statistics-explained/index.php/International_investment_position_statistics

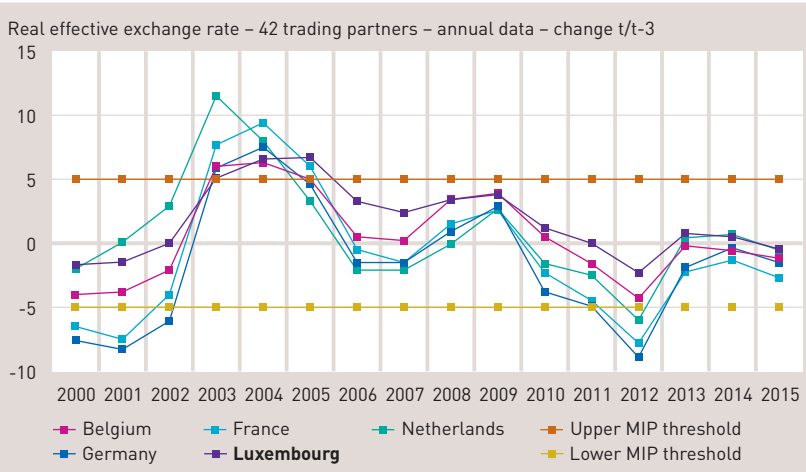
c. Real effective exchange rate (REER)[53]

The REER indicator tracks the evolution of price competitiveness and cost competitiveness by analysing the relationship between domestic prices or costs and foreign prices or costs in euro. Thus an increase in the REER is usually equivalent to a decline of competitiveness, due to the fact that domestic prices/costs increase faster than those in foreign countries. The REER is constructed from currencies of major trading partners.

For this indicator, it has been agreed for the euro area Member States that a country is potentially at risk if the REER indicator is above + 5% or under -5%.

Just like its neighbouring countries, Luxembourg often ranks in the interval considered as not posing a risk of macroeconomic imbalances.

Chart 26
The real effective exchange rate (% change over 3 years)



Source: Eurostat, orange and yellow lines = thresholds of +/- 5% for euro area Member States
Note: A euro area Member State is considered to be at risk of imbalance if its REER is above +5% or below –5%. If REER changes are within these two thresholds (in the 'tunnel'), a Member State is not considered to be at risk.

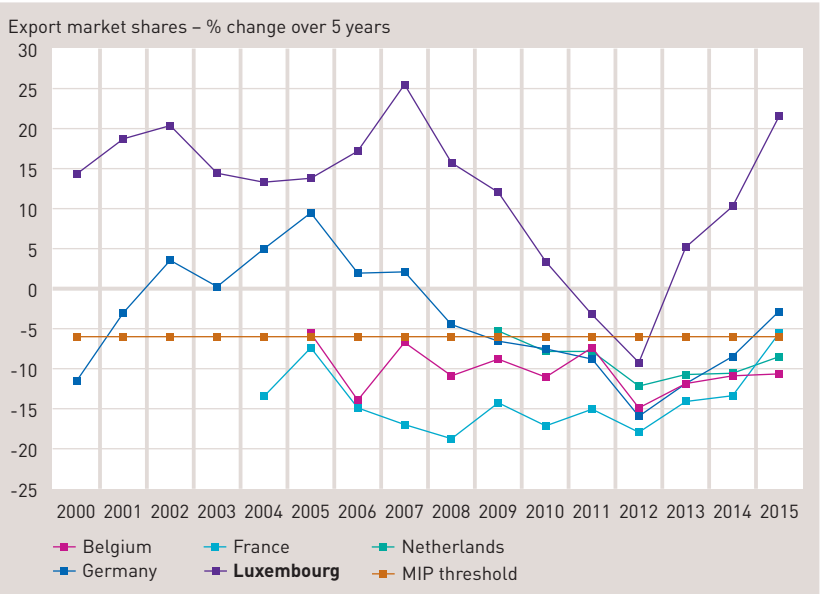
[53] The REER (or 'real effective exchange rate') aims to assess the price competitiveness or the cost competitiveness of a country compared to its main competitors in international markets. Changes in cost competitiveness and price competitiveness depend not only on changes in the exchange rate, but also on the cost and price evolution. The specific REER for excessive imbalance procedure is deflated with the price index compared to a group of 42 countries (double weighting of exports is used to calculate the REER in order to take into account not only the competition on the domestic markets of the various competitors, but also on other export markets). A positive value implies a real appreciation. Data are given in 3-year percentage change and in 1-year percentage change. The scoreboard indicator corresponds to the 3-year percentage change of the real effective exchange rate based on the consumer price index of the 42 trading partners.

d. Export market shares[54]

The scoreboard includes an indicator on changes in the market share of a country in global exports of goods and services, in order to measure in volume the slow and persistent losses in competitiveness. It is an outcome indicator, which also captures the components of non-cost competitiveness, or the ability of a country to exploit new business opportunities due to the increased demand. For this indicator, it has been agreed under the MIP that a country is potentially at risk if this indicator is less than -6%.

For the majority of the years under observation, Luxembourg has observed the established threshold limits, with the exception of 2012. Between 2007 and 2012, Luxembourg's shares fell significantly but, since 2013, they have been on the rise again.

Chart 27
Export market shares (% change over 5 years)



Source: Eurostat, orange line = threshold of -6% set by the MIP
Note: A Member State is considered to be at risk of imbalance if the change in its export market shares is below -6%. If the indicator is above this threshold, a Member State is not considered to be at risk.

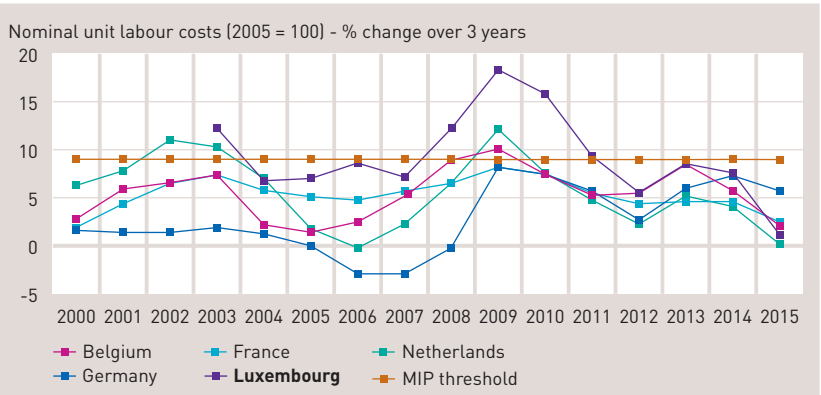
[54] This indicator shows the evolution of the export shares of goods and services of the EU Member States in total world exports. Data on the values of exports of goods and services are developed in the context of the balance of payments of each country. To take into account the structural losses of competitiveness that can accumulate over long periods, the indicator is calculated by comparing year Y to year Y-5. The indicator is based on the data from the balance of payments provided to Eurostat by the 28 EU Member States.

e. Nominal unit labour costs[55]

The nominal unit labour costs (nominal ULC) are the indicator traditionally used to measure the cost-competitiveness of an economy. The change in domestic nominal unit labour costs of a country, or the cost of labour per unit of value added produced, is compared to those of the main trading partner countries. Thus this indicator includes two factors: firstly, the average labour cost in an economy and secondly, the level of productivity. For this indicator, it has been agreed that a country is at risk if this indicator is higher than +9%.

Luxembourg's performance for this indicator has varied somewhat. The 2008 increase is largely due to a drop in productivity, which can be observed in almost all sectors. An explanation for Luxembourg's subpar performance is the stronger weighting of the financial sector in Luxembourg's economy, a sector whose significant loss of productivity over the last few years has heavily contributed to the increase in Luxembourg's ULC. The same explanation can be given for industry, which, over the course of the most recent years of the crisis, has implemented major job-saving plans. Luxembourg has scored under the threshold limit every year since 2012 and therefore does not constitute a macroeconomic imbalances risk under this indicator.

Chart 28
Nominal ULC - % change over 3 years



Source: Eurostat, orange line = threshold of +9% for euro area Member States
Note: A euro area Member State is considered to be at risk of imbalance if the change in its nominal ULC is above +9%. If the indicator is below this threshold, a Member State is not considered to be at risk.

[55] The nominal unit labour costs (NULC) are defined as the ratio of total employee compensation (D1), in millions of national currency, relative to the total number of employees, divided by the ratio of GDP at market prices in millions, expressed in chain-linked volume for the reference year 2010 with the 2005 exchange rate into national currency relative to the total number of people employed. The change in nominal unit labour costs is the change in the total compensation of employees by number of employees not covered by the change in labour productivity as well as the change in the proportion of employees in total employment. The input data are obtained through official data transmissions from countries' national accounts in the SEC2010 transmission programme. Data are expressed as a percentage change in indices between the year Y and the year Y-3.

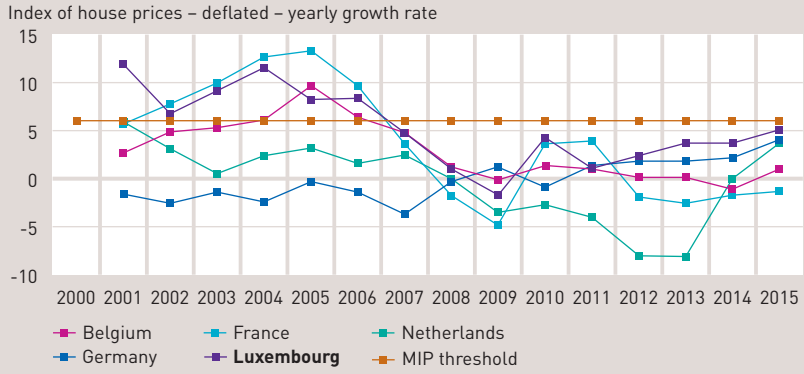
4.2.4.2 Internal imbalances

a. House prices[56]

This indicator measures changes in the acquisition prices of real estate within the EU Member States to detect internal imbalances linked to a potential 'housing bubble'. It has been agreed under the MIP that a country is at risk if this indicator is higher than +6%.

Real estate prices (housing) have risen, in real terms, almost continuously since 2001, with the exception being in 2009. Between 2001 and 2006, Luxembourg was above the threshold limit, with prices rising too quickly. Since 2007, annual price rises have been below the threshold limit although Luxembourg's score was very close to the threshold limit in 2015.

Chart 29
Deflated index of house prices (% change over 1 year)



Source: Eurostat, orange line = threshold of +6% set by MIP
Note: A Member State is considered to be at risk of imbalance if the change in housing prices is above +6%. If the indicator is below this threshold, a Member State is not considered to be at risk.

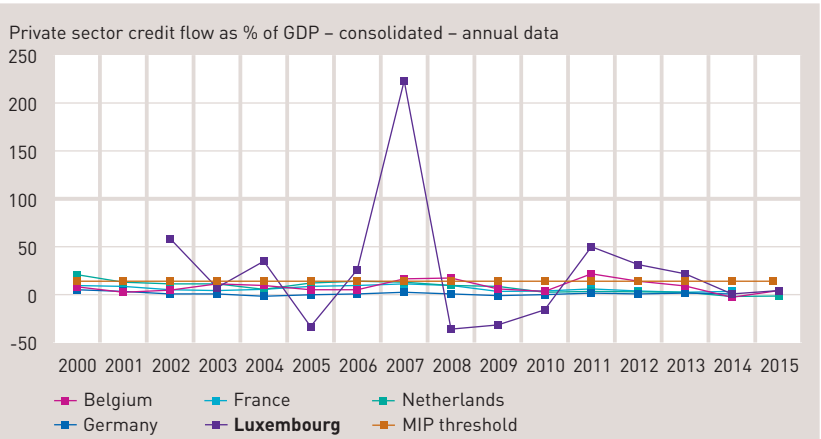
[56] The deflated index of house prices is the ratio between the housing price index and the deflator of private final consumption expenditure (households and non-profit institutions). Therefore, this indicator measures inflation in the housing market compared to that of final consumption of households and NPI. Eurostat index of housing prices reflects the price changes of all types of housing purchased by households (apartments, detached and non-detached houses, etc.), both new and existing, regardless of their final use and previous owner. Only market prices are considered, so built housing on own account is excluded. The land is included. Data show changes in percentage from year Y compared to the year Y-1.

b. Private sector credit flow[57]

This indicator measures the credit flow of the private sector that corresponds to the net changes in liabilities of the non-financial corporate sectors, households and non-profit institutions serving households. A country is at risk if this indicator is above +14%.

Luxembourg's performance for this indicator varies greatly, much more so than the performance of neighbouring countries. The structure of the Luxembourg economy, a very small but open economy, home to several large, non-financial companies, whose financial decisions can have a major impact on the national economy, could be the explanation for this situation.

Chart 30
Private sector credit flow (as % of GDP)



Source: Eurostat, orange line = threshold of +14% set by MIP
Note: A Member State is considered to be at risk of imbalance if the change of private sector credit flows is above +14%. If the indicator is below this threshold, a member State is not considered to be at risk.

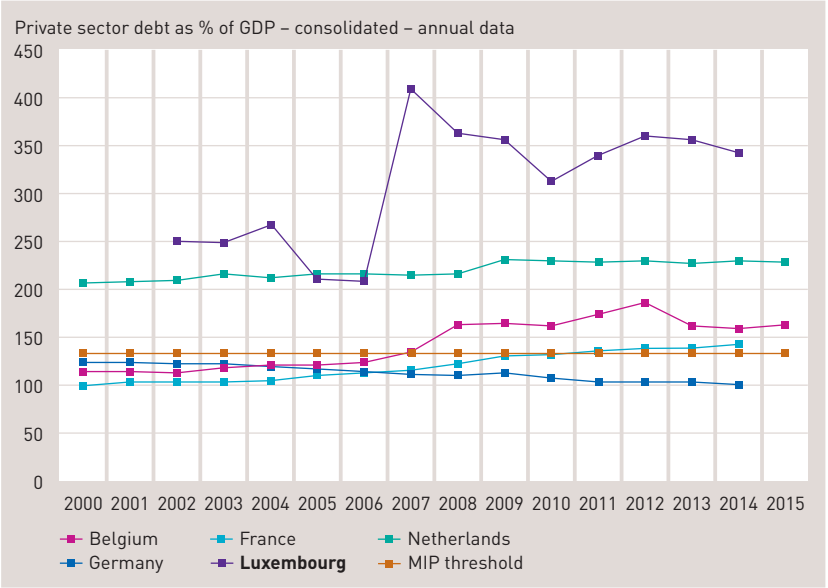
[57] The private sector credit flow corresponds to the net changes in liabilities of the non-financial corporate sectors (S.11), households and non-profit institutions serving households (S.14_S.15) incurred during the year. The instruments included in the calculation of private sector credit flow are the 'Securities other than shares' (F.3) and 'Credits' (F.4), to the exclusion of any other instrument. The concepts used in the definition of sectors and instruments are consistent with SEC2010. Data are expressed in EUR million and calculated on a non-consolidated basis, i.e. by including transactions among units of the same sector.

c. Private sector debt[58]

The private sector debt indicator is important because if it is excessively high, private sector debt involves significant risks to growth and financial stability of a country. The indicator measures the level of private debt of the economy: non-financial corporations, private households and non-profit institutions serving households (as a % of GDP). The indicator is based on non-consolidated data, meaning it includes for example intra-sector debt at national level. It has been agreed that a country is potentially at risk if this indicator is above +133% of GDP.

Since this indicator is available for Luxembourg, it significantly overruns the threshold set by the MIP. For Luxembourg this indicator should be interpreted with caution because non-financial companies incur most of this private sector debt. Given the liquidity of financial markets and the experience in international transactions, a company may choose to incur debt through funding in Luxembourg, not for its own need but for another related entity that may be located abroad (e.g. intra-group loans). This debt then contributes to the numerator of the 'private sector debt relative to GDP' indicator used here, without taking into account the added value produced by this funding if it is out of Luxembourg because the GDP (denominator) is a national concept. For a small and very open economy such as Luxembourg, this indicator therefore tends to be overestimated because the numerator (debt) is overvalued and the denominator (GDP) is undervalued because the added value created abroad from these sources of financing (debt) raised inside the country is not taken into account. With particular regard to private household debt, this debt results mainly from loans taken for housing acquisition, and is close to the euro area average.

Chart 31
Consolidated private sector debt (as a % of GDP)



Source: Eurostat, orange line = threshold of 133% set by MIP
Note: A Member State is considered to be at risk of imbalance if the private sector debt exceeds 133% of GDP. If the indicator is below this threshold, a Member State is not considered to be at risk.

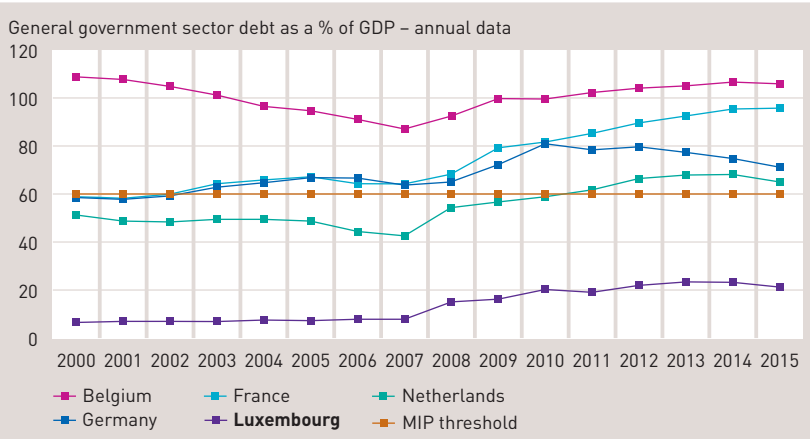
[58] The private sector debt corresponds to the outstanding amount of liabilities of non-financial corporate sectors (S.11), households and non-profit institutions serving households (S.14_S.15). Instruments included in the calculation of the private sector debt are 'Securities other than shares', to the exclusion of financial derivatives (F.33) and credits (F.4) to the exclusion of any other instrument. The concepts used in the definition of sectors and instruments are consistent with SEC2010. Data is calculated on a non-consolidated basis, i.e. excluding transactions among units of the same sector. The PDM indicator is calculated as a percentage of GDP.

d. General government sector debt[59]

This indicator takes into account the potential contribution of general government sector debt to macroeconomic imbalances. The definition used is that set by the Stability and Growth Pact (SGP). This indicator is not included to monitor the risk of unsustainable public finances, but should be considered as a complement to the indicator on private debt. A high level of government debt is more alarming when accompanied by a high level of private debt. For this indicator, it has been agreed under the MIP that a country is potentially at risk if this indicator is above +60% of GDP.

Luxembourg has a general government sector debt level well below the 'Maastricht' threshold (60% of GDP), although since 2007 general government sector debt has also started to rise sharply in Luxembourg.

Chart 32
General government sector debt (as a % of GDP)



Source: Eurostat, orange line = threshold of 60% set by the Maastricht treaty
Note: A Member State is considered to be at risk of imbalance if its general government sector debt exceeds 60% of GDP. If the indicator is below this threshold, a Member State is not considered to be at risk.

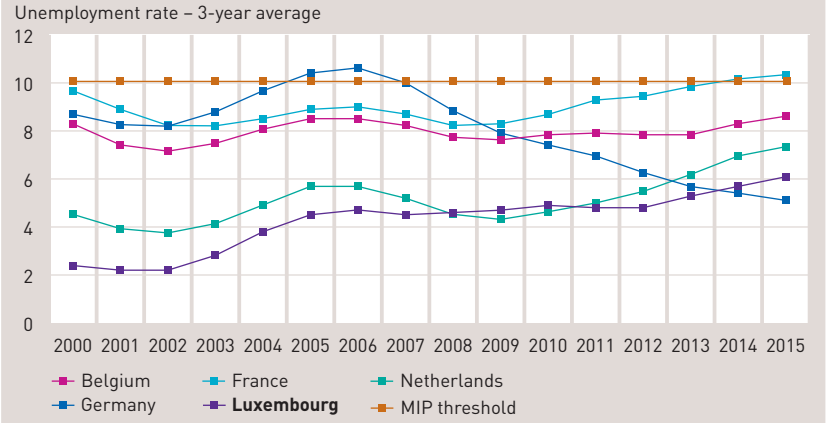
[59] General government gross debt is defined in the Maastricht Treaty as the consolidated gross debt of the whole general government sector in nominal value at the end of the year. The government sector includes the following subsectors: central government, State government, local government and social security funds. Definitions are available in the 479/2009 Regulation, as amended by the 679/2010 Council Regulation. National data for the general government sector are consolidated over sub-sectors. The series are available as a percentage of GDP. GDP denominator comes from the SEC2010 transmission programme, and not from the EDP notifications. The revised GDP data being transmitted in a delayed schedule, it may result in potential differences in debt as a % of GDP, according to the source, EDP or AMR score-board.

e. Unemployment rate[60]

This indicator is intended to monitor high and persistent unemployment rates and it points a possible misallocation of resources (incompatibility) and the general lack of responsiveness in the economy. It should therefore be read in conjunction with other more future-oriented indicators and should be used to better understand the potential severity of macroeconomic imbalances. It has been agreed that a country is at risk if this indicator is above 10%.

Luxembourg has an unemployment rate well below the threshold. However, since 2000 unemployment has risen sharply in Luxembourg.

Chart 33
Unemployment rate (3-year average)



Source: Eurostat, orange line = threshold of 10% set by MIP
Note: A Member State is considered to be at risk of imbalance if its unemployment rate exceeds 10%. If the indicator is below this threshold, a Member State is not considered to be at risk.

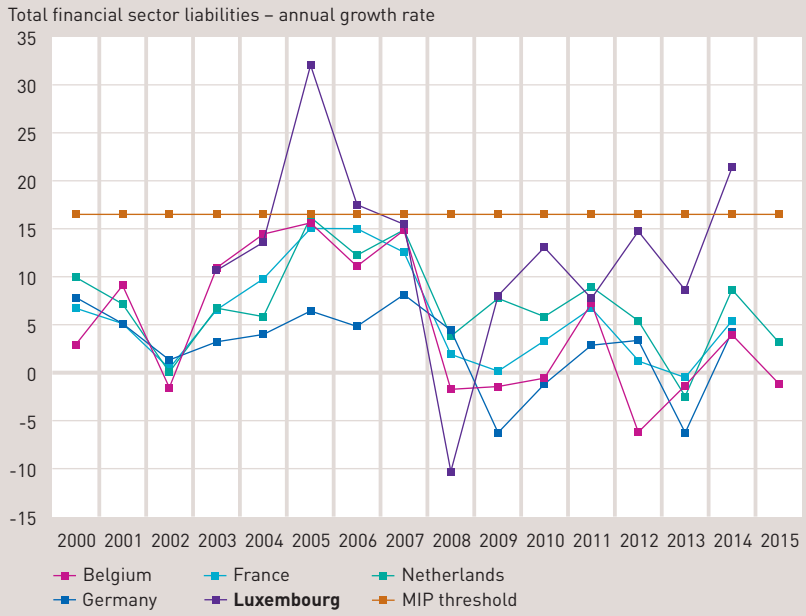
[60] The unemployment rate represents the number of unemployed persons as a percentage of the labour force as defined by the International Labour Organization (ILO). The labour force consists of employed and unemployed persons. Unemployed persons are those aged 15 to 74 who: - were jobless during the reference week - were available for work during the next two weeks - and were either looking actively for a job during the previous four weeks or had already found a job that began in the following three months. Data are 3-year moving averages, i.e. year Y data are the arithmetic mean of the years Y, Y -1, Y -2. In this context, it is not the national definition of unemployment used in Luxembourg, which is the one used by the Agency for Employment Development (Adem): 'The unemployment rate is the ratio between the number of resident jobseekers available and the labour force. The latter consists of all persons living in the country who are working (employee or self-employed) or looking for a job (jobseeker).'
For additional details: http://www.adem.public.lu/publications/communiques/Note_technique_sur_les_DSM_-_ADEM_24_02_2012.pdf

f. Total financial sector liabilities[61]

This indicator measures the evolution of the sum of the liabilities of the entire financial sector of a country. The indicator is expressed as an annual growth rate. For this indicator, it has been agreed under the MIP that a country is potentially at risk if this indicator is higher than +16.5%.

In most of the years under analysis, Luxembourg was below the threshold limit. The exception was in 2005 and 2006, although thereafter the indicator proceeded to drop below the threshold. In 2014, the year of the latest available data, Luxembourg exceeded the threshold limit once again.

Chart 34
Growth rate of the total financial sector liabilities



Source: Eurostat, orange line = threshold of 16.5% set by MIP
Note: A Member State is considered to be at risk of imbalance if the growth rate of the total financial sector liabilities exceeds +16.5%. If the indicator is below this threshold, a Member State is not considered to be at risk.

[61] Total financial sector liabilities measure the evolution of the sum of all liabilities (including currency and deposits, securities other than shares, loans, shares and other equity, insurance technical reserves and other accounts payable) of the entire financial sector. The indicator is expressed as an annual growth rate.

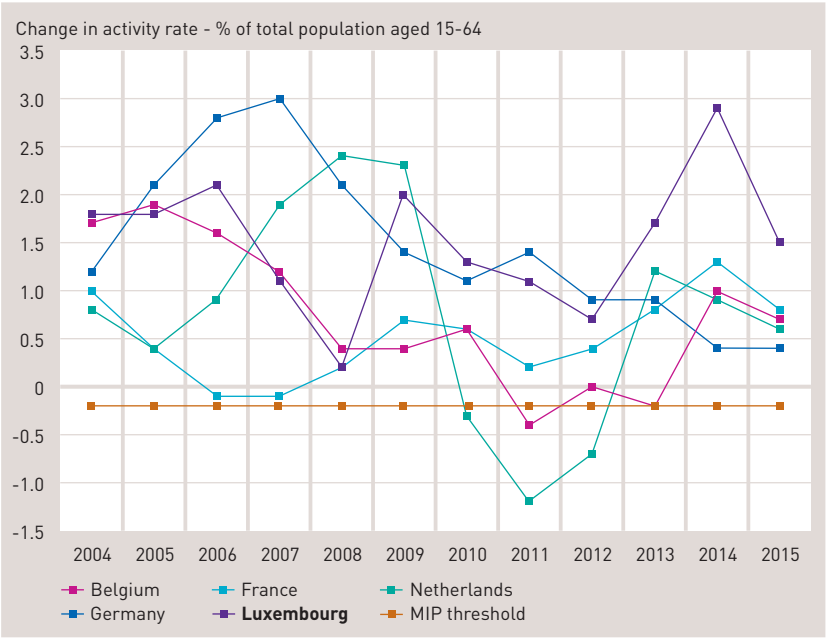
4.2.4.3 New employment indicators

a. Activity rate[62]

This indicator measures variations in the activity rate amongst Member State residents. The indicator is expressed in percentage points over a three-year period. For this indicator, a country is deemed to be potentially at risk if the activity rate falls by more than 0.2 p.p. over the period in question.

Over the entire period under analysis, Luxembourg posted positive growth figures for its activity rate and thus exceeds the threshold limit.

Chart 35
Activity rate - % of total population aged 15-64 - 3 years change in p.p. (t, t-3)



Source: Eurostat, orange line = threshold of -0.2 p.p. set by MIP
Note: A Member State is considered to be at risk of imbalance if the growth rate is below -0.2 p.p. If the indicator exceeds this threshold, a Member State is not considered to be at risk.

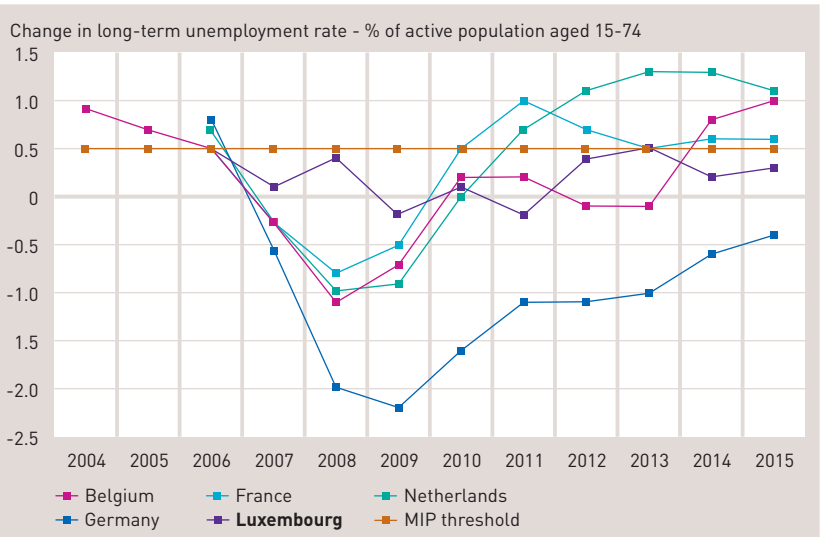
[62] The activity rate is the ratio between the number of economically active individuals aged 15-64 years and the total population in the same age bracket. In line with the International Labour Organisation (ILO) definitions and for the purpose of compiling labour market statistics, individuals are categorised as follows: employed, unemployed and economically inactive. The economically active population (also referred to as 'the labour force') corresponds to the sum of employed and unemployed individuals. Inactive individuals are individuals who, during the reference period, were neither employed or unemployed. The scoreboard indicator reveals the change over three years expressed in percentage points. The indicative threshold is -0.2 p.p. This indicator is based on the results of the EU's quarterly Labour Force Survey (LFS), which covers the resident population living in private households.

b. Long-term unemployment rate[63]

This indicator measures the variation in long-term unemployment rates in the Member States. The indicator is expressed in percentage points and measured over a three-year period. For this indicator, a country is deemed potentially at risk if the rate increases by more than 0.5 p.p. over the period in question.

Over the entire period under analysis, Luxembourg's long-term unemployment rate variation has been below the threshold limit.

Chart 36
Long-term unemployment rate - % of active population aged 15-74 - 3 years change in p.p. (t, t-3)



Source: Eurostat, orange line = threshold of +0.5 p.p. set by MIP
Note: A Member State is considered to be at risk of imbalance if the growth rate exceeds +0.5 p.p. If the indicator is below this threshold, a Member State is not considered to be at risk.

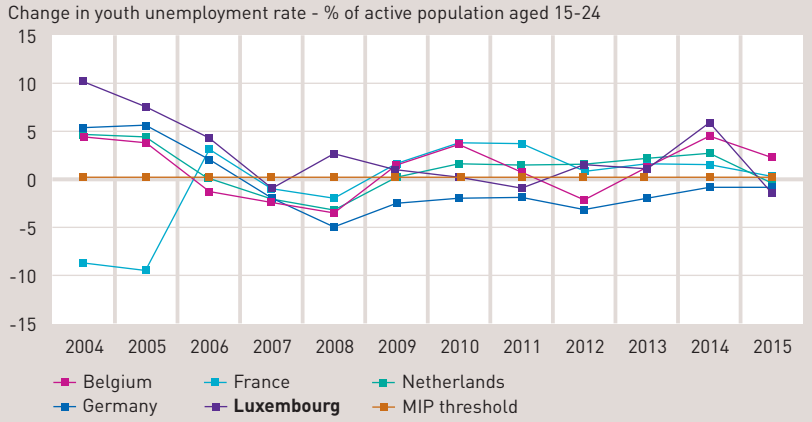
[63] The long-term unemployment rate is the number of individuals who have been unemployed for at least 12 months expressed as a percentage of the active population (the economically active population). The unemployment rate is the percentage of unemployed individuals in the active population (the total number of persons employed and unemployed), as per the International Labour Organisation (ILO) definition. The term 'unemployed' covers individuals aged 15 -74 who meet the following criteria:
- unemployed during the reference week;
- available to begin work within the following two weeks;
- actively looking for a job during the four previous weeks or have found a job which they will start within the following three months.
The scoreboard indicator corresponds to the change in percentage points over a three-year period. The indicative threshold is 0.5 p.p. This indicator is based on the results of the EU's quarterly Labour Force Survey (LFS), which covers the resident population living in private households.

c. Youth unemployment rate[64]

This indicator measures the variation in the youth unemployment rate in the Member States. The indicator is expressed in percentage points over a three-year period. For this indicator, a country is deemed to be at risk if the rate increases by more than 0.2 p.p. over the period in question.

Over the vast majority of the period under analysis, Luxembourg's variation rate was above the threshold limit. The exceptions were in 2007, 2011 and 2015.

Chart 37
Youth unemployment rate - % of active population aged 15-24 - 3 years change in p.p (t, t-3)



Source: Eurostat, orange line = threshold of +0.2 p.p. set by MIP
Note: A Member State is considered to be at risk of imbalance if the growth rate exceeds +0.2 p.p. If the indicator is below this threshold, a Member State is not considered to be at risk.

[64] The youth unemployment rate is the percentage of unemployed individuals aged 15-24 in the active population of the same age bracket. The unemployment rate is the percentage of unemployed individuals in the active population (the total number of persons employed and unemployed), as per the International Labour Organisation (ILO) definition. The term 'unemployed' covers individuals aged 15-74 who meet the following criteria:
- unemployed during the reference week;
- available to begin work within the following two weeks;
- actively looking for a job during the four previous weeks or have found a job which they will start within the following three months.
The scoreboard indicator corresponds to the change in percentage points over a three-year period. The indicative threshold is 0.2 p.p. This indicator is based on the results of the EU's quarterly Labour Force Survey (LFS), which covers the resident population living in private households

4.2.4.4 Interim conclusions

Based on the updated data used in this chapter, and pending the 2017 Alert Mechanism Report, issued in November 2016, we note that Luxembourg has exceeded 2 thresholds, namely the private sector debt level and the flow of total financial sector liabilities.

Table 5
Summary table of the alert mechanism update

	External imbalances					Internal imbalances						Employment indicators		
	Current account balance	Net international investment position	Real effective exchange rate	Export market share	Nominal ULC	Deflated house prices	Private sector credit flow	Private sector debt	General government sector debt	Unemployment rate	Total financial sector liabilities	Activity rate	Long-term unemployment rate	Youth unemployment rate
LU (2015)	5.6	31.6	-0.5	+21.5	+1.1	+5.1	+0.5*	342.2*	21.4	6.1	+21.5	+1.5	+0.3	-1.4
Thresholds**	> -4% < +6%	> -35%	>-5% <+5%	> -6%	< +9%	< +6%	< +14%	< 133%	< 60%	< 10%	< +16.5%	>-0.2 pp	<+0.5 pp	<+0.2 pp

Source: European Commission, Eurostat
Notes: * Data 2015, except for the private sector debt and the private sector credit flow (2014).
** Conditions for not being considered imbalanced (for some indicators these thresholds are different for the euro area Member States and for other Member States).

4.3 Bibliography

CENTRE FOR EUROPEAN POLICY STUDIES
Macroeconomic Imbalances in the Euro Area: symptom or cause of the crisis?, Policy Brief No. 266, April 2012

EUROPEAN COMMISSION
EUROPE 2020
Une stratégie pour une croissance intelligente, durable et inclusive, COM(2010) 2020, Brussels, 3.3.2010

EUROPEAN COMMISSION
Alert Mechanism Report 2016, Brussels, November 2015

EUROPEAN COMMISSION
État des lieux de la stratégie Europe 2020 pour une croissance intelligente, durable et inclusive, Brussels, March 2014

EUROPEAN COMMISSION
Results of the public consultation on the Europe 2020 strategy for smart, sustainable and inclusive growth, Brussels, 2 March 2015

EUROPEAN COMMISSION
Macroeconomic Imbalances Luxembourg 2014, European economy - Occasional Papers 183, March 2014

COMMISSION EUROPÉENNE
COMMISSION STAFF
WORKING DOCUMENT
Country Report Luxembourg 2016, Brussels, Februrary 2016

EUROPEAN COUNCIL
Conclusions,
Bruxelles, 26 March 2010

EUROSTAT
Smarter, greener, more inclusive? Indicators to support the Europe 2020 strategy - 2016 edition, Eurostat statistical books, Luxembourg, 2016

LUXEMBOURG GOVERNMENT
Programme national de réforme Luxembourg 2020, Luxembourg, April 2016

WEBSITES

http://ec.europa.eu/europe2020/index_fr.htm

http://ec.europa.eu/eurostat/web/europe-2020-indicators/statistics-illustrated

http://ec.europa.eu/eurostat/web/macroeconomic-imbalances-procedure/indicators

5 The economic impact of the 5 new priority sectors

5.1 Introduction

The *Observatoire de la compétitivité* has carried out this study to increase the pool of statistics and indicators so as to better assess developments in the government's 5 new priority sectors, namely information and communication technologies (ICT), space technologies, logistics, health sciences and technologies and eco-technologies. The aim is to analyse the economic impact of these new sectors on productivity, economic growth and employment.

Following an analysis of the available studies and the proposal of a single definition for each of the 5 sectors in question (see 2014 Competitiveness Report[1]), it was possible to identify several indicators for monitoring de developments in the government's 5 new priority sectors.

5.2 Methodology

The results set out in this study were calculated based on the available data provided by STATEC and the RCS (Trade and Companies Register). While respecting the confidentiality rules applicable to STATEC data, the *Observatoire de la compétitivité* (ODC) calculated the value added at factor cost for each company according to the International Accounting Standards (IAS) and Commission Regulation (EC) 250/2009 of 11 March 2009[2].

The difference between the figures published in this chapter and those of previous years can be explained primarily by the fact that Central Balance Sheet Data (STATEC) has been used. This data was not previously available. Revisions of annual business accounts and/or national accounts published by STATEC may also be the cause of differences with previously published figures.

Finally, this study only analyses businesses in the private sector with headquarters in Luxembourg and whose activities are directly linked to the 5 new priority sectors.

1 http://www.gouvernement.lu/4290949/ppe-029-fr.pdf

2 Value added at factor cost refers to 'turnover, plus capitalised production, plus other operating income (including operating subsidies), plus or minus the changes in stocks, minus the purchases of goods and services, minus other taxes on products which are linked to turnover but not deductible, minus the duties and taxes linked to production'.

5.3 Macroeconomic indicators of the 5 new priority sectors

5.3.1 Information and communication technologies (ICT)

ICT is a cross-cutting tool for the economy. The sector, as defined in the 2014 Competitiveness Report, is composed of three categories of stakeholders:

- ICT producers, according to the strict OECD or Eurostat definitions (electronic hardware and components, telecommunications, ICT services or software, etc.);
- Activities involving digital content, the existence of which is linked to the emergence of ICT (online services, video games, e-commerce, etc.);
- ICT users who use ICT to make productivity gains but whose activities pre-date the emergence of ICT (banks, insurance, automotive and aeronautics, distribution, administration and tourism, etc.).

This analysis draws upon two previously employed definitions:

- Strict definition: this definition includes the production of ICT hardware and software (manufacturing), the distribution of ICT products and services (commerce) and the provision of services to facilitate the use of ICT (service activities), on the basis of the OECD and Eurostat definitions of the ICT sector;
- Broad definition: this definition is more difficult to pinpoint as it comprises other activities indirectly linked to ICT use, such as activities which are dependent upon the emergence of ICT, e.g. e-commerce, media and digital content).

Statistical analysis of ICT in the private sector is based upon activities which fall under the strict and broad definitions of the sector.

a) ICT (strict definition)

The strict definition of the ICT sector is underpinned by the analysis of activities listed in the European nomenclature of economic activities, NACE Rev. 2, in accordance with the Eurostat definition (Table 1).

Table 1
List of ICT activities under the strict definition of the sector

Activities	NACE Rev. 2 Code	Description
Manufacturing industries	26.110	Manufacture of electronic components
	26.120	Manufacture of loaded electronic boards
	26.200	Manufacture of computers and peripheral equipment
	26.300	Manufacture of communication equipment
	26.400	Manufacture of consumer electronics
	26.800	Manufacture of magnetic and optical media
Services industries	46.510	Wholesale of computers, computer peripheral equipment and software
	46.520	Wholesale of electronic and telecommunications equipment and parts
	58.210	Publishing of computer games
	58.290	Other software publishing
	61.100	Wired telecommunications activities
	61.200	Wireless telecommunications activities
	61.300	Satellite telecommunications activities
	61.900	Other telecommunications activities
	62.010	Computer programming activities
	62.020	Computer consultancy activities
	62.030	Computer facilities management activities
	62.090	Other information technology and computer service activities
	63.110	Data processing, hosting and related activities
	63.120	Web portals
	95.110	Repair of computers and peripheral equipment
	95.120	Repair of communication equipment

Table 2 lists several macroeconomic indicators showing how the ICT sector has developed since 2005.

Table 2
Indicators relating to the ICT services sector - Private sector

ICT (strict definition)	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of companies	1,357	1,429	1,497	1,554	1,618	1,694	1,755	1,838	1,960
	5.1%	*5.2%*	*5.3%*	*5.3%*	*5.3%*	*5.4%*	*5.4%*	*5.5%*	*5.6%*
Number of people employed	10,467	11,298	12,458	13,515	13,888	14,372	15,022	15,353	15,833
	3.4%	*3.5%*	*3.7%*	*3.9%*	*3.9%*	*4.0%*	*4.1%*	*4.1%*	*4.1%*
Number of salaried workers	10,303	11,155	12,309	13,338	13,722	14,184	14,816	15,169	15,613
		3.7%	*3.9%*	*4.1%*	*4.1%*	*4.2%*	*4.3%*	*4.3%*	*4.3%*
Value added at factor cost (in EUR millions)	1,593.4	1,739.3	1,887.3	2,101.2	2,186.1	2,542.2	2,766.1	2,853.3	2,989.7
	6.1%	*5.9%*	*5.8%*	*6.3%*	*6.8%*	*7.2%*	*7.3%*	*7.3%*	*7.3%*
Turnover (in EUR millions)	5,398.0	6,460.3	6,064.7	6,107.6	6,635.9	8,800.7	9,694.2	11,448.7*	14,652.6
Staff costs (in EUR millions)	629.6	713.4	802.3	874.3	920.1	982.1	1,074.1	1,079.1	1,139.2
Gross investment in tangible goods (in EUR millions)	125.7	320.5	340.8	202.0	454.6	613.7	649.3	628.7	336.1
Turnover per employee (in EUR millions)	515.7	571.8	486.8	451.9	477.8	612.3	645.3	745.7*	925.4
Apparent labour productivity (gross value added per employee)	152.2	153.9	151.5	155.5	157.4	176.9	184.1	185.8	188.9
Investment rate (investment/value added at factor cost)	7.9%	18.4%	18.1%	9.6%	20.8%	24.1%	23.5%	22.0%	11.2%

Note: Aside from the 'number of companies' variable, which refers to the whole of the ICT industry (manufacturing and service providers), all other indicators refer only to ICT services due to the confidential nature of data relating to ICT manufacturing activities (3 companies).
The percentages shown in italics represent the sector's share of the total indicator figure for Luxembourg.
* Break in the series due to the reclassification of certain companies.
Source: Structural Business Statistics (STATEC)

In recent years, the ICT sector has grown significantly in terms of the number of companies operating in the sector, particularly between 2012 and 2013. From a mere 1,357 ICT companies in 2005, the sector expanded to 1,960 by 2013 (+44.4%, i.e. +5.6% per year on average), which was 122 more than in 2012 (+6.6%). These ICT companies, which represented 5.6% of the total business population in Luxembourg in 2013, employed 15,833 people (4.1% of those employed in the country).

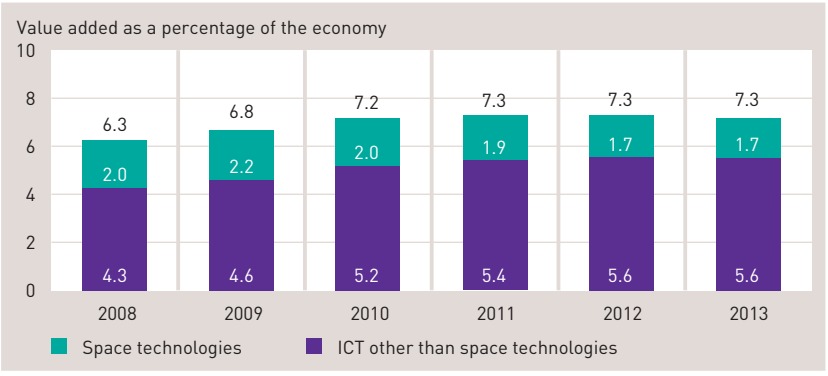
Following a sharp rise in the number of jobs in ICT before the crisis, recruitment in the sector has continued to increase but at a slower pace. The number of jobs has increased by 51.3% (6.4% annual growth rate) with an 80.9% increase in spending on staff during the same period (i.e. an annual growth rate of 10.1%). The ICT sector therefore seems to have largely escaped the effects of the economic and financial crisis, as the numbers of companies and employees (Chart 1) as well as turnover have all grown considerably.

Chart 1
Variation in number of employees and companies in the ICT sector (strict definition)

Source: Structural Business Statistics (STATEC)

By the end of 2013, the country's ICT companies were contributing 7.3% of the value added of the Luxembourg economy, i.e. EUR 3 billion (87.6% increase compared to 2005 and 42.3% between 2008 and 2013). Although the value added created increased, in absolute terms, compared to 2012 (+4.8%), this growth is less than the total value added of the Luxembourg economy, which nuances slightly the share of ICT in the economy compared to the previous year. Of this 7.3%, the space sector, i.e. space technology companies, accounts for almost 1.7% of the value added of the ICT sector but, under Eurostat's definition, these are categorised as ICT companies (see paragraph 3.2) (Chart 2).

Chart 2
Breakdown of value added at factor cost in the ICT sector (strict definition)

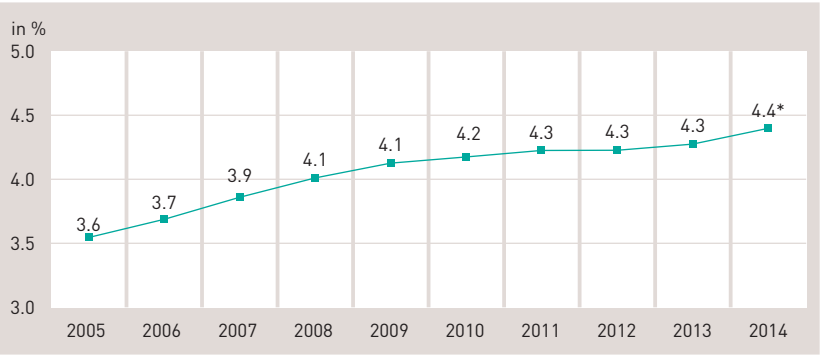


Source: Structural Business Statistics (STATEC), Balance sheets available at the RCS, Calculation: ODC

Telecommunications activities (the majority of which characterizes the space technology sector) contributed most to the value added for the ICT sector in 2013 (51.5%), in spite of a 5.5% decline compared to 2012. These are followed by programming, consultancy and other ICT activities which are gaining ground and have increased from 21.3% to 22.3% in a year, production of electronic games and other software (3.1% compared to 3.4% in 2012) and information services (2.1% compared to 1.3% in 2012). The ICT sector, according to the strict definition, has thus created a gross value added of nearly EUR 3 billion and a turnover of nearly EUR 15 billion in 2013.

As regards employment, the share of the ICT sector in the number of jobs in Luxembourg has constantly increased. In 2005, the sector accounted for 3.6% of all jobs whereas in 2014, it represented 4.4% of all jobs in Luxembourg, i.e. 16,365 jobs in 2014 (Chart 3).

Chart 3
Variation in the number of jobs in the ICT sector (strict definition) as a % of total jobs



Note: * IGSS data annual average
Source: Structural Business Statistics (STATEC)

The *Note de conjoncture*[3] published last year states that ICT employment is heavily concentrated in the field of ICT services (90%) and ICT trade (10%) whilst employment in ICT manufacturing represents only 0.2% of total employees in the sector. Furthermore, there were over 4,541 employees in telecommunications (NACE code 61) in 2014 compared with only 3,744 in 2005, an increase of 29.3% over a 9-year period. The Post Luxembourg group, which employs almost 4,000 people, features amongst the companies in this sector[4]. However, over half of the ICT jobs in Luxembourg (over 8,000 jobs) are in programming, consultancy and other ICT activities (NACE code 62). This category features companies such as Sogeti Luxembourg SA, which has more than 500 employees, Telindus SA and Computer Task Group Luxembourg PSF SA.

[3] STATEC, Note de conjoncture No. 1-15, 2015.

[4] It should be noted that this figure accounts for the whole of the Post Luxembourg group as the NACE for a company's, or group's, primary activity code is allocated by STATEC on the basis of the activities which generate over 50% of the company's value added (STATEC, NACELUX Rev. 2, Luxembourg version of NACE Rev. 2, statistical nomenclature of economic activities in the European Community. Introduction, structure and explanatory notes, 2008).

However, these activities only account for one fifth of the sector's gross value added, i.e. EUR 660 million and a turnover of approximately EUR 2 billion[5]. The most significant sectors of growth in the period between 2012 and 2014 were data processing, hosting and related activities (NACE 63.110) and computer programming activities (NACE 62.010) which registered an increase in job numbers of 403 and 280 respectively over the two years. The increase in jobs in the NACE 62.010 category is due, amongst other things, to the creation of two new legal entities in the Amazon group and the reclassification, compared with 2012, of several legal entities which are also considered e-commerce companies under our definition (see paragraph entitled 'ICT (broad definition)').

The 51 companies which produce video games and other software (NACE 58.200) generate 3.4% of the sector's value added, i.e. EUR 98 million[6]. The three video game producers have made a significant contribution to growing the sector's value added since their arrival in Luxembourg in 2012 (including Kabam which has since left Luxembourg).

Table 3 lists the main employers in the ICT sector at the beginning of 2016, based on the group's primary activity.

Table 3
Main employers in the ICT sector

Name	Approx. number of employees
Group Post Luxembourg	4,320
Sogeti Luxembourg SA	560
SES	510
Telindus SA	430
Computer Task Group Luxembourg PSF SA	300
Intrasoft International SA	190
CGI Luxembourg SA	190
Orange Communications Luxembourg SA	180
Groupe IBM	170
Comptoir Électrotechnique Luxembourgeois SARL	150
Eltrona-Interdiffusion SA	140
Champ Cargosystems SA	130
Tango SA	130
Groupe Fujitsu Technology Solutions SA	110
CSC Computer Sciences Luxembourg SA	110
Aubay SA	110

Source: List of Luxembourg's main employers, situation as of 1st January 2016 (STATEC)

[5] Source: Structural Business Statistics (STATEC).

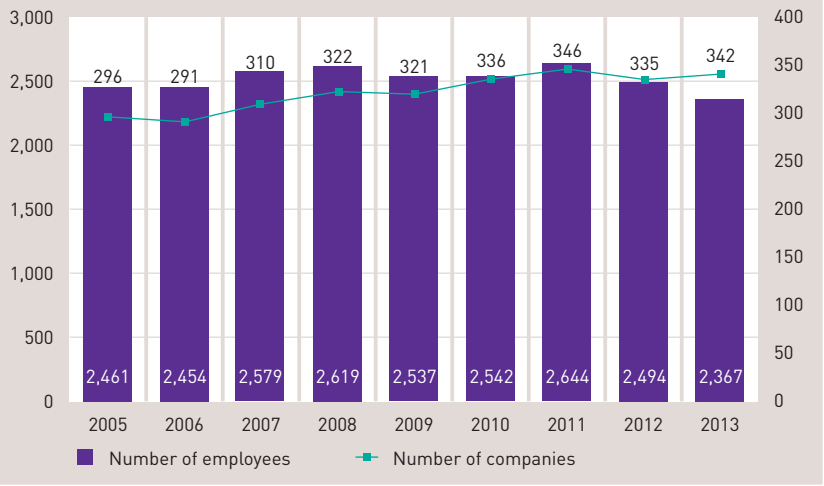
[6] Source: Structural Business Statistics (STATEC).

b) ICT (broad definition)

Content and media

In addition to Eurostat's definition of the ICT sector, the *Observatoire de la compétitivité* carried out analysis of ICT-related activities in a bid to broaden the definition of the sector and include activities whose existence is dependent upon ICT. Therefore, the sector which the OECD refers to as 'content and media' and Eurostat calls 'information services'[7] was analysed. At the end of 2013 this sector featured 342 companies employing 2 367 staff (slight decrease since 2011) and representing a gross value added of the country's economy of 0,6% (Chart 4).

Chart 4
Development of the content and media sector



Source: Structural Business Statistics (STATEC)

E-commerce

In addition to the 'content and media' activities, distance selling (e-commerce) should also be included as it is an activity which is dependent upon traditional ICT infrastructure. Such activities, very significant in Luxembourg's ICT landscape, deserve special attention in order to present the as complete snapshot as possible of the ICT sector. The e-commerce sector has grown exponentially since its arrival in Luxembourg, a country which, for several years, has been very attractive for e-commerce companies in spite of the recent departure of some of the largest companies in the sector, e.g. Netflix, Kabam and Zynga.

[7] Definition of the 'information services' sector:
NACE code 58.1 – Publishing of books, periodicals and other publishing activities, 59.1 – Motion picture, video and television programme activities, 59.2 – Sound recording and music publishing activities, 60.1 – Radio broadcasting, 60.2 – Television programming and broadcasting activities, 63.9 – Other information service activities.

In order to establish a series of indicators to measure the economic characteristics of this sector, the Ministry of the Economy worked with the Media and Communications Service to develop a list of key players in the sector. The list is based on a definition of e-commerce featuring several activities such as distance selling, online gaming and financing (predominantly mobile payment) which are dependent upon e-commerce and could not exist without it. The indicators shown in the table below only apply to the shortlist of companies which is representative of the sector as it constitutes almost all of the value added and jobs created in this sector.

This list of major e-commerce groups with headquarters in Luxembourg contained 48 legal entities in 2013, rising from only 7 in 2005. Back then, these few companies employed just 58 workers. In 8 years, this figure has multiplied by more than 20, with the number of employees rising to 1,387 (Table 4). The most significant growth took place between 2012 and 2013, with the number of employees increasing by 58% in a single year, accounting for 0.4% of the total number of workers in the country (Chart 5).

Table 4
E-commerce indicators

E-commerce	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014 (p)
Number of legal entities[8]	7	11	12	13	15	17	26	38	48	49
Number of salaried workers	58	101	145	221	294	396	656	877	1,387	1,427
	0.0%	*0.0%*	*0.0%*	*0.1%*	*0.1%*	*0.1%*	*0.2%*	*0.2%*	*0.4%*	*0.4%*
Value added at factor cost (in EUR millions)	-153.4	-31.9	203.9	373.7	539.9	585.2	511.5	603.8	1,084.2	1,333.4
	-0.6%	*-0.1%*	*0.6%*	*1.1%*	*1.7%*	*1.6%*	*1.3%*	*1.6%*	*2.6%*	*3.1%*
Sample size:	6	9	10	11	14	16	25	36	40	35
Turnover (in EUR millions)	116.7	2,337.3	4,459.1	5,512.1	7,291.5	9,855.1	13,058.7	17,309.8	20,811.5	24,964.2

Note: Information on the sector's value added is only available for companies included in the 'sample size' figure.
(p)= provisional data
Source: Balance sheets available at the RCS, Central Balance Sheet Data (STATEC), IGSS, Calculation: ODC

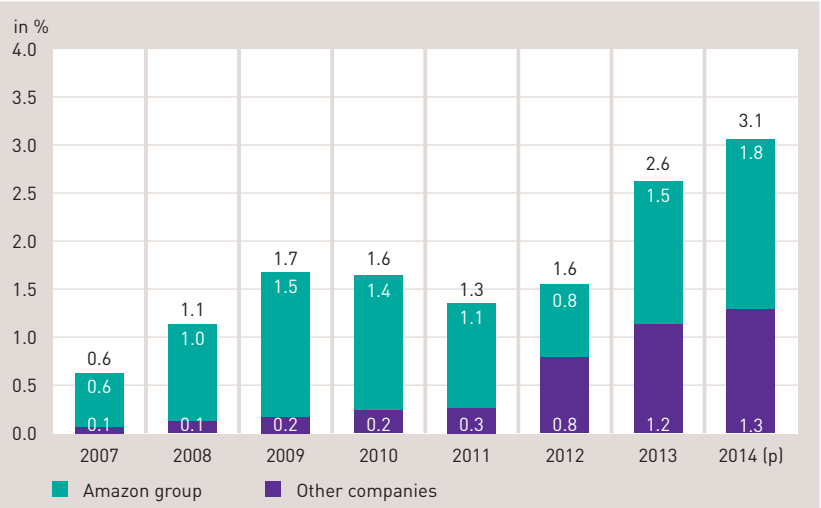
Chart 5
Development of the e-commerce sector (key players)

Source: Balance sheets available at the RCS, Central Balance Sheet Data (STATEC), IGSS, Calculation: ODC

[8] The concept of a legal unit is different from that of a company (INSEE definitions):
1. A legal unit is a legal entity governed by public or private law. A legal entity may be a legal person, whose existence is recognised by law regardless of the persons or institutions who own it or who are members thereof, or a natural person who, as a self-employed individual, can exercise an economic activity;
2. A company is the smallest combination of legal entities forming an organisational unit producing goods and services which can enjoy a certain independence in decision-making, especially in terms of allocating current resources.

Based on these companies, it has been possible to estimate the impact of e-commerce on the national economy. In 2014, it represented 3.1% of the gross value added of the national economy (Chart 6). In the same year, these companies recorded a turnover of nearly EUR 25 billion. According to the public data and the calculations made by the *Observatoire de la compétitivité*, the Amazon group remains the primary operator in the sector and alone represents 1.5% of the value added generated by these activities in the country in 2013. Over the next few years, it will be useful to monitor potential negative repercussions of the modified regulations on distance sales (e-VAT) introduced on 1 January 2015.

Chart 6
Value added generated by e-commerce as a share of the national economy



Note: Data available at the Trade and Companies Register and Central Balance Sheet Data at the time of drafting this document. The calculation basis may be lower than the number of companies recorded for the same year.
Source: Balance sheets available at the RCS, Central Balance Sheet Data (STATEC), IGSS
Calculation: ODC

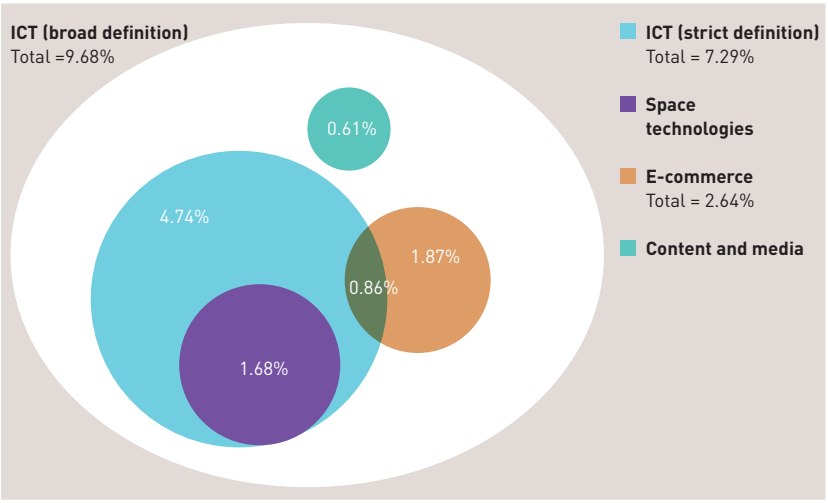
This analysis is based solely on companies whose main activity is e-commerce. Unfortunately, it is not currently possible to measure this kind of activity within Luxembourg companies listed under NACE codes other than those linked to the previous definition of ICT. As such, the impact of this kind of activity is therefore larger than that which can be reported in this report.

ICT (broad definition)

It seems useful to add up the results of these different aspects to obtain a comprehensive overview of the sector. As a whole, the ICT sector employs over 19,000 people (5.3% of the total salaried workforce) and accounts for over 2,350 companies in Luxembourg (6.8% of companies). In 8 years, the number of companies and the size of the salaried workforce increased by 41.6% and 51% respectively, with an annual growth rate of 4.4% and 5.3% respectively.

The value added generated by the ICT sector can be sub-divided into different sub-sectors on the basis of the different NACE codes assigned to each company under analysis. This reflects how complex it is to define the sector in question (Chart 7). In 2013, the gross value added of ICT according to the Eurostat definition (including space technologies) was 7.3% (see section 3.2). However, by also including related activities such as e-commerce and the content and media sector, which are dependent on ICT, the figure equates to 9.6% of Luxembourg's economy.

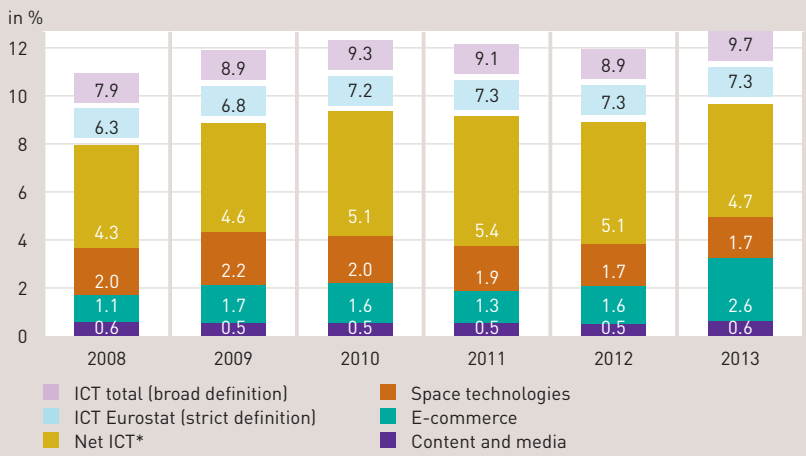
Chart 7
Simplified diagram of ICT (broad definition) value added per NACE code - 2013



Calculation: ODC

2013 was a very positive year for the ICT sector (9.7% of Luxembourg's value added), especially for the e-commerce sector which generated 2.6% of the value added compared with 1.6% the previous year. Under the broad definition, the sector created 9.7% of Luxembourg's value added, the highest level recorded since 2008 (Chart 8).

Chart 8
Variation in the share of ICT (broad definition) value added as a % of the economy as a whole



* Net ICT = Eurostat ICT definition – Space technologies definition – Share of e-commerce activities already included in the Eurostat ICT definition
Calculation: ODC

5.3.2 Space technologies

The definition of the space sector which has been used in this study is an adaptation of the OECD definition: 'all activities and resources used which create and offer value and advantages to human beings in space exploration, management and use. Consequently, [the space economy] includes all public and private sector players involved in the development, supply and use of space-related products and services, ranging from research and development and the manufacturing and use of space infrastructure (ground stations, launchers and satellites) to applications for space components (navigation equipment, satellite telephones, The areas of application for space technologies are satellite communication, satellite navigation, satellite earth observation, space exploration and space science.

In 2013, the sector comprised 18 companies employing 634 individuals (Table 5), with 448 people employed by SES, by far Luxembourg's largest employer in the sector (70.7% of total jobs in the sector).

Table 5
Space technologies sector indicators – Private sector

Space technologies	2008	2009	2010	2011	2012	2013
Number of employees	14	14	16	16	16	18
	0.05%	*0.05%*	*0.05%*	*0.05%*	*0.05%*	*0.05%*
Number of employees	-	-	596	597	639	634
	-	-	*0.2%*	*0.2%*	*0.2%*	*0.2%*
Value added at factor cost (in EUR millions)	657.8	694.9	705.3	710.1	670.8	694.8
	2.0%	*2.2%*	*2.0%*	*1.9%*	*1.7%*	*1.7%*
Sample size:	8	10	10	14	16	16

Note: An estimate of the percentage of employees and the value added linked to space activities has been calculated on the basis of estimates provided by the companies themselves in individual interviews and/or specific questionnaire mails.
Source: Balance sheets available at the RCS, Central Balance Sheet Data (STATEC).
Calculation: ODC

In 2013, these 18 companies created 1.68% of the economy's value added, i.e. almost EUR 700 million. This indicator shows that the sector grew by 5.6% between 2008 and 2013, i.e. 1.1% per annum. Whilst several new players start targeting this market, the total value added created thus far has been created by the SES group (Chart 9).

Chart 9
Breakdown of value added generated by space technologies

Source: Balance sheets available at the RCS, Central Balance Sheet Data (STATEC).
Calculation: ODC

5.3.3 Logistics

As part of the analysis of the economic impact of the logistics sector, a decision was taken to only focus on aspects linked to freight transport, thus excluding passenger transport and removal activities. Therefore, the indicators shown below are based on logistics activities as defined in the NACE, which refer to a company's main activity (Table 6). However, in the future, it would be propitious to include companies with important activities linked to the logistics sector even if they fall under a different NACE code. For example, Champ Cargosystems and CTI Systems are major players offering a range of solutions to logistics companies based in Luxembourg and abroad. FANUC and RAK Porcelain also perform significant logistics and supply chain activities in Luxembourg. Furthermore, Amazon manages its 'European Fulfilment Network' from Luxembourg and POST (Luxembourg Post Office) delivers packages which have been purchased from cyber-traders (for whom logistics lies at the heart of their business model). These examples, among others, illustrate the fact that the logistics sector is much larger than a definition of the sector based on the concept of principal activity.

In conclusion, it should be stressed that the figures do not include the activities of the NATO Support and Purchase Agency (NSPA) which employs over 1,000 individuals in Luxembourg and provides logistics support services to NATO member countries and other NATO agencies.

Table 6
Overview of logistics sector activities

NACE Rev. 2 Code	Description
49.200	Freight rail transport
49.410	Freight transport by road
50.200	Sea and coastal freight water transport
50.400	Inland freight water transport
51.210	Freight air transport
52.100	Warehousing and storage
52.210	Service activities incidental to land transportation
52.220	Service activities incidental to water transportation
52.230	Service activities incidental to air transportation
52.240	Cargo handling
52.290	Other transportation support activities
53.200	Other postal and courier activities

Table 7 shows a selection of the macroeconomic indicators analysed. Since 2010, there has been a decrease in the number of companies active in the freight sector (727 companies in 2013 versus 746 in 2011) and in the number of individuals employed (12,565 in 2013 versus 13,652 in 2010). However, the apparent labour productivity has increased markedly thanks to the increase in value added created since 2011, which has returned to pre-crisis levels.

Table 7
Logistics sector indicators – Private sector

Logistics	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of companies	675	664	700	719	739	725	746	741	727
	2.5%	*2.4%*	*2.5%*	*2.4%*	*2.4%*	*2.3%*	*2.3%*	*2.2%*	*2.1%*
Number of employees	11,162	11,589	12,591	13,834	13,492	13,652	13,256	12,812	12,565
	3.6%	*3.6%*	*3.8%*	*4.0%*	*3.8%*	*3.8%*	*3.6%*	*3.4%*	*3.3%*
Number of salaried workers	10 995	11,448	12,454	13,651	13,285	12,913	12,975	12,635	12,458
	3.8%	*3.8%*	*4.0%*	*4.2%*	*4.0%*	*3.8%*	*3.7%*	*3.5%*	*3.4%*
Value added at factor cost (in EUR millions)	765.8	799.7	817.3	852.7	673.1	863.4	800.0	824.3	859.8
	2.9%	*2.7%*	*2.5%*	*2.5%*	*2.1%*	*2.4%*	*2.1%*	*2.1%*	*2.1%*
Turnover (in EUR millions)	2,696.8	2,945.9	3,434.3	3,772.6	3,048.8	3,568.7	3,850.8	3,742.9	3,843.6
Staff costs (in EUR millions)	485.1	523.8	564.0	626.2	623.3	635.7	653.3	653.8	657.1
Gross investment in tangible goods (in EUR millions)	80.7	131.6	185.2	273.8	85.9	89.6	67.0	567.3	371.9
Turnover per employee (in EUR millions)	241.6	254.2	272.8	272.7	226.0	261.4	290.5	292.1	305.9
Apparent labour productivity (gross value added per employee)	68.6	69.0	64.9	61.6	49.9	63.2	60.4	64.3	68.4
Investment rate (investment/value added at factor cost)	10.5%	16.5%	22.7%	32.1%	12.8%	10.4%	8.4%	68.8%	43.3%

Note: Percentages in italics refer to the sector's share of the total indicator figure for Luxembourg.
Source: Structural Business Statistics (STATEC)

Between 2005 and 2008, there was a significant rise in the number of jobs in the logistics sector. However, since then, the number of people employed in the sector has been falling steadily in Luxembourg. Over the course of 8 years, the number of people employed in the sector has increased by 12.6%, i.e. an annual growth rate of 1.5% (Chart 10). Staff costs increased by 35.5% to reach 657.1 million, i.e. an annual growth rate of 4.9% over the same period.

Chart 10
Trends in employee and company numbers in the logistics sector

Source: Structural Business Statistics (STATEC)

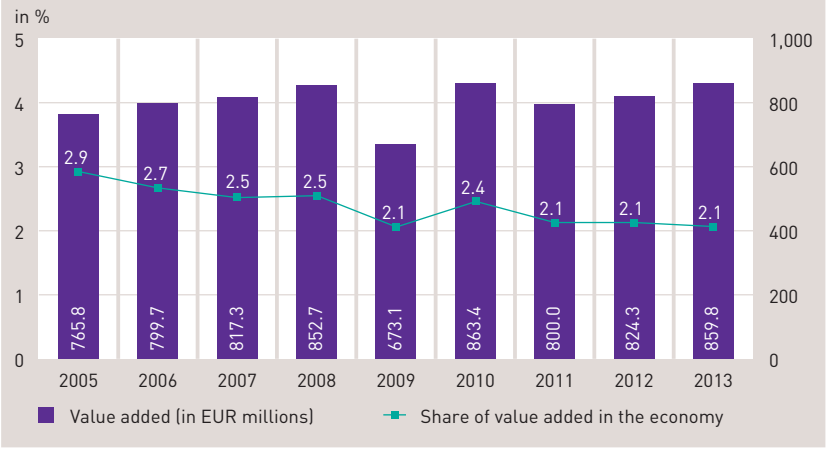
In spite of this, the sector's share of total jobs has been consistently falling since 2008 (Chart 11) mainly due to the loss of jobs linked to road freight transport, probably owing to strong foreign competition. Road freight accounted for 65% of jobs in 2005 but today the figure is a mere 57%, with other freight transport activities consistently on the rise since 2005. Conversely, the number of companies providing auxiliary transport services has been constantly rising since 2006, with 193 companies active in 2013. In spite of a reduction in the number of road transport jobs, there has been an increase in the number of jobs linked to services providing high value-added services and other ancillary services which align with the sector's strategic objectives.

Chart 11
Variation in the share of logistics sector jobs as a % of total jobs

Note: * IGSS data annual average
Source: Structural Business Statistics (STATEC), Calculation: ODC

Whilst the turnover generated by the sector reached EUR 3.84 billion in 2013, a level similar to the 2011 figure (a record for the logistics sector), the value added created by the sector accounts declined from 2.9% in 2005 to 2.1% of the national economy in 2013. However, in absolute terms, there has been growth over the last three years and, in 2013, the sector was worth almost EUR 860 million, with an annual growth rate of 1.9% (Chart 12).

Chart 12
Variation in the value added at factor cost of the logistics sector



Source: Structural Business Statistics (STATEC)

In 2013, the logistics sector consisted of 445 road freight transport companies (61.2% of the sector's companies producing 40.8% of the sector's value added), 193 others providing auxiliary transport services and a further 54 companies engaged in postal and courier activities. In addition, there were 6 air transport companies and one firm providing rail freight services (CFL Cargo) and 7 warehousing and storage companies. Cargolux Airlines International SA, the leader in air freight, accounted for nearly the half of 2013 sector's turnover and employed almost 1,300 salaried workers on 1 January 2014.

In comparison with 2012 figures, the value added created by road freight transport companies fell to EUR 351 million in 2013. In 2012, these companies employed 7,361 people, accounting for 1.9% of total jobs (Table 8). However, since 2008, almost 1,400 jobs have been lost. Conversely, the number of companies providing ancillary transport services has been consistently on the increase since 2006 to reach a total of 193 companies in 2013.

Table 8
Road freight transport indicators

Road freight transport	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of companies	433	430	453	468	483	467	482	468	445
Number of employees	7,141	7,381	8,066	8,789	8,416	8,614	7,991	7,647	7,361
Number of salaried workers	7,030	7,287	7,976	8,657	8,260	7,923	7,761	7,520	7,298
Value added at factor cost (in EUR millions)	338.8	356.4	379.8	389.3	358.9	349.6	366.7	367.5	351.1
Turnover (in EUR millions)	898.1	948.5	1,077.8	1,174.0	1,037.2	1,095.2	1,209.5	1,187.3	1,177.9

Source: Structural Business Statistics (STATEC)

Finally, Table 9 shows some of the main employers, listed in order of employee numbers, in the logistics sector, based on their main activity.

Table 9
Main employers in the logistics sector

Name	Staff numbers (approx.)
Cargolux Airlines International SA	1,340
Luxair Cargo	N.C.
CFL Multimodal SA	N.C.
Kuehne + Nagel SARL	570
Groupe Arthur Welter Transports	460
Imperial Shipping SARL	360
Jost Group SA	250
Wallenborn Transports SA	300
Lehnkering Shipping Lux SA	230
Panalpina Luxembourg SA	220
W.S.A. SARL	180
Champ Cargosystems SA	160
DHL Express (Luxembourg) SA	120
Bas Shipping SARL	120

Source: List of Luxembourg's main employers, situation as of 1st January 2016 (STATEC)

5.3.4 Health sciences and technologies

This sector was initially restricted to 'health technologies'. It has since been enlarged to include, in addition to the biomedical domain, synergies and relationships between sectors as well as technologies. It has been entitled 'new life technologies and sciences'. Although for communication purposes the term 'health sciences and technologies' is employed, it was deemed more relevant to expand the definition of the sector to 'life technologies and sciences' in order to encompass all of the activities in the sector present in Luxembourg.

In 2013, the science and technology sector featured around 30 companies and 572 salaried employees, a figure which has more than tripled since 2008 (Table 10). In addition, the value added created has more than doubled, in absolute terms, and accounts for 0.24% of the gross value added of the Luxembourg economy. This significant rise in value added, in comparison with last year's figures, is down to the inclusion of a new pharmaceutical company in the scope of the study and the inclusion of additional data made available by the Central Balance Sheet Data. This new data source affords a more exhaustive overview of the health sciences and technologies sector.

Table 10
Indicators for the health sciences and technologies sector - private sector

Health sciences and technologies	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Number of companies	17	19	22	29	31	30
	0.06%	*0.06%*	*0.07%*	*0.09%*	*0.09%*	*0.08%*
Number of salaried workers	168	202	233	473	552	572
	0.05%	*0.06%*	*0.07%*	*0.14%*	*0.16%*	*0.16%*
Value added at factor cost (in EUR millions)	37.7	38.4	39.5	49.0	65.7	100.4
	0.11%	*0.12%*	*0.11%*	*0.13%*	*0.17%*	*0.25%*
Sample size:	10	10	11	23	26	26

Note: The percentages in italics denote the share of the sector in the total value of the indicator for Luxembourg. Information on numbers of employees and the value added of the sector is only available for the number of companies listed in the 'sample size' row. Numbers of employees were not available.
Source: Balance sheets available at the RCS, Central Balance Sheet Data (STATEC) and IGSS, Calculation: ODC

5.3.5 Eco-technologies

a) Eco-technology producers

In 2012 a first list of companies active in the eco-technologies sector was drawn up by sector's national experts. It included 134 companies 'producing' eco-technologies that were involved in the sector in varying degrees:

a) The eco-technologies sector, under the strict definition of the term, consisted of 30 companies. The main activity of these companies was oriented towards developing and selling products and services aimed at measuring, preventing, limiting or redressing environmental impacts and reducing the consumption of natural resources whilst still meeting the same needs as traditional techniques;

b) 104 companies were developing eco-technologies focussed on clean production, without necessarily being part of the eco-technologies sector (e.g. Bétons Feidt, Goodyear, Paul Wurth, etc.). These eco-activities covered all goods and services production tasks which support environmental protection and rational management of natural resources.

In addition to these two categories, many companies in Luxembourg may be considered 'environmentally responsible' as considerable efforts have been made to protect the environment through strict regulations. Furthermore, SuperDrecksKëscht, an initiative with almost 3,600 affiliate companies directly involved in the optimal management of waste (and which can thus be considered 'environmentally responsible'), was recognised as an example of 'best practice' in Europe[9].

Since then, an updated list has enabled the monitoring of indicators linked to companies in the sector. The eco-technologies sector in the strict definition remains limited in size. In 2013, the development of eco-technologies was the primary activity of 33 companies and 637 employees and there was a slight increase in the value added generated in absolute terms although the overall figure remained at a stable 0.1% of the gross value added of the Luxembourg economy, in spite of better data representation compared with data collected the previous year (Table 11).

[9] https://www.sdk.lu/index.php/fr/about-us-2

Table 11
Indicators relating to the eco-technologies sector (strict definition) – Private sector

Eco-technologies	2008	2009	2010	2011	2012	2013
Number of companies	22	22	23	27	30	33
	0.07%	*0.07%*	*0.07%*	*0.08%*	*0.09%*	*0.09%*
Number of salaried workers	497	543	535	569	579	637
	0.14%	*0.15%*	*0.15%*	*0.15%*	*0.15%*	*0.17%*
Value added at factor cost (in EUR millions)	27.7	23.9	18.7	39.2	34.1	38.0
	0.08%	*0.07%*	*0.05%*	*0.10%*	*0.09%*	*0.09%*
Sample size:	10	10	11	21	26	28

Note: Percentages shown in italics represent the sector's share of the total indicator figure for Luxembourg. Information pertaining to the number of salaried workers and the sector's value added was only available for the companies included in the 'sample size'. Data on employee numbers were not available.
Source: Balance sheets available at the RCS, Central Balance Sheet Data (STATEC) and IGSS, Calculation: ODC

The number of companies producing eco-technologies (strict definition) and the share of the national value added still remain low in spite of the fact that these companies have created several hundred jobs. However, the figures do not include companies that are developing eco-innovative products, such as Goodyear and Arcelor, but cannot be included in the sector as this is not their primary activity. Such companies are thus assigned to a different economic sector.

b) Eco-technology users

Whilst the previous section of the analysis only covers companies whose principal activity is the development of new technologies with a view to fulfilling sustainable development goals, several other companies make use of these technologies. In addition to the concept of eco-technologies, given the growing importance of the development of environmentally friendly processes and products, several companies in a wide range of different sectors are developing innovative products or processes which have a positive impact on the environment whilst also improving the efficiency and productivity of the company's internal processes. Such activities are analysed by STATEC in the context of the environmental goods and services sector (EGSS), collected by Eurostat. Production activities of goods and services seeking to prevent, measure, control, limit, minimise or redress environmental damage and the depletion of natural resources are thus measured. Such activities represent 2% of the Luxembourg's gross value added across all sectors of the nation's economy and account for almost 9,200 jobs. The industrial sector, as a whole, produces the lion's share (55%) of the gross value added of the EGSS (Table 12).

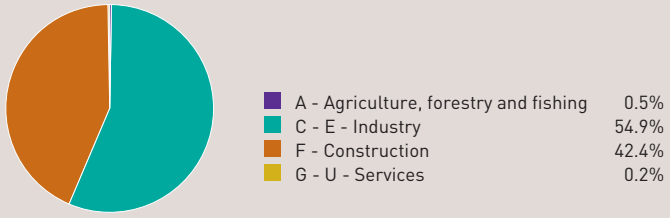
Table 12
EGSS data

EGSS	2008	2009	2010	2011	2012	2013
Production (in EUR millions)	1,698.8	1,340.7	1,524.3	1,664.5	1,587.6	1,610.5
	1.5%	*1.4%*	*1.3%*	*1.3%*	*1.2%*	*1.1%*
Employees (FTE)	10,215	8,721	9,529	9,276	9,518	9,239
	2.9%	*2.5%*	*2.7%*	*2.5%*	*2.5%*	*2.4%*
Gross value added (in EUR millions)	625.9	565.4	668.7	723.6	722.3	729.2
	1.9%	*1.7%*	*1.9%*	*1.9%*	*1.9%*	*1.8%*

Note: Percentages shown in italics represent the sector's share of the total indicator value for Luxembourg.
FTE = full-time equivalents
Source: STATEC

In 2013 the construction sector is the main contributor, accounting for 42,4% of gross value added in terms of environmental goods and services (Chart 13).

Chart 13
Breakdown of gross value added linked to environmental goods and services by branch - 2014



Source: STATEC

As regards employment, these proportions are similar between industry and construction accounting for 41,3% and 55,5% of EGSS jobs respectively in 2013. This demonstrates the intensity of EGSS jobs in the construction sector (Chart 14).

Chart 14
Share of jobs linked to EGSS per branch – 2014

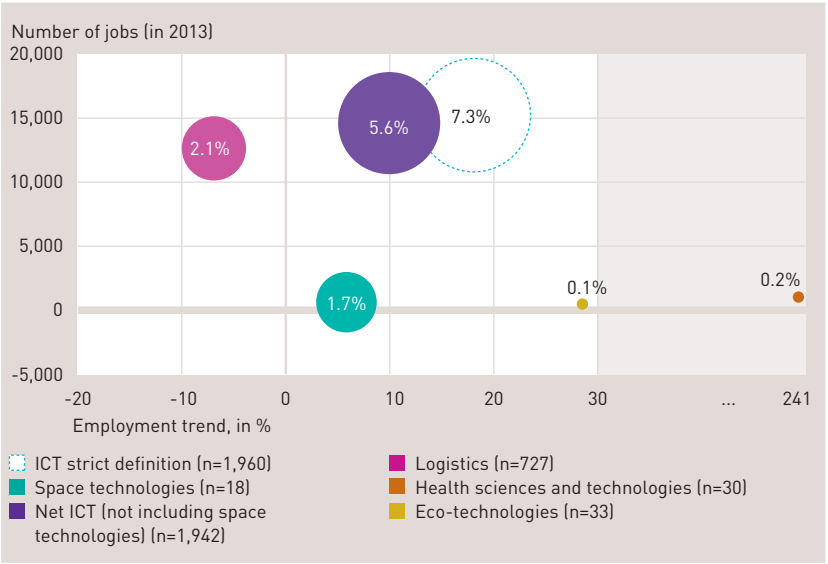
Source: STATEC

It is possible to conclude that, in addition to the development of the sector, eco-innovation enables greater competitiveness in all sectors, especially via a circular economy approach aiming to decouple growth from the use of raw materials and thereby reduce companies' exposure to price volatility. In a 2014 study, the Ministry of the Economy concluded that at least 7,000 jobs in Luxembourg are dependent upon the circular economy[10]. By further developing the circular economy, Luxembourg could create numerous jobs in the years to come and make substantial savings on the cost of raw materials.

5.4 Conclusions

In 2013, the 5 new priority sectors in their *strict definition* definitions accounted for 9.7% of the value added of the country and close to 30,000 jobs in over 2,750 companies. Of these sectors, ICT was responsible by far for the greatest share of value added created in the economy, followed by logistics and space technologies. The biggest rise in employment occurred in the health sciences and technologies sector, although this sector only represented 523 jobs in the private sector. Conversely, the number of jobs in the logistics sector has shrunk since 2008, mainly due to the decline in road freight transport as a result of fierce international competition in this area of activity. Nonetheless, the logistics sector still accounted for over 12,000 jobs (3.4% of total employment) in 2013 (Chart 15).

Chart 15
Economic impact of the five new priority sectors (private sector) – 2008-2013 development

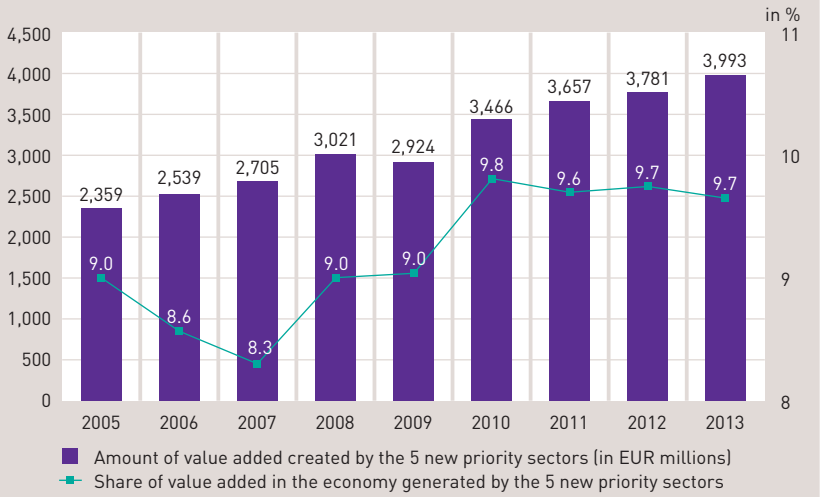


Note: The size of the bubble represents the share of the sector in the economy.
The ICT sector includes Space technologies and Net ICT (not including space).
n = number of companies
Calculation: ODC

[10] http://www.gouvernement.lu/4432858/Presentations-a-la-Chambre-de-Commerce_9-fevrier-2015.pdf

In absolute terms, the value added generated by the five new priority sectors (strict definition) has grown consistently since 2005, with the exception of 2009 (following the economic and financial crisis), and reaches almost EUR 4 billion in 2013, accounting for almost 10% of the total value added of the economy (Chart 16).

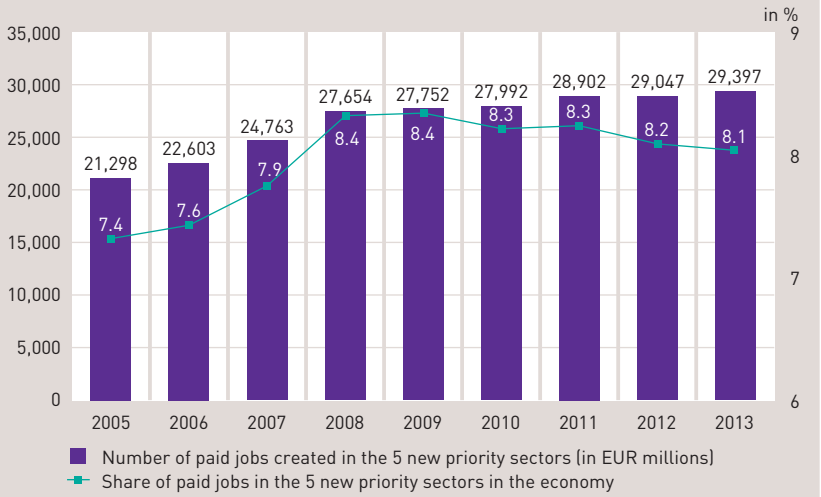
Chart 16
Trends in value added created by the 5 new priority sectors (private sector)



Calculation: ODC

A similar trend can be observed in the number of jobs, which has been steadily rising since 2005 to reach 29,000 in 2013 across the 5 priority sectors under analysis, an increase of almost 8,000 jobs over an 8-year period. After three years of rapid growth between 2005 and 2008, the share of new jobs created by these new sectors fell slightly to 8.1% of total jobs in Luxembourg in 2013 (Chart 17).

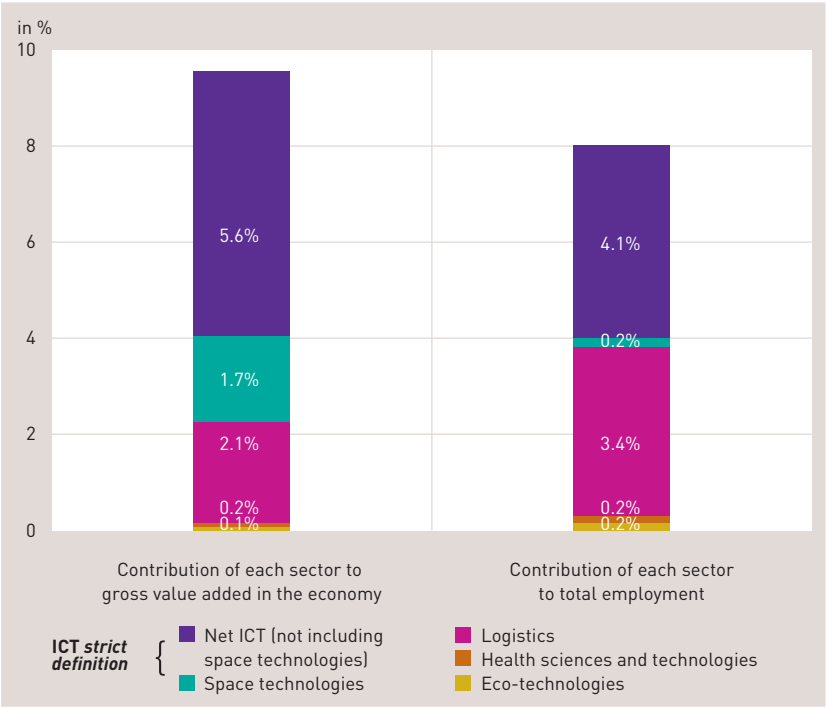
Chart 17
Trends with regards to jobs created in the 5 new priority sectors (private sector)



Calculs: ODC

The ICT sector, defined in the strict sense and including space technologies, remains the main contributor to value added and jobs created in the 5 new priority sectors in 2013. ICT (strict definition) represents 7.3% of the gross value added to the economy and 4.3% of Luxembourg's total salaried employment. The logistics sector is in second place, accounting for 2.1% of gross value added and 3.4% of total jobs in Luxembourg. Currently the contribution made to these two microeconomic indicators by health sciences and technologies and eco-technologies remains low (Chart 18). Figures relating to e-commerce and media and content could be added and would register a value added of 2.5% to the Luxembourg economy and account for almost 1% of the number of jobs created. Therefore, the value added and jobs generated by the 5 new priority sectors represent more than 12% and 9% of the national total respectively.

Chart 18
Contribution of each priority sector to gross value added and employment (private sector) – 2013



Calculation: ODC

The main conclusions for each sector under analysis are outlined below. However, it should be borne in mind that the data used in this chapter refers to 2013, with only some data available as of 2014. This means that the figures do not take into account more recent information and projects.

- The **ICT** sector is currently the best-established of the 5 new priority sectors identified by the government and represents 7.3% of gross value added in the economy and 4.3% of the national workforce. From the perspective of both producers and users of ICT, the sector has been experiencing clear growth in Luxembourg for several years now. The number of jobs and ICT production companies based in Luxembourg and active in this sector, according to the strict definition, has grown continuously since 2005, mainly due to public and private significant investment in high-quality infrastructure (data centres, broadband networks, etc.), a favourable business environment and a modern and attractive regulation. This is especially true for certain 'e-commerce' companies, which create numerous jobs in Luxembourg and generate a great deal of value added. The positive development in the sector is also reflected in the numbers of ICT users which continues to rise, throughout all sectors of the economy. Electronic trade activities based in Luxembourg have been growing considerably for several years now, and represented 2.6% of the gross value added in the economy. The Amazon group alone accounts for over half of the gross value added generated by e-commerce companies. This activity has grown considerably since 2009, and Luxembourg now lists several major names in the sector which run their activities from the country.

- The **space technologies** sector, which is an integral part of the ICT sector according to the definition, is dominated by a major international group, SES, which represents at this stage almost the entire sector. Since 2008, the government has sought to strengthen its position in the sector, has invested in major projects and has supported space research, particularly the research carried out by the smaller companies which also populate Luxembourg space sector. In addition, the Luxembourg government recently announced a series of measures to position the country as a European pole of space resource exploration and use. The drawing up of a specific legal framework, ensuring legal certainty in terms of the ownership of minerals and other valuable space resources, is one of the main pillars of the project.

- The number of jobs in the **logistics** sector has fallen slightly since 2008 following an increase in international competition in the road freight transport sector. Conversely, however, high-value-added activities grew between 2008 and 2013. The sector counts over 12,000 jobs and provides employment for a low-skilled or unskilled workforce, which has the advantage of helping to reduce unemployment among this category of the population.

- Activities in the domain of **health sciences and technologies** are still very limited in the private sector. The number of active companies is small and the value added created remains small too, in spite of the addition of a pharmaceutical company to the list, which has an impact on the value added created by this sector. Nonetheless, a great deal of progress still needs to be made in adapting the regulatory framework to promote dynamism in the sector and attract more private companies to the sector.

- The impact of the **eco-technologies** sector remains difficult to assess, as innovations in this sector are often subject to increasingly strict regulations. Although the number of companies producing eco-technologies remains very small in Luxembourg, the environment is becoming an increasingly important issue for both companies and households. As such, the number of companies using eco-technologies has been increasing consistently for several years.

It remains quite difficult to compare (benchmark) these sectors because of their numerous different characteristics. For example, levels of maturity vary widely depending on the sector. While the ICT and logistics sectors have been priority sectors for over a decade, other sectors which depend heavily on R&D such as space technologies, health sciences and technologies and eco-technologies became priorities at a much later stage. Therefore, while the health sciences and technologies sector has mainly developed in the public domain, the eco-technologies sector has developed along rather different lines. Although the number of companies producing eco-technologies based in Luxembourg remains very small, Luxembourgish companies are experiencing a change in mind-set in terms of the attention they pay to the environment and to the use of resources. For example, they are trying to reduce the energy and environmental impact caused by their operations by developing production methods for goods and services which use of eco-technologies to prevent, measure, check, restrict, minimize or counteract environmental damage and the using up of natural resources. The macroeconomic impact is therefore indirect rather than direct, as more efficient production is ensured. Moreover, other factors such as R&D activities or the current regulatory framework have bolstered or hampered the development of certain sectors in comparison to others in relation to the macroeconomic indicators taken into consideration in this analysis.

In order to obtain a more complete overview of the effectiveness of the economic diversification strategy over the last few years, the Ministry of the Economy commissioned a 'Study on the Diversification of the Luxembourg Economy'. The aim of the study is to assess the work that has been done up to this point so as to confirm the current diversification policy and, if necessary, adapt it as well as considering possible new sectors which have not yet been explored. The study should enable a better evaluation of the financial investment the government has made in economic diversification (investments, social contributions paid by the State, etc.) but also the returns (tax levied) in a 'cost-benefit' perspective. The government now has the opportunity to actively plan Luxembourg's future economic strategy: an objective and critical review of the real contribution and of the potential of Luxembourg's economic sectors constitutes a vital basis for the evaluation of the efforts made thus far in terms of economic diversification and its impact on public finances. If necessary, the government strategy could be revised to cover potential new sectors in the future.

6 Establishment of National Productivity Boards in the euro area

6.1 Background: proposal submitted by BRUEGEL

Following the economic and financial crisis of 2008 and the sovereign debt crisis which it triggered in the euro area, the process of reforming euro area governance has been hindered by major disagreements on the cause of the problems, particularly between Member States.

In February 2015 Brussels-based think tank BRUEGEL published a study on the future of euro area governance[1]. According to the authors, the euro area was suffering before the crisis due to the accumulation of budgetary imbalances, as well as a failure to adequately consider the viability of the debt. Prices and wages also varied between Member States. In addition to public finances, the authors also investigated the competitiveness of the euro area Member States in greater detail.

Wage-setting and wage bargaining systems vary a great deal from one country to another. As such, the link between nominal wage increases and productivity increases also tends to differ considerably between countries. This leads to competitiveness divides between countries which are difficult to remedy within the euro area without a flexible exchange rate instrument. Furthermore, an analysis of the current political situation in the euro area led the authors to the prevailing starting hypothesis that it is neither desirable nor possible at this juncture to create a unified European labour market with a unified social protection system which would allow citizens to change their country of residence several times during their lifetime. Greater mobility would be probably desirable and achievable, but the authors do not believe that the euro area can create in the near future a unified labour market in which regional shocks can essentially be absorbed by significant migratory flows.

The euro area therefore would need more tools for preventing and correcting significant discrepancies in competitiveness between countries. According to the authors, given that wage-setting and wage bargaining systems are deeply entrenched and difficult to change, competitiveness gaps between countries should be more closely monitored and if necessary corrected before they can grow too wide.

Following the crisis in 2008, the EU introduced a mechanism in 2011 to monitor internal and external macroeconomic imbalances in its Member States. The Macroeconomic Imbalance Procedures (MIP)[2] has the potential to be a significant tool[3]. at European level. According to the authors, the MIP will nonetheless need to be fleshed out in future with national procedures so that competitiveness problems can be monitored and, if necessary, resolved and national appropriation of the procedure increased.

1 For more details, see: http://bruegel.org/wp-content/uploads/imported/publications/pb_2015_01_270215_01.pdf

2 For more details, see: http://ec.europa.eu/economy_finance/economic_governance/macroeconomic_imbalance_procedure/index_en.htm

3 See Chapter 4 on the European Semester in 2016 for a descriptive analysis of Luxembourg in the MIP.

Therefore, to ensure better coordination of economic policies and prevent too significant differences in competitiveness from arising across the euro area countries, especially in terms of unit labour costs (ULC) which can diverge over time, all euro area countries should introduce a mechanism to ensure that wage-setting at national level is compatible with the common principles of the euro area. Finally, the authors recommend the creation of National Competitiveness Boards as part of the Eurosystem, tasked with monitoring national wage indicators in order to prevent future competitiveness problems from arising.

Frame 1
Extracts from the Bruegel policy brief *EURO-AREA GOVERNANCE: WHAT TO REFORM AND HOW TO DO IT* (2015)

'All euro-area countries should put in place a competitiveness-monitoring framework involving regular assessments and the definition of instruments to prevent problems. An interesting example is the Belgian framework, introduced in 1996 to preserve the country's competitiveness in EMU by keeping the evolution of wages in line with wage developments in the main trading partners. A national body regularly reports on the evolution of Belgian competitiveness relative to its three main trading partners (Germany, France and the Netherlands). These reports are used by social partners to fix a wage norm for the next round of wage negotiations. Although the norm amounts only to a non-binding guideline, it has generally been respected by the private sector (to which the system applies). In case social partners fail to agree a wage norm compatible with the evolution of competitiveness, the government can step in and make the norm legally binding. The system has worked fairly well: it kept untouched the wage formation and bargaining system that existed prior to the euro, but made the behaviour of social partners compatible with membership of the euro-area. The result has been that ULCs in Belgium have evolved more or less in line with those in its main trading partners, thus avoiding major competitiveness problems.

The Belgian system could be improved, and anyway cannot be exactly copied by other euro area countries since they typically have different wage formation and bargaining systems. What is important is that all euro-area countries put in place a mechanism to ensure that, although operating within their own system, the behaviour of social partners and the outcome of their wage negotiations is compatible with membership of the euro-area in terms of competitiveness and employment. These national mechanisms would constitute national competitiveness boards.

We would recommend therefore the creation of a Eurosystem Competitiveness Council (ECC) consisting of both national competitiveness boards and the European Commission. The ECC's primary task would be to coordinate the actions of national competitiveness boards to ensure that no euro-area country fixes a wage norm that implies significant competitiveness problems for itself and/or others. In case this fails, the Commission should have the power to require the relevant competitiveness boards to take corrective action using the MIP and the European Semester instruments'.

6.2 Political appropriation: *The Five Presidents' Report*

In June 2015, a report on a roadmap towards the completion of the Economic and Monetary Union (EMU) was published[4]. This *Five Presidents' Report* identifies four areas where progress is needed, one of which is the establishment of a true Economic Union where each economy has the structural qualities to allow it to prosper within the EMU. Some of the actions outlined will need to be introduced swiftly over the next few years before being followed up with other, further-reaching measures to pool sovereignty between the Member States which have adopted the euro. The tangible measures proposed were divided into three implementation stages as follows:

- Stage 1 (1 July 2015 - 30 June 2017): in this first stage ('deepening by doing'), the EU institutions and euro area Member States would build on existing instruments and make the best possible use of the existing Treaties. In a nutshell, this entails boosting competitiveness and structural convergence, completing the Financial Union, achieving and maintaining responsible fiscal policies at national and euro area level, and enhancing democratic accountability;

- Stage 2: in this second stage ('completing EMU'), concrete measures of a more far-reaching nature would be agreed to complete EMU's economic and institutional architecture. Specifically, during this second stage, the convergence process would be made more binding through a set of commonly agreed benchmarks for convergence that could be given a legal nature. Significant progress towards these standards – and continued adherence to them once they are reached – would be among the conditions for each euro area Member State to participate in a shock absorption mechanism for the euro area during this second stage;

- Stage 3 (at the latest by 2025): at the end of Stage 2, and once all the steps are fully in place, a deep and genuine EMU would provide a stable and prosperous place for all citizens of the EU Member States that share the single currency, attractive for other EU Member States to join if they are ready to do so.

During the first 'deepening by doing' stage planned for 1 July 2015 - 30 June 2017 period, four pillars are identified as the basis for an 'Economic Union of Convergence, Growth and Jobs', one of which is the creation of a system of Competitiveness Authorities for the euro area.

[4] For more details, see: http://ec.europa.eu/news/2015/06/20150622_en.htm

According to the Five Presidents' Report, there is strong governance in the euro area in the field of budgetary policy coordination and monitoring. However, governance appears to still be insufficient in the broader area of competitiveness, which is assuming an increasingly important role. The European Semester and the creation of the Macroeconomic Imbalance Procedure (MIP) have already bridged this gap to some extent, but there is still much to do to ensure all Member States can improve their competitiveness. Each euro area Member State must therefore set up a national body to monitor domestic competitiveness performance and policies. This would help to prevent economic divergence and strengthen support for reforms at national level.

These competitiveness authorities should be independent bodies tasked with determining whether wages are developing in line with productivity, in comparison with developments in other euro area countries and the main comparable trade partners. They should also be mandated to assess the progress of economic reforms brought in to strengthen competitiveness more generally. Together with the European Commission, which would coordinate their actions, these national bodies would be brought together in a European network of euro area competitiveness authorities.

These competitiveness authorities should not aim to harmonise wage-setting practices and institutions. Wage-setting processes can vary greatly between one country and the next as they reflect national legal preferences and traditions. Each Member State should be able to decide, on the basis of a common model, on the precise set-up of its national competitiveness authority but these authorities should also be democratically bound to produce reports and should also be independent from an operational point of view. National stakeholders such as social partners should continue to play a role as per the practices established in each Member State, but they should take the opinion of the competitiveness authorities into account during wage bargaining procedures.

6.3 European Commission proposal

In a communication on the measures needed to complete EMU (October 2015), the European Commission went on to expound upon certain essential components of the first stage of a deeper EMU. The communication notably includes a raft of measures to boost economic governance, including the establishment of national competitiveness authorities. At the same time as this communication[5], the European Commission also published a Recommendation for a Council Recommendation on the establishment of national competitiveness bodies[6]. This recommendation is addressed to euro area Member States, but the other Member States are also encouraged to set up similar bodies.

According to the European Commission, competitiveness is essential to guarantee resilience, the EMU's ability to be flexible, as well as long-term, sustainable growth and convergence. To speed up the progress of structural reforms, the economic policy coordination mechanisms implemented at EU level should be supported by a strong national appropriation of National Reform Programmes (NRPs) as part of the European Semester. It would therefore be useful to call upon independent experts at national level and strengthen dialogue between the EU and its Member States on the necessary policies.

As a result, the European Commission suggested that the Council recommend that Member States establish national competitiveness authorities tasked with monitoring competitiveness-related performance and policies. Competitiveness bodies should help to improve the national policy development process by providing independent expertise, particularly in evaluating performance and reforms. These bodies should contribute to the efficient development and implementation of reforms. An exhaustive concept of competitiveness should be used to determine the range of competitiveness-related aspects to be monitored, including price and non-price development. National competitiveness bodies should collate and publish their conclusions on an annual basis. They should also uphold several joint principles whilst taking into account the diverse range of experiences and practices present in different Member States. Their advice should shed light on the wage-setting process but they should not aim to interfere with this process or with the role of social partners nor should they seek to harmonise national wage-setting systems. These bodies should be independent from the competent public authorities and be capable of providing high-quality economic analyses. As long as these requirements are fulfilled, Member States should be free to choose how to structure their national competitiveness authorities, whether they decide to create a new institution or adapt the mandate of an existing body.

[5] For more details, see: http://eur-lex.europa.eu/legal-content/FR/TXT/PDF/?uri=CELEX:52015DC0600&from=EN

[6] For more details, see: http://ec.europa.eu/priorities/publications/system-national-competitiveness-boards_en

Frame 2

Bruegel Conference in Luxembourg (November 2015)[7]

In late November 2015, the Ministry of the Economy's *Observatoire de la compétitivité* organised a conference in partnership with the Brussels-based think tank BRUEGEL in order to hold discussions with social partners and the Luxembourg academic world on the implications, opportunities and risks of the new proposal to establish National Competitiveness Boards, thus ensuring transparency in the process and boosting national appropriation.

The conference was launched by the President of the Committee for Economic Affairs in the Chamber of Deputies, the Hon. MP Franz Fayot.

Professor André Sapir, Senior Fellow at BRUEGEL, explained the justification for establishing National Competitiveness Boards in the Member States.

The conference began with one main observation: competitiveness issues are a vital part of the discussion on how to prevent macroeconomic imbalances, but competitiveness is not yet fully under control in the EU and the Member States. Therefore, we can legitimately ask whether Europe needs stronger mechanisms in the field of competitiveness.

More specifically, the conference focussed on the purposes, issues and interest of establishing national authorities for monitoring competitiveness performance and policies across the Member States. It was remarked that a debate on the functioning of the euro area as a whole would be necessary because of current structural dysfunctions inherent to the euro area which could threaten the stability of the Economic and Monetary Union (EMU). These shortcomings were impossible to predict when the Treaty of Maastricht was drawn up and approved. The EMU in its current form has proven unable to keep the harmful effects of the global economic and financial crisis in 2008 and the ensuing years to a minimum. The European regulations known as the 'Six-Pack' and 'Two-Pack' were only introduced in 2011. The relevant tools, including the Macroeconomic Imbalance Procedures (MIP), monitor, inter alia, developments in competitiveness and enable above all ex-post evaluation of the policies adopted. The need for a preventive mechanism was cited, as was the need to consider the functioning of the euro area as a whole.

The historical situation before the existence of a common currency was evoked to justify the creation of national competitiveness boards. Before the introduction of the euro, diverging progress in European economies could be adjusted thanks to the exchange rate mechanism. When there were serious discrepancies in competitiveness, exchange rates could be realigned and national competitiveness adjusted by altering the value of currencies. The introduction of the euro in 1999 changed all this. By definition, no exchange rate mechanism can be used when the Member States of a monetary union share a common currency with a fixed exchange rate. Adjusting exchange rates when a national economy loses competitiveness is therefore no longer an option. Such instruments to adjust the competitiveness gaps between Member States are currently lacking in the euro area and the only way to close such gaps is to devalue wages by cutting production costs. During the conference, regrets were expressed that the changes to the currency system, i.e. the introduction of the euro, did not lead to a change in the habits and behaviour of economic policy actors in the euro area Member States. To tackle this situation, a preventive monitoring system would therefore be needed to better limit or even prevent loss of competitiveness in Member States and reduce the future risk of economic and financial crises in the EMU, as well as to allow Member States to react promptly if need be. This system could include warnings for economic misconduct, or a mechanism to trigger or at least provide a context for a discussion between social partners should competitiveness problems arise. Social partners should nonetheless be left to negotiate their own relationships. Discussions must be held about the details of such a structure as well as the possible inclusion of coercive or corrective measures.

A representative of the European Commission presented and explained the content of the October 2015 recommendation on the establishment of national competitiveness authorities. A system of national competitiveness authorities would be a key step towards the completion of EMU. Their establishment would help to reinforce economic policy coordination within the EU and intensify dialogue between the EU and Member States.

[7] For more details, see: http://www.gouvernement.lu/5665613/2015-11-25-conference-bruegel?context=4683873

Frame 2
Continued

Competitiveness would be essential to ensure resilience and adaptation capacity within the EMU and ensure sustainable growth and convergence. Competitiveness in the euro area as a whole and in relation to the rest of the world should be emphasised. The competitiveness boards should be able to act in the domain of competitiveness in its broadest sense, including cost competitiveness, a macroeconomic quantity which links wages and productivity, as well as non-price or structural competitiveness which have an impact on quality of life, innovation capacity, training, etc. These two aspects of competitiveness should be deemed equally important.

During the conference, it was specified that the aim of the European Commission recommendation was not to harmonise wage-setting systems and that national competitiveness boards were not intended to interfere with the wage-setting process but simply inform social partners on the topic.

The European Commission's approach was intended to allow as much flexibility as possible and take into account the work of pre-existing institutions in different Member States. The Commission therefore limited itself to defining the minimum requirements which national competitiveness boards should fulfil:

- A statutory body rooted in national legislation or regulation or in binding national administrative provisions;
- Structural independence and operational autonomy from any public body of the Member State working on competitiveness issues and from social partners to ensure neutrality;
- No bias towards the opinions and interests of any particular group of stakeholders;
- Sufficient analytical and scientific abilities to carry out high-quality economic and statistical analyses;
- Sufficient resources and appropriate access to information.

To ensure smooth functioning, it would be useful to link up the national competitiveness boards and the European Commission as part of a network. The European Commission would play the role of coordinator between the national competitiveness boards and exchange views with them, primarily to ensure the objectives of the euro area and the EU are taken into consideration in their work. The Commission should raise collective and mutual awareness in the Member States of the EMU.

A representative of the Central Economic Council of Belgium explained the role that this body has played for many years in our neighbouring country's competitiveness strategy. The Central Economics Council sets a wage standard which is then used as a reference point in wage bargaining procedures. Ironically, the Central Economics Council representative lamented the fact that this consensus-based practice does not satisfy the current European Commission criteria for the establishment of national competitiveness boards as outlined in the October 2015 recommendation. The role of the *Observatoire de la compétitivité*, which also fails to satisfy European Commission criteria, is descriptive. The *Observatoire* closely monitors several aspects of competitiveness in its broadest sense, drawing comparisons with other European countries and producing a report which aims to garner the broadest possible consensus. It does not make any recommendations on wages.

The round table discussion involved representatives of social partners. They discussed the opportunities afforded by the creation of national boards.

First of all, the panel debated whether there is a need for a new authority or stronger competitiveness monitoring measures in Luxembourg. Developments in the country's competitiveness are regularly discussed at public and institutional level, thanks in particular to the *Observatoire de la compétitivité*, the Economic and Social Council (ESC), the annual debate on competitiveness in the Chamber of Deputies, discussions regarding the National Reform Programme (NRP) as part of the European Semester, and the MIP mechanism introduced as part of the 'Six-Pack' European legislative package.

During the conference, the social partners agreed that there was a need for a European instrument but questioned whether the European Commission's recommendation was the correct solution. Workers' representatives were opposed to the creation of a new national competitiveness board and expressed concern that this body could degenerate into a wage-setting tool.

Frame 2
Continued

Employers' representatives were in favour of such a national authority mandated to advise social partners and would like an objective instrument to provide information on the options for setting wages based on sectoral productivity. By virtue of their mandate, the boards could provide detailed expertise to strengthen constructive dialogue between social partners and foster appreciation for necessary structural reforms in Member States. During the discussions, it was universally agreed that all social partners should be consulted on the structure of national competitiveness boards to ensure these boards will be structured in a suitable way to account for the differing characteristics of the different Member States. Several questions which are worthy of attention but which have not yet been answered were raised as part of the discussions, such as: How will the national and European levels of management work separately and together? What happens if top-down action is required as a last resort? Which European institution would have the mandate to intervene? Will national governments be prepared to accept the measures imposed or recommended by the European Commission?

The debate then moved on to the issue of the democratic legitimacy of the national competitiveness boards and the role of national parliaments in the process. Concern was expressed that national policy could be depoliticised or even subordinated. As such, it was stated that political willingness is necessary for national competitiveness boards to be established and their status must be enshrined in legislation. It would also be wise not to depend on a system of independent experts removed from the national social context if national appropriation is to be achieved.

Participants also discussed the definition of competitiveness, emphasising the complementary nature of cost competitiveness and structural competitiveness. There was a discussion about the weight of different elements (unit labour costs, social peace, education and training, housing, security, taxation, culture, social inequalities, etc.) in national competitiveness assessments, as well as the countries which are used as reference points when analysing national competitiveness.

All euro area Member States have different trading partners and therefore different points of reference against which to compare themselves. Some countries have close links with other EU Member States whereas others trade more with third (non-EU) countries or non-European countries. Towards the end of the discussion, the participants addressed the difference between intra- and extra-euro area (compared to the rest of the world) competitiveness issues. Given that a common currency leaves no room for exchange rate adjustment between Member States, countries need to consider other methods for correcting diverging developments in national economies. As such, we should consider how best to reconcile collective and mutual awareness within the EMU with trade competition between countries in order to ensure national objectives are coherent with those of the euro area as a whole. Currently, national competitiveness often takes precedence over implications for the whole euro area in the economic policies of Member States. This is specifically a problem within the euro area Member States, and does not affect the competitiveness of the euro area as a whole in comparison with other world economies. For the latter, adjustments can be made by adapting the euro exchange rate as necessary against the dollar, yen and other currencies.

Overall, a profitable and informative exchange was held between Luxembourg's main relevant stakeholders regarding the setting up of national competitiveness authorities. The parties involved were informed and made aware and were able to express and debate their opinions. The event demonstrated that the subject is both controversial and complex. While the participants agreed on then principle that monitoring performance and competitiveness policies is paramount, opinions on how this could best be accomplished were divided.

6.4 Adoption by the Council of Ministers of the European Union

Following the publication of the Five Presidents' Report (June 2015) and the communication and recommendation for a recommendation by the European Commission (October 2015), discussions began at national level (particularly with the social partners) and European level between Member States. The initial proposal by the European Commission for a recommendation on the establishment of national competitiveness authorities was therefore discussed between October 2015 and June 2016 in the various preparatory committees (e.g. the Economic Policy Committee) and in the various relevant formations of the Council of Ministers (e.g. the Competitiveness and Growth Council, Economic and Financial Affairs Council, etc.).

After carrying out studies and holding discussions, the Council finally adopted a Council Recommendation on the establishment of national productivity boards[8] in June 2016 and the European Council endorsed the Recommendation on the establishment of national productivity boards when it gave an update on progress towards the completion of EMU at the end of June 2016.

These new boards now have a stronger focus on the various aspects of productivity, rather than competitiveness and wage developments alone as initially proposed by BRUEGEL and also (to a lesser degree) the initial recommendation of the European Commission.

The Council of Ministers concluded that potential growth in the euro area and in the EU as a whole had slowed considerably since 2000. The downward trend in potential GDP growth is largely due to a consistent decrease in the contribution of total factor productivity (TFP). Since 2008, economic growth has weakened due to declining investment. Economic growth in the future will ultimately depend on increased productivity. Achieving this increase is a multi-faceted challenge that requires a balanced policy mix to boost innovation, improve skills, reduce rigidities in the labour and products markets and ensure more efficient allocation of resources. The 2008 crisis demonstrated that the EU Member States who have adopted the euro could be particularly vulnerable to the escalation and ensuing rapid correction of macroeconomic imbalances which may then spread to other Member States. Given the lack of flexible nominal exchange rates, adequate mechanisms of adjustment to country-specific shocks are needed. Productivity and competitiveness affect both the accumulation and correction of macroeconomic imbalances (e.g. current account deficits) and the effectiveness of adjustments following asymmetric shocks. Research into and analysis of policies that influence productivity and competitiveness should thus serve as a basis for developments that are compatible with the objective of the smooth functioning of EMU.

[8] For more details, see: http://data.consilium.europa.eu/doc/document/ST-10083-2016-INIT/en/pdf

The Council Recommendation on the establishment of national competitiveness boards notably states the following points:

- The Recommendation is addressed to euro area Member States. Other Member States are also encouraged to designate or set up similar bodies;

- The establishment of national productivity boards should ensure a stronger sense of appropriation at national level;

- The boards should analyse developments in productivity and competitiveness taking into account specific national characteristics and established practices and long-term determining factors such as innovation, ability to attract investment, and cost-/non-cost-related factors likely to have an impact on the prices and quality of goods and services in the short term;

- National productivity boards should be operationally independent from all public authorities involved in the development and implementation of productivity and competitiveness policies;

- The composition of national productivity boards, although left to the discretion of the Member States, should be neutral to ensure they can provide expert analysis which is in the general interest;

- National productivity boards should work continuously and make their results available to the public;

- National productivity boards can be built around already-existing national structures, particularly those which ensure stakeholder participation and consultation.

Member States have 18 months from the adoption of the Council Recommendation (June 2016) to set up their National Productivity Boards.

6.5 The future for Luxembourg

The joint Commission and Council Recommendation is a far cry from the original European Commission text. It is certainly wise to focus on productivity, which is a more precise and robust concept than that of competitiveness. Productivity has an impact on the quality of life in a country and the extent of primary income distribution – between capital and labour.

The government asked the ESC to produce an opinion on the productivity of the Luxembourg economy.

As part of this work, social partners could also consider the implementation of the Council Recommendation of June 2016.

The third industrial revolution (J. Rifkin), i.e. the combination of the Internet with energy and the widespread automation of tasks and jobs, should lead to significant leaps forward in productivity. An in-depth debate must be held about this deep structural change in all areas - work, education, consumption, production, etc.

At institutional level, Luxembourg already has the means to launch a National Productivity Board as per the requirements set out by Brussels, as this role could be played by the ESC with the support of the *Observatoire de la compétitivité*. A suitable regulatory framework has yet to be designed.

7 Measuring Productivity in Luxembourg

Measuring Productivity in Luxembourg

Chiara Peroni[1]

Productivity is regarded as a key indicator of the economic performance of firms and industries, and as a source of countries' economic growth and improvements in living standards. For these reasons, productivity indicators are often the focus of attention of economists and policy-makers. Despite its prominence, the concept of productivity is complex and multifaceted, and its measurement has many challenges. In a recent publication on "The future of productivity", the OECD states that productivity is "about working smarter rather than working harder" (McGowan et al. 2015). This contribution aims to clarify the concept of productivity and to introduce the reader to the challenges involved in its measurement. It also presents research on productivity conducted at STATEC-ANEC, highlighting how different methods and data sources are used to produce accurate productivity figures and give insights into the different sources of productivity growth in Luxembourg.

7.1 The concept of productivity

Understanding the reasons why different economies grow at different speeds has been a long interest in economics. Earlier studies on economic growth explained these differences by the amount of production factors owned by countries, and put the main emphasis on capital accumulation, population growth and natural resources. Once it has been understood that different endowments of those traditional production factors were not sufficient to explain alone differences in the growth performance across countries, the term "productivity" has entered into the economic literature.

The concept of productivity refers to all the forces that influence the production performance of a producer, except the amount of production factors — capital, labour and intermediate inputs — used in production. Productivity involves various components, a limited list of which should include the quality of inputs used in production, managerial talents, organisational structure, knowledge and innovation. While these components have important roles in the process through which producers transform inputs into outputs, they are generally unobservable in ordinary datasets. Measuring productivity, therefore, is at the core of today's applied economic research.

In practice, productivity can be measured in many ways. An intuitive and straightforward manner to measure productivity is taking a ratio of output produced to the inputs used in production. Such a ratio represents how much output is obtained from a given level of inputs use. Thus, higher ratios represent higher levels of productivity. Broadly speaking, in this setting increases in productivity reflect the ability to expand output by using inputs to production more efficiently.

[1] This article is based on, and benefits from, the research on productivity conducted for many years by the STATEC-ANEC research team. This research has been conducted with the support of the Observatoire de la compétitivité, STATEC, and the Luxembourg National Research Fund (FNR) grant number 4964438. The views in the articles are those of the author and do not engage neither STATEC nor the Observatoire. Thanks are due to Umut Kilinc, Charles-Henri Dimaria, Serge Allegrezza, Cesare Riillo and Bruno Rodrigues.

At the aggregate level, labour productivity and Total Factor Productivity (TFP) are the most widely analysed measures of productivity. Labour productivity captures the use of the labour input, while TFP involves both labour and the stock of capital. (The stock of physical capital includes tangible assets to production such as equipment and infrastructure.) These two fundamental measures of productivity are closely related. Indeed, changes in labour productivity can be decomposed into changes in the capital intensity (capital per unit of labour), termed as capital deepening, and TFP gains. This indicates that both capital intensity and TFP can be regarded as labour productivity drivers (Peroni 2012a).

Before continuing to examine determinants of TFP, the following gives two important remarks on the concept of productivity. Firstly, productivity is fundamentally a relative concept. Researchers and analysts compare productivity performances of firms, industries and countries; they compare productivity figures at different points in time. Secondly, productivity is often used as a synonym of efficiency. The two concepts, however, although closely related are not the same. The concept of efficiency itself is not unique in the literature. In productivity studies, the two most widely used concepts of efficiency are productive efficiency and allocative efficiency. While productive efficiency identifies the highest possible output attainable for a given level of resources and the available technology, allocative efficiency refers to the state of an industry in which resources to production are employed by the most productive producers.

The remaining of this article is structured as follows. Section 2 briefly overviews the determinants of productivity. Section 3 presents the productivity studies that are conducted at STATEC-ANEC: it introduces the approaches used to analyse productivity in Luxembourg, the main projects undertaken, the data used, and presents selected results from this analysis. Section 4 discusses the main challenges involved in productivity measurement, and, finally, Section 5 summarises the main points of this contribution and presents directions of future research.

7.2 The drivers of productivity

A crucial issue to scholars and decision-makers is what causes productivity growth over time. A related question is what explains the large observed variations in productivity performances across countries, industries and firms. To identify the sources of productivity growth one needs to consider many elements — from the characteristics of the labour force to the role of technology and management in production processes — and study which of these elements enable some producers to be more efficient than others. Over the past two decades, researchers have increasingly focused on the analysis of the determinants of productivity. The study of the reallocation of resources towards more productive producers and the role of firms heterogeneity in shaping aggregate outcomes have gained prominence. This research has been made possible by the availability of detailed production data collected at firm and plant level. As a result, policy organisations and institutions have coupled the analysis of aggregate productivity patterns with ambitious research programmes aimed at studying productivity drivers. Recently, the OECD has launched two projects aimed at studying the aggregate dynamics of employment and productivity based on harmonised cross-country aggregated firm-level data. One of these projects, MultiPROD seeks to explain cross-country productivity differentials based on the analysis of the distribution of productivity across firms. This analysis aims to quantify the contribution to overall productivity performances of different types of firms, those at the bottom and those at the top of the productivity distribution, and considers firms' size, age, and ownership categories. The project also aims to study the relationship between productivity and wage inequality, and the effectiveness of various policy frameworks aimed at enhancing productivity. The DynEmp project aims to provide empirical evidence on firms demography and firms' characteristics, focusing on start-ups and young firms, for employment and productivity growth. STATEC participates in both these projects. (Kilinc and Ben-Aoun Peltier, 2015, present preliminary results from DynEmp).

Studies of productivity determinants consider factors such as the quality of inputs, namely the quality of the labour force and of the equipment used in production; the knowledge incorporated in technology and the introduction of new technology; management practices, etc.

These factors/drivers can be grouped into the following categories:

1. Macro drivers. Productive efficiency, technical progress (that is, changes in the available technology that expand production possibilities), and allocative efficiency can be regarded as "macro drivers", in the sense that they directly affect aggregate productivity outcomes.

2. Micro drivers. These are drivers under the direct control of firms. Among micro drivers we find inputs such as human capital, management quality, innovation, intangibles such as intellectual property rights, know-how, and reputation. Other forms of capital, such as ICT, also enter this category.

3. External drivers. These factors shape the environment in which firms operate and affect aggregate productivity (and its distribution), but are not under the direct control of firms. Among these factors, we find technology spillovers, market structure aspects, such as competitive pressure and sunk costs, and demand factors.

Syverson (2011) provides a broad and engaging review of the many productivity drivers that are being investigated by the economic literature.

In recent years, new lines of research and new perspectives have emerged. Scholars are devoting increasing attention to the role of managers' skills, and to the impact of well-being and job satisfaction on productivity. These studies are usually conducted on individual and firm-level data; some studies examine the impact of these factors from an aggregate or industry-level perspective. (One can see the studies by Oswald et. al., 2014, Böckerman and Ilmakunnas, 2012, DiMaria et. al., 2014.)

In summary, from an aggregate perspective, the production process is largely viewed as a black-box that transforms inputs into output, and productivity is an indicator of the ability of producers to obtain more and better output for a given level of inputs use. Studies on determinants of productivity "dissect" aggregate productivity into various components, which are then added to the list of inputs used to analyse production processes. Each of these factors shed some light into the productivity black-box. As a result, the concept of productivity is nowadays largely identified by its drivers, and the study of such drivers is the study of productivity itself.

One should be aware, however, that these studies have limitations. The measurement of some factors to production is intrinsically difficult (such as, for example, intangibles). The quantification of the effect on productivity of each of the drivers listed above in isolation from others is also highly problematic. For these reasons, the availability of sound aggregate indices of productivity is still crucial to analysts and policy-makers. Such indices provide a synthetic measurement of the factors listed above as determinants of productivity.

The remaining of this short article presents the approach to study productivity adopted at STATEC. The focus is on the first group of drivers, namely the macro drivers of productivity, as these are most closely related to the aggregate outcomes that are of interest to policy-makers.

7.3 The study of productivity in Luxembourg

STATEC research programme on productivity focuses on the measurement of productive and allocative efficiency at the national and industry level. The main objective of this research is to provide sound measures of productivity, which can be used to track the dynamics of productivity in Luxembourg and to identify the country's international position. In previous years, this research has provided valuable outcomes, namely productivity indices for key industries computed under minimal assumptions, and insights on the sources of allocative and productive efficiency at industry level.

The study of Luxembourg's productivity performance focuses on the analysis of labour and total factor productivity (TFP) indicators. Two distinct approaches to productivity analysis, the frontier and the micro-founded econometric approach, allow us to study, respectively, productive and allocative efficiency. The frontier approach uses National Accounts data to derive indices of productivity at national and industry-level. This comparative framework tells us whether productivity gains are sourced from efficiency gains or technical progress.

The econometric approach, based on firm-level data, gives allocative efficiency indicators constructed using quantity and nominal measures of inputs and output. Such indicators provide insights into the role of the allocation of productive inputs among firms on aggregate productivity changes. Furthermore, they enable us to understand the differences between firms' productivity and profitability dynamics, which can be significantly different from each other in case of inefficient regulation of industries. This research also studies the role of international trade in shaping productivity performances (Kilinc, 2016a).

This section outlines the two approaches above and presents selected results from the research on productivity conducted at STATEC.

The frontier approach: the LuxKLEMS project

LuxKLEMS rests on a National Account framework where countries (or industries) use resources to produce goods and services. Resources (inputs) are classified into the 5 following categories: physical capital (K), labour (L), energy (E), materials (M) and purchased services (S), which explains the term KLEMS in the acronym of the project title.[2] (The latter 3 categories are usually aggregated and termed as intermediate inputs.) The output of this project is a database of statistics on input use and output produced, labour productivity and TFP indices at the industry and country level. Since its inception, regular LuxKLEMS reports inform on the evolution of TFP in Luxembourg in a comparative perspective. (DiMaria and Ciccone, 2008; Dubrocard et. al., 2010; Peroni, 2012b, 2013, 2014).

[2] LuxKLEMS was incepted as a country version of the international EU-funded project EUKLEMS (Timmer et al. 2007).

LuxKLEMS annual productivity indices are derived from National Accounts data using a frontier approach, in a way that nicely adapts to the characteristics of the Luxembourg's economy and data. In this framework, countries' TFP is computed by comparing GDP to stock of physical capital and employment/hours.[3] This is done using a computational method developed in operational research studies. The main idea underlying this approach is that observed cross-country differences in the levels of output – at comparable levels of inputs' use – can be attributed to inefficiencies in production. Higher levels of output can be obtained by increasing the efficiency in production and by advancements in the available technology. Noticeable features of TFP indices computed in this framework are as follows. Firstly, they capture two macro determinants of productivity, namely productive efficiency and technical progress. Secondly, they enable cross-national and cross-industries comparisons. Thirdly, they are robust to the arrival of new data, a key property for policy-makers.[4]

The following presents selected results on country-level TFP indices from ongoing research. Chart 1 shows the evolution of TFP in Luxembourg from 1980 to 2014. One can see that the long-term evolution of TFP is characterised by 3 regimes. Firstly, a sustained TFP increase took place from the early 80s till the end of the 90s, with TFP growing at an average yearly rate of nearly 2 percent. This was followed by a period of stagnation during the 2000s, when TFP growth barely attained an average 0.2% per year. A sharp fall in TFP was observed during the recession of 2008 and 2009. TFP growth has failed to recover ever since.

These results, however, are better interpreted in a comparative perspective, which evidences that the patterns of productivity observed in Luxembourg and in other countries are comparable. Indeed, Chart 2 shows that the neighbouring countries, namely France, Belgium and Germany exhibit similar trends.

Chart 3 provides insight into the sources of the observed productivity changes. The graph is interpreted as follows. (Recall that, in this framework, productivity changes can be decomposed into efficiency gains and technical changes.) Each data point represents a productivity change observed at a given point in time; on the x-axis and y-axis one reads the corresponding changes in, respectively, efficiency and technology.[5] The decomposition of TFP growth in efficiency gains and technical change shows that sustained TFP growth in Luxembourg was mainly due to the latter component. The stagnation period was characterised by slow or negative technical progress only partially offset by some efficiency gains. After 2007, we observe technical regress but also some improvements in the efficiency components.[6]

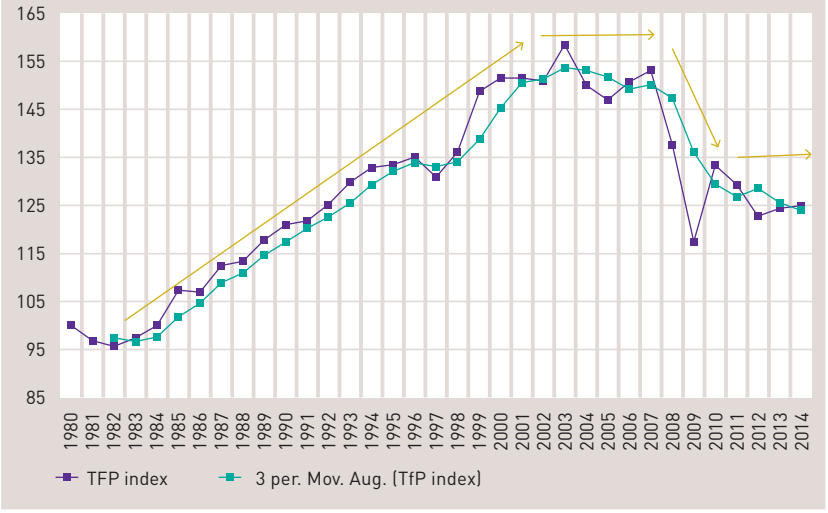
[3] The use of real GDP, capital stocks and hours worked is grounded in the theory of economic growth. Early studies have emphasized the accumulation of physical capital and the use of labour as main drivers of growth.

[4] More details on the computational method — Data Envelopment Analysis (DEA) — used in LuxKLEMS to compute TFP indices can be found in DiMaria and Ciccone (2006) and in the Appendix to Peroni (2012b). DEA rests on a theoretical framework where, given certain levels of inputs use and the available technology, there exists a level of output that cannot be exceeded — and might not be attained — by the operating economic units (Farrell, 1957). Operating units can be firms, industries, or countries. These maximal levels of output define the so-called *efficient (or best-practise) frontier*. The *distance* between the frontier and the level of production recorded for each operating unit gives a measure of the productive (in)efficiency of that unit. This method is widely used in management and operational research studies, but is also applied in economics to study productivity of industries and countries. For more details on the method, one can see Fare et al. (1994) and Coelli et al. (2005).

[5] As an example, a point with coordinates (0,2) is interpreted as follows: the overall 2 percent increase in productivity is explained by zero efficiency gains and 2 percent technical progress. Points in the first and fourth quadrant correspond, respectively, to positive and negative overall changes in productivity. In the other regions of the graph the net effect on productivity depends on the relative strength of the two effects.

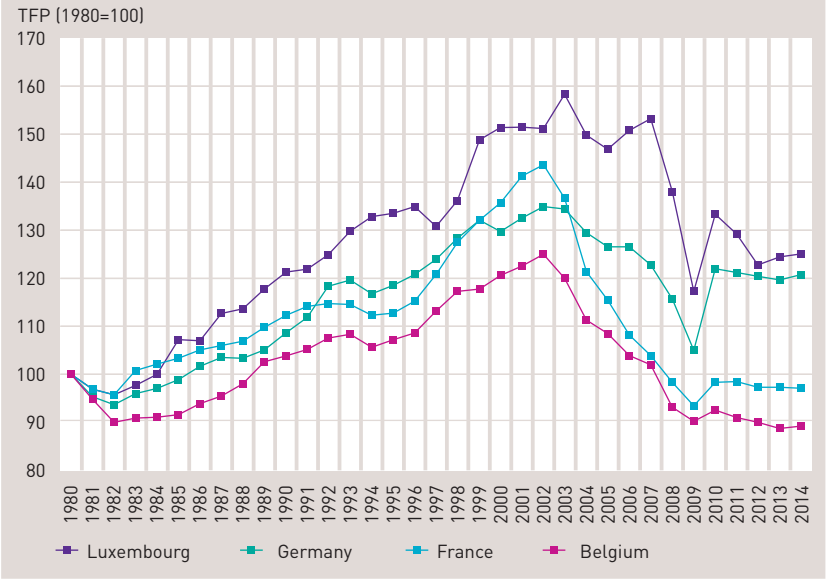
[6] In a frontier approach, efficiency gains are measured by changes in the producers' distance to the best-practice frontier. Technical shifts are movements of the frontier itself. Technical regress is essentially a reduction in observed output for all levels of inputs use between two periods of time. This is often observed in empirical studies, and can be due to lack of new investment and demand-side factors.

Chart 1
TFP evolution in Luxembourg



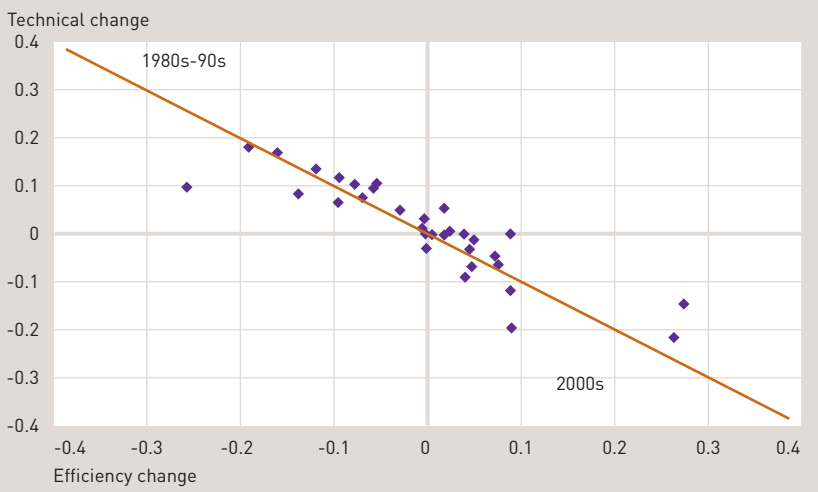
Source: ANEC-STATEC on Penn World Tables

Chart 2
TFP evolution in Luxembourg and neighbouring countries



Source: ANEC-STATEC on Penn World Tales

Chart 3
Sources of TFP growth: efficiency gains and technical change



Source: ANEC-STATEC on Penn World Tables

Here, the data come from the Penn World Tables version 9, a dataset maintained by the University of Groningen (Feenstra et al., 2015). This data is an unbalanced panel of 182 countries from 1950 to 2014. The observations are sourced from countries' National accounts and are expressed in constant US dollars, reference year 2005. Note that GDP is also purchasing power parities (PPPs) - adjusted. PPPs measure relative price level differences across countries, thus provide the proper basis for comparing living standards and examining productivity levels over time and across countries.

One advantage of the frontier approach to the analysis of productivity is its flexibility. This framework can be extended to consider many inputs and outputs, which permit to examine the role of various tangible and intangible inputs, as well as additional outputs, in the production process. In various contributions, researchers at STATEC have exploited this property and analysed the environmental impact of production activities (Peroni, 2012a), as well as the impact of well-being on productivity (DiMaria et al., 2014, 2015). DiMaria et al. (2014) compute measures of TFP that account for subjective well-being, regarded as a possible intangible factor to production. The study finds that well-being-adjusted productivity measures are significantly correlated to standard TFP measures, and that well-being has a significant positive impact on productive efficiency, which also excludes reverse causation. A further extension to this framework is the inclusion of measures of human capital as an input to production, which is widely regarded as a main driver of total factor productivity. This work is currently being undertaken at STATEC.

The impact of ESA2010 regulation

The recent introduction of the new European System of Accounts, ESA 2010, a major revision of the national statistical systems, has important consequences for the measurement of productivity.

The System of National Accounts (SNA) regards production as an activity that transforms inputs, namely labour and capital stock, into outputs. This view is grounded in the theory of economic growth. In this context, ESA 2010 aims to integrate in the production framework ICT and intangible factors to production. In doing so, the new system of accounts goes beyond a mere update of standards, classification and accounting rules: it seeks to reflect developments in the measurement of modern economies and to account for inputs that are widely recognised as important contributors to production activities and growth. In the field of productivity measurement, the main contribution of ESA 2010 is to consider R&D expenditure as an investment and, as a result, a component of capital stocks. (These were previously accounted as intermediate consumption with no lasting effect on output). Moreover, chapter 22 of ESA 2010 suggests the development of, among others, satellite accounts of productivity measurement, aimed at providing a comparable cross-country and cross-industry database for academic research.

The introduction of the new standards in Luxembourg National Accounts, and a revision in the classification of economic activities, have prompted a major data revision for the entire period under study. This has led to a revision of LuxKLEMS coding and computations and, as a result, productivity indices at country and industry level have been fully updated. These changes will allow us to put more emphasis on the determinants of productivity and growth in a knowledge economy, such as R&D and human capital.

The structural approach: LuxPROD

The overall evolution of Luxembourg's productivity shown in the previous section evidenced a large fall in TFP during the global macroeconomic shock of 2008–2009. This fall largely explained the slow-down in GDP observed in Luxembourg during the recession. One also observes that the slow-down in productivity started well before the crisis, a pattern that is also found in other countries' data. These observed overall patterns, however, are not the same in all industries.

These results should be interpreted with care. One reason is that productivity trends do not only reflect the economic cycle, but also reveal changes in the structure of the economy. In Luxembourg, the rapid economic and employment growth of the last decades was paralleled by the shift of a large portion of productive resources from steel manufacturing to financial intermediation. The transformation in the country's production structure affected productivity trends. Another reason is that aggregate patterns conceal a great deal of between and within-industry variations. In other words, patterns of productivity growth exhibit large variations across industries. Productivity also varies across firms within the same industries.

Firm-level production data permit to analyse the evolution of productivity at this finer level, and help interpreting and better understanding the aggregate results. This has also important policy implications. Moreover, firm-level data allow us to study an important determinant of aggregate productivity, namely the allocative efficiency. (Allocative efficiency is the state of an industry where an important portion of resources is employed by the most efficient/productive producers.) Micro-founded productivity studies, typically based on business statistics, focus on the productivity heterogeneity across firms and on the statistical analysis of the relation between productivity and the size of firms.

Studies based on micro-data conducted at STATEC aim at investigating the different sources of allocative efficiency and aggregate productivity growth. In addition, micro studies give insights on how the Luxembourg's industries reacted to the global shock. An important source of allocative efficiency is the so-called entry-exit mechanism, by which inefficient producers exit the market, while more productive firms enter. (This mechanism is expected to be activated during recessions, and is referred to as the "cleansing effect of recessions"). Another source of allocative efficiency is the shift of productive resources, namely labour and capital, towards more productive producers (the between effect). Aggregate productivity also increases when certain firms become more productive (the within effect). Finally, one expects to find a positive relation between the firms' market shares and productivity.

The main source of data for these studies are the structural business statistics (SBS) and the business register.

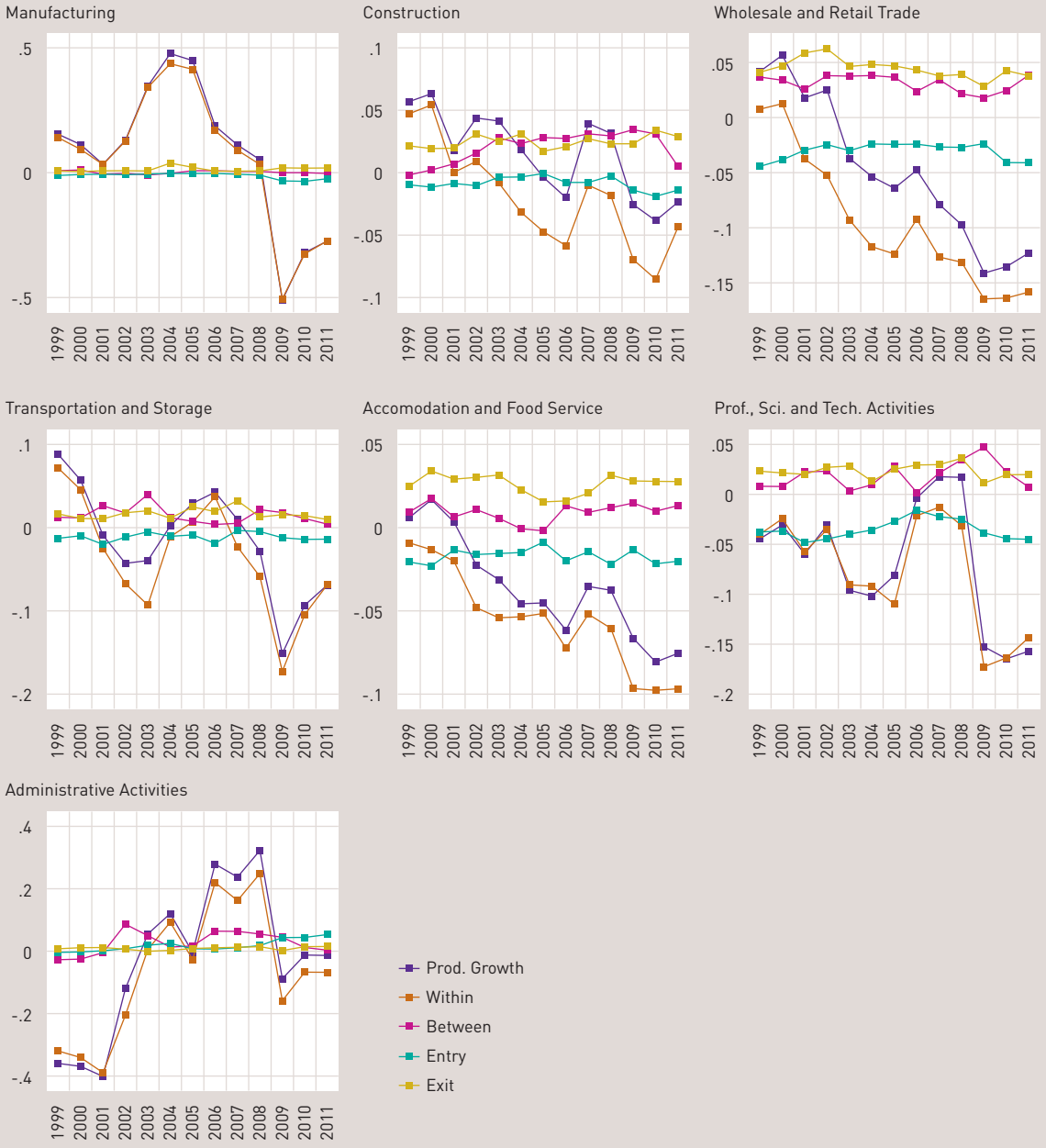
Chart 4 depicts the contributions of the within, between and entry/exit effects to the overall productivity growth in Luxembourg's manufacturing and market non-financial service industries. (Here, aggregate productivity is a weighted average of firms' productivity.) One can see that the largely predominant effect is the within effect. In other words, Luxembourg's productivity growth is explained by (large) firms becoming more productive rather than by more productive firms gaining market shares. An in-depth analysis of re-allocation effects, the crisis and post-crisis productivity patterns in Luxembourg's industries can be found in the study by Kilinc (2016b). This investigation has been conducted on business register data. Notice that, here, the productivity indicator is labour productivity, which measures deflated sales per hour worked. (This is because business register data do not include information on investments and intermediate inputs.) Results on TFP patterns in Luxembourg's manufacturing sector are based on SBS data and are reported in Kilinc (2014b). Noticeably, preliminary results on productivity indices computed at industry level based on the National Accounts data confirm the trends shown above.

Chart 5 shows in more detail the entry and exit dynamics in Luxembourg's industries. (Entry and exit rates take into account the relative importance of firms in the industry of reference; observations are weighted for the share of resources — i.e. labour — employed by firms.) One observes that, since 1995, exit rates have been relatively stable; entry rates have been falling ever since. This suggests that an important reallocation mechanism and source of allocative efficiency is not working properly in Luxembourg's economy.

On entry/exit and, more generally, business demography in Luxembourg's industries, one can also see Kilinc (2014a). The author analyses exit and entry rates in the broad sectors of Luxembourg economy, based on data sourced from SBS. Noticeable data features are as follows: entry/exit rates are low in Luxembourg industries; exit rates are higher than entry rates in manufacturing, while entry rates are higher than exit in business services; most of entry/exit dynamics are observed in the smallest firms group.

One reason why the entry/exit mechanism is policy-relevant is that it is strictly linked to employment dynamics, as well as the quality of institutions and regulators. In the context of the DynEmp project, Kilinc and Ben-Aoun Peltier (2015) found that in Luxembourg small and medium enterprises (SMEs) and *young* firms account for a large portion of net job creation. SMEs exhibit higher job creation and destruction rates than large firms; among SMEs, young firms create a higher number of jobs in comparison to both older SMEs and larger firms. This is a known stylised fact of firms dynamics observed in other countries.

Chart 4
Sources of productivity growth



Source: ANEC-STATEC on Business Register data

Chart 5
Entry and exit in Luxembourg industries

Source: ANEC-STATEC on Business Register data

Overall, these results show that allocative efficiency is an important source of productivity gains in transforming economies. They also show that in Luxembourg productivity dynamics are largely due to "within" effects, that is, are primarily explained by facts at play in incumbent firms.

7.4 Challenges of productivity measurement

The previous section showed that studies conducted at STATEC provide reliable productivity figures for the economy of Luxembourg, as well as policy-relevant insights on efficiency drivers. Productivity indices, however, should always be interpreted with care due to the difficulties inherent in productivity measurement. Indeed, this is an exercise largely dependent on data availability, and on the definition and choices of inputs and output to production. The following describes some of the challenges posed by measuring productivity that are particularly relevant for Luxembourg.

Firstly, the measurement of inputs to production is far from being simple, even when restricting the set of inputs to the primary inputs, namely labour and capital stock. Inputs to production are often estimated or proxied rather than directly observed. As an example, the stock of physical capital is estimated using perpetual inventory methods which typically require long time series.[7] The measurement of the labour input involves the choice between hours and number of persons employed, a choice often restricted by data availability. Extensions of the standard framework to consider additional inputs to production — inputs quality, intangibles, etc. — also incur into measurement difficulties as well as issues of data availability and periodicity. The case of human capital, one of the most widely used additional inputs in empirical studies, provides an example of these difficulties. Economists attempt to account for variations in the skills of workers by resorting to proxies and/or constructing indices that take into account years of education, training, experience etc. The measurement of workers skills is particularly problematic in Luxembourg due to data limitations (see DiMaria and Ciccone, 2006, p. 54-61). (A large portion of the labour force is accounted for by cross-border workers, for which data on variables of interest are not always readily available.)

Secondly, the measurement of productivity in services poses conceptual and practical problems. These stem primarily from difficulties in defining and measuring the output of these economic activities. Indeed, the measurement of productivity relies on a conceptual framework that has been largely developed for manufacturing-based economies. However, while measuring output is straightforward in manufacturing, it is not so for services.

The service sector includes economic activities that are quite heterogeneous: education, public administration, health and social work, cultural activities, non-financial business services and financial intermediaries. Some of these activities deliver "non-market services", that is, services that are not sold on a market. For those services, it is difficult or impossible to observe prices and quantities, thus to obtain the information needed to compile real output and productivity figures. (A good that is not exchanged on a market does not have a price; as a result, it is not possible to measure gross output using data on turnover from the sales of that good, as it is commonly done for manufacturing industries.)[8] Output in non-market services is measured by the cost involved in producing those services.[9]

7 Researchers and statisticians compile gross capital stock by cumulating flows of past investments, which requires assumptions on the lifetime of assets and the specification of survival functions for investment goods. Investments are distinguished by type of asset On the measurement of capital stock in Luxembourg at aggregate and firm level one can see DiMaria and Ciccone [2006] and [Kilinc 2012].

8 In some cases it is possible to observe quantities of provided services. Still, the assessment of productivity performances might be problematic due to aggregation and comparability issues.

9 In SNA, non-market production is valued at total cost, that is, the sum of intermediate consumption, compensation of employees, consumption of fixed capital plus taxes less subsidies on production.

The problem of defining output is not unique to non-traded services; it applies also to the output of traded services, and, in particular, to the output of financial intermediaries. In the latter case, the problem is that many services provided to customers are not charged for explicitly.

Currently, output data for financial intermediaries are produced in accordance to international guidelines set by the System of National Accounts (SNA). The output of financial intermediaries is computed by adding indirect and direct measures of output. Direct measures include fees and charges levied on customers. Indirect measures of output, termed FISIM (Financial Intermediation Services Indirectly Measured), aim at capturing implicitly-priced services to borrowers and depositors. This is done by multiplying a margin by the stock of deposit and loans. (The margin is computed as a spread between, say, a rate on deposit/loan and a reference rate.) Clearly, results rely heavily on the choice of the rates used to compute the spreads. It can be easily seen that these computations provide only a rough proxy of the output of financial activities.

A further and not lesser problem surrounding services' productivity is separating prices from volumes, and isolating price changes due to changes in quality of the services from pure price changes.[10]

The difficulties associated to measuring productivity in services are very relevant to Luxembourg, an economy where these activities account for a predominant share of value added. In Luxembourg we typically observe that service industries' productivity patterns differ substantially from those of manufacturing industries: in the light of the discussion above, these figures should be interpreted with care. The issues surrounding the measurement of productivity in services, which question not only the interpretation but also the legitimacy of such measurement itself, are still subjects of debate and ongoing research.

[10] Productivity measures are based on real measures of activity. For services, data are often available only at current prices, which poses the problem of identifying appropriate deflators to account for price changes. This task is complicated by the relevance of quality in the provision of services. On this issue, one can see [Crespi,Criscuolo,Haskel & Hawkes 2006] and [Wolfl 2004].

7.5 Conclusions

This short article aimed to provide a definition of productivity and to introduce the reader to emerging issues and challenges faced by researchers in productivity studies. It also presented productivity researches conducted at STATEC.

Productivity is a multifaceted concept strictly related to the concept of efficiency. In the context of productivity measurement, two types of variables are important: outputs and inputs to production. Productivity is essentially a ratio of output to inputs, and its measurement depends crucially on the definition and measurement of those inputs and output, a task complicated by data limitations and measurement problems. Some of these are very relevant to the Luxembourg case, as they concern the study of productivity in service-based economies.

The description of STATEC's research showed that the use of different approaches to the study of productivity, namely the frontier approach and the structural approach, deliver reliable productivity indices. This analysis offers insights on the role of productivity drivers, such as technological progress, and productive and allocative efficiency, in shaping aggregate productivity growth. Indeed, the strength of STATEC's approach lies in the use of different methods, which permit to check robustness of results and analyse different aspects of productivity growth. Micro-level studies permit to take into account firms' heterogeneity and the contributions of different types of firms to productivity growth, while productivity indices based on national accounts data provide information on the overall evolution of productivity under minimal assumptions.

The analysis of Luxembourg data highlighted the productivity slow-down affecting the country's economy. This is an important result because productivity is a source of economic growth and well-being. In this context, the analysis of productivity drivers is policy-relevant because the identification of the sources of the productivity dynamics is an essential pre-requisite to put in place the correct policy actions.

Future work will continue the current projects to provide updated and improved productivity figures for Luxembourg. It will place emphasis on the issue of productivity measurement in service industries; the role of labour quality and human capital in determining aggregate productivity; the role of international trade in shaping productivity performance.

In addition, researchers at STATEC-ANEC try to account for new emerging important issues, as productivity is increasingly associated to themes such as sustainability, well-being, inequality and social cohesion. They endeavour to analyse the role of intangible factors in achieving productivity gains, as well as issues of environmental degradation related to production activities.

Finally, this contribution highlighted that the measurement of productivity is largely dependent on the availability of data. Many unresolved and emerging issues in productivity studies can be tackled by enlarging the data sources and by using matched employers-employees datasets. Thus, improving data availability and data access for research purposes is crucial to achieve better knowledge of a factor — productivity — that represents the most important source of economic growth in developed economies.

7.6 References

BÖCKERMAN, P. AND ILMAKUNNAS, P. (2012)
The job satisfaction-productivity nexus: A study using matched survey and register data, Industrial & Labor Relations Review 65(2):244-262.

COELLI, T.; RAO, D. P.; O'DONNELL, C. AND BATTESE, G., (2005)
An introduction to efficiency and productivity analysis. Springer.

CRESPI, G.; CRISCUOLO, C.; HASKEL, J. AND HAWKES, D. (2006)
Measuring and understanding productivity in UK market services, Oxford Review of Economic Policy 22(4):560-572.

DIMARIA, C. AND CICCONE, J. (2006)
La Productivité Totale des Facteurs au Luxembourg, n° 102, STATEC, Luxembourg.

DIMARIA, C. AND CICCONE, J. (2008)
LUXKLEMS: Productivité et Compétitivité, Perspectives de Politique Économique, n° 8, Le Gouvernement du Grand-Duché de Luxembourg.

DIMARIA, C.; PERONI, C. AND SARRACINO, F. (2014)
Happiness matters: the role of well-being in productivity, Quaderni del Dipartimento di Economia Politica e Statistica, Universita di Siena, n° 699.

DIMARIA, C.; PERONI, C. AND SARRACINO, F. (2015)
Happiness matters: the role of well-being in productivity, 2015 Competitiveness Report, Perspectives de Politique Économique, Observatoire de la compétitivité, n° 230.

DUBROCARD, A., GOMES FERREIRA, I., AND PERONI, C. (2010)
Productivité et Compétitivité au Luxembourg: une comparaison par pays et par branches, Perspectives de Politique Économique, n° 14, Ministère de l'Économie et du Commerce extérieur du Grand-Duché de Luxembourg.

FARE, R.; GROSSKOPF, S. AND LOVELL, C. K., 1994
Production Frontiers. Cambridge University Press.

FEENSTRA, R. C., INKLAAR, R. AND TIMMER, M. P. (2015)
The next generation of the Penn World Table, The American Economic Review 105(10):3150-3182.

KILINC, U. (2012)
A note on measuring firm-level capital stock and productivity in Luxembourg's manufacturing sector. 2012 Competitiveness Report, Perspectives de Politique Économique, Observatoire de la compétitivité, n° 26, pp. 165-179.

KILINC, U. (2014A)
Aspects of Business Demography. In: STATEC (Ed.), Dynamiques des entreprises du Luxembourg, Compétitivité de la nation, STATEC.

KILINC, U. (2014B)
Factor Allocation and Firm-Level Productivity Dynamics in Luxembourg's Manufacturing Sector, Économie et Statistique, working paper series du STATEC, n° 71.

KILINC, U. (2016A)
Productivity, Markups and International Trade: The Case of Small Open Economy, Économie et Statistique, working paper series du STATEC, n° 88.

KILINC, U. (2016B)
Resource Misallocation and Productivity Slowdown: Luxembourg's Manufacturing in the Post-Recession, mimeo.

KILINC, U. AND BEN-AOUN PELTIER, L. (2015)
Dynamics of Net Job Creation, Firm Entry and Exit in Luxembourg's Main Sectors, 2015 Competitiveness Report, Perspectives de Politique Économique, Observatoire de la compétitivité, n° 27, pp. 218-222.

MCGOWAN, A., ANDREWS, M., CRISCUOLO, C. AND NICOLETTI, G. (2015)
The future of productivity, OECD Publishing.

OSWALD, A., PROTO, E., AND SGROI, D. (2014)
Happiness and productivity, Journal of Labor Economics 33:789-822.

PERONI, C. (2012A)
Environmental efficiency indices: towards a new approach to green-growth accounting, Économie et Statistique du STATEC, n° 61.

PERONI, C. (2012B)
Productivity and competitiveness in Luxembourg: the evolution of total Factor productivity in Luxembourg from 1995 to 2010, Perspectives de Politique Économique, n° 25, Ministère de l'Économie et du Commerce extérieur du Grand-Duché de Luxembourg.

PERONI, C. (2013)
Productivity and Competitiveness in Luxembourg, Perspectives de Politique Économique, Observatoire de la compétitivité, n° 27, pp. 169-195.

PERONI, C. (2014)
Total Factor Productivity at the industry level. In: STATEC (Ed.), Dynamiques des entreprises du Luxembourg, Compétitivité de la nation, STATEC.

SYVERSON, C. (2011)
What determines productivity?, Journal of Economic Literature, 49:326-265.

TIMMER, M., O'MAHONY, M., AND VAN ARK, B. (2007)
The EU KLEMS Growth and Productivity Accounts: An Overview, University of Groningen & University of Birmingham.

WOLFL, A. (2004)
Productivity growth in services industries: is there a role for measurement?, OECD.

8 Rediscovering the role of small economies: a challenge for competitiveness

8.1 Professor Lino Briguglio: *Small States and the European Union*

Why take the time to study small countries? Well, firstly because there are so many of them! The seven largest countries in the world, which include China and India, make up 50% of the global population. Of the 217 countries listed by the World Bank (2015 figures), Luxembourg ranks 168th, just ahead of Suriname, Cape Verde and Malta, from where Professor Briguglio hails. This researcher earned his reputation as a pioneer in the systematic analysis of the vulnerability of small countries and islands. He examined the risks faced by small States in the case of external shocks, their resilience strategies and their capacity for post-crisis recovery.

One of the most difficult tasks in such studies is establishing a benchmark by using a metric based on country size prior to identifying which States class as 'small'. While numerous criteria have been used in the literature, including population, surface area, GDP level, openness to external trade and foreign investment, foreign-born population share, influence in international organisations and decision-making, etc., often, studies focus solely on population in terms of thousands of people for the sake of simplicity.

It is this criterion which Professor Briguglio picked up on in his latest book *Small States and the European Union* (Briguglio 2014), which was presented to the public on 30 June 2016 at Cercle Cité in Luxembourg, shortly after being released by Routledge.

The sample of countries examined in this text is arbitrary: it includes the seven Member States of the EU with populations of under 3 million inhabitants (the three Baltic States, Slovenia, Cyprus, Malta and Luxembourg), plus accession candidates Macedonia and Montenegro, as well as Iceland, a country which was negotiating its membership of the Union between 2009 and 2015. If we consider the 28 differently-sized EU Member States in terms of their population, one quarter of them have under 3 million inhabitants each. Jointly, these smallest members account for 3% of the total EU population! The sample therefore takes in very small countries, micro-States.

Countries such as Belgium and the Netherlands, our long-standing partners, have often found themselves saddled with the gracious epithet of 'small' countries, even though they are considerable in size and larger than the European average. In fact, the median size is around 9.1 million inhabitants (the mean is around 18 million, with a standard deviation of 23.5 million inhabitants; see Table 1). The group of medium-sized countries, with less than 9 million inhabitants each, includes Ireland, Finland, Denmark and Austria. The third group with less than 17 million inhabitants each is made up of Sweden, the Netherlands, Portugal, Greece and Belgium. The final group is made up of the four biggest countries along with Spain, Poland and Romania. We can therefore see that while it is clearly difficult to know how to go about profiling small countries, it is also important to do so.

Table 1
Population distribution in the EU (2015)

	Percentiles			
1%	423.808	423.808		
5%	557.74	557.74		
10%	865.388	865.388		
25%	3582.146	1315.447		
50%	9118.408		Mean	18180.12
			Std. Dev.	23547.7
75%	18429.88	60891.12		
90%	64407.43	64407.43	Variance	5.54e+08
95%	66228.49	66228.49	Skewness	1.538449
99%	82407	82407	Kurtosis	3.965253

In his introduction, Briguglio (2016) discusses the similarities shared by small countries: limited natural resources and little diversification of the range of activities, goods and services on offer. Small countries are therefore highly dependent on external trade and exposed to external shocks. Membership of the European Union ensures they can benefit from free movement of goods, capital and persons. The adoption of common rules and standards, not necessarily via legal instruments such as regulations and directives, leads to the structural convergence of economies and a degree of harmonisation amongst the disparate ensemble of European Union Member States.

L. Briguglio also highlights the proportionally higher administrative costs which small countries incur when transposing European law into national legislation, as smaller countries cannot offset these expenses due to the absence of economies of scale. If we believe this hypothesis, which to our knowledge has yet to be proven, then the administrative structure of small countries must be somewhat overinflated.

EU membership is also advantageous in that it offers development funds for countries who have recently joined. The small countries analysed in the book are all net beneficiaries of EU handouts except Luxembourg, which nonetheless profits from hosting European institutions employing thousands of civil servants on its territory. In addition, the voting system in the Council prevents small countries from having significant sway in votes, although the quest for unanimity does mean that the arguments put forward by their representatives, who sit at the table with representatives of larger countries, are at least heard and discussed. Small countries can also become more influential by working together, as the Scandinavian countries do. L. Briguglio, unlike some of the book's other contributors, says little about the euro, even though the monetary union reins in the fiscal policies of smaller States while equipping them with rules for managing public finances.

L. Briguglio compares a variety of statistics for his nine selected countries with the average figures for the EU during the 2004-2009 and 2010-2014 periods. As might be expected, the share of GDP attributable to exports is higher than the EU average, particularly for Malta and Luxembourg. Malta is the most densely populated country, and Iceland, which has a large surface area, has the lowest population density. Although this indicator is questionable, Luxembourg's GDP per capita is higher than the EU average, as is that of Iceland, while the GDP per capita of other small countries is lower than the European average. It is noteworthy that the small countries in this sample seem to have higher growth rates than the European average, except for Cyprus in the most recent period. Public debt is lower in small countries, except in Malta and Cyprus. Only Luxembourg and Slovenia have a current account surplus. The unemployment rate is under the European average in Iceland, Luxembourg, Malta and Slovenia. The highest hourly wage can be found in Luxembourg, and is above the European average. The competitiveness indicator calculated by the World Economic Forum paints Luxembourg in a favourable light in the European context, whereas the other small countries fare less well. This topic will be discussed further in the second section. The financial sector, measured in terms of private debt in relation to GDP, is significant in three countries and above the European average in Cyprus, Luxembourg and Malta.

In addition to economic factors, Briguglio also examines the attitudes of citizens of small countries as surveyed in Eurobarometer polls. Based on the attitudes to several issues, such as the trustworthiness and the image of the European institutions, the feeling of belonging to the European Union etc., he has produced a composite indicator which reveals that public opinion in small countries is more favourable to the European Union than the average across the EU. The two exceptions to this statement are Cyprus and Slovenia, countries which were particularly afflicted by the major recession and banking crisis.

There are certain methodological biases in the analysis put forward in the book which must be highlighted. Firstly, it is surprising that Briguglio did not make use of his research into the vulnerability of small countries to draw up a classification of the EU's smaller countries which is not solely based on the traditional population-centric criterion. Secondly, he could have extended the sample to other non-EU European countries and included some medium-sized or even large countries by way of comparison. It would have been helpful to perform a multivariate analysis in order to construct a typology of the countries based on different economic, social, environmental and political factors. This would have pinpointed the unique characteristics of small States/economies. Following on from this, it would also have been interesting to extend the analysis to an econometric assessment of the performances of small countries in comparison with other countries, linking up with a series of studies carried out by Alesina et al.

Nonetheless, the monographic and thus largely descriptive approach has its merits, because it delivers a report rich in nuanced conclusions on the problems faced by small countries. This report offers an interesting alternative approach of issues that cannot be explained in all their nuances and complexity by statistics, even when employing sophisticated analytical techniques.

8.2 Studies of the Luxembourg 'micro-economy'

Historians have the honour of being the first to be quoted in this text, as it is thanks to their analyses of the turbulent foundation of the young, fragile and vulnerable small country of Luxembourg, buffeted by the changing whims of great powers, often at war with one another, that we can better understand the nature of the country. We shall refer to contemporary Luxembourgish historians such as Gilbert Trausch (1991), more recently Michel Pauly and others[1]. Historical analysis combines several different geographical, economic, political, social and cultural aspects, and provides us with valuable information to help us understand the struggles this young country has had to grapple with in order to take its rightful place.

Certain economists have also ventured into the domain of historical analysis, including Gérard Trausch (2009), with a trilogy of works published by STATEC, as well as André Bauler (2002), a liberal MP who highlights in his book the importance of the State as a productive factor, creating institutions and rules which have resulted in resources and talent being drawn to Luxembourg.

G. Reinesch, current governor of the Luxembourg Central Bank, deserves a special mention as the first economist to have devoted a series of texts to the specific characteristics of the Luxembourg economy, making explicit reference to its small size (Reinesch 1985). He summed up his findings in a catchy-titled article in *Forum* (No. 93/94 p. 16, February 1987): *Does small-scale determinism exist?* He broaches several topics, including the macroeconomic dependence of neighbouring countries, the crucial role of exports and international terms of trade, the impact of the international context, and the inability to implement monetary and fiscal economic policies due to the weakness of spending multipliers. This is an advantage which means that the State does not have to issue money or get involved in costly, prestigious projects. The author also highlights the virtues of being small, as the margin for manoeuvre and tools available to the State are more limited, forcing it to make do with structural policies, particularly the development of infrastructure and the creation of attractive regulatory and fiscal environments. However, 'cashing in on sovereignty' (a concept which the writer attributes to former minister Robert Goebbels) should not give rise to excesses which would irritate our powerful neighbours, as 'it is important to be powerless'. Another advantage of being insignificant is possibility to behave as a free rider in the international arena and enjoy the benefits generated by policies funded by other countries. Moreover, austerity policies appear more palatable as they can be applied painlessly in small countries with homogenous populations. There is no point *'standing out for making great scientific discoveries, attempts which can only be doomed to fail'*. The author therefore recommends *'avoiding bragging of any kind, so as not to arouse the jealousy of others'*.

[1] The chapter on Luxembourg in Briguglio's book refers to the book by Émile Haag (2015).

The author acknowledges that based on the arguments put forward, no ex-ante conclusion can be made about whether it is the pros or cons of small countries that win out in the end.

This text was written in the mid-1980s following Luxembourg's troubled conversion from steel industry to the services economy, and at the dawn of a new phase of rapid expansion of the Luxembourg economy.

Patrice Peretti, professor at the University of Luxembourg, and former head of CREA, also deserves a mention here. To our knowledge, he is the only scholar to have continued working with partners to investigate the characteristics of small countries, in particular the asymmetrical distribution of foreign direct investments which can influence public services and taxation (Han et al. 2014).

It would be unfair to leave out econometrists who have taken up the challenge of producing equations to explain small-scale economies, even at a time when this intellectual endeavour was met with a degree of scepticism due to the dominant belief that small-scale economies were over-determined by their exports and the unpredictable, uncontrollable and volatile external environment, making any attempts at modelling misleading (Adam et al. 2007).

We must also recall the political scientists who have made significant contributions by studying the international relations of small countries and investigating the influence that small States can have in the international arena (Steinmetz and Wivel 2010). These authors, after reviewing the relevant literature, examine the definition of a small country: *'typically small States are defined in terms of capabilities, i.e. the possession of – or rather the lack of – power resources in absolute and relative terms. Generally, capabilities are measured by a reference to proxies such as population size, GDP, military expenditures etc.'* (op. cit., chapter 1). The writers highlight the importance of small countries in the study of international relations: they make up the majority of the countries in any given geographical region and so the balance of power between bigger countries, which are themselves composed of smaller provinces or regions, cannot be understood without taking into consideration the stabilising role of small countries in broader alliances. The authors also note that, at least in Europe, small countries do not simply stay in the shadows anymore: they implement active external policies, motivated by the quest for harmony. The authors describe this quite neatly as moving *'from hiding to binding'*!

Other authors, such as Romain Kirt, have committed to the endeavour of pleading the cause of small States (Kirt, date unknown).

As our own contribution to the debate, we decided in our submission for Briguglio's book to analyse the impact of size on economic success based on per capita national income[2] (Allegrezza 2016).

[2] This econometric analysis is only a starting point and will be followed up with a broader study covering other detailed variables spanning a longer period (panel).

A basic econometric analysis using data from the *Observatoire de la compétitivité*'s Scoreboard reveals *no link* between size and per capita national income (see Table 2 below), whereas the competitiveness composite indicator calculated by the *Observatoire de la compétitivité* (Ministry of the Economy, 2014) is positively and strongly correlated to per capita income. This therefore seems to suggest that in an economic union such as the EU, the performance of a State in terms of per capita income can be explained solely by its *capacity to do better* than others in the fields of education, research, initiative, productivity, … in other words, competitiveness! There is therefore no over-determination for small countries, to answer the question asked by G. Reinesch long ago in the aforementioned *Forum* article. The empirical literature on this subject expresses mixed opinions.

Table 2
Results of regression (figures from 2015)

Mco Regression	(1)	(2)
Dep. variable	GNI/capita	GNI/capita
Scoreocsb	3191.7** (977.6)	3231.1** (992.0)
Pop	0.0000478 (0.0000559)	
Small		-334.6 (3004.8)
_cons	6186.2 (5332.8)	6928.2 (5465.7)
N	28	28
R2	0.319	0.300

Dependant variable: gross national income per capita (GNI/capita)
Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Small= auxiliary variable (=1) if a country has under 3.6 million inhabitants
(i.e.: Luxembourg, Malta, Baltic countries, Slovenia and Cyprus)

Table 3
Omnibus test on first regression (1): Cameron & Traverdi's decomposition of IM-test

Source	Chi2	df	p
Hetroskedasticity	4.79	5	0.4420
Skewness	2.34	2	0.3109
Kurtosis	0.69	1	0.04065
Total	7.82	8	0.4517

The studies and ideas produced over the years have entered the national economic and political discourse, providing it with a common analytical framework and vocabulary, enabling officials to understand Luxembourg's specificities. Although the conceptual framework remains largely informal, one used it nonetheless to draft and develop an economic expansion strategy to overcome the aforementioned handicaps of being small (absence of economies of scale, weakness in negotiations, small size of domestic market etc.). This discourse can also be found in the opinion of the Economic and Social Council, the upper house for national social dialogue. Thanks to this representation of the functioning of the local micro-economy, something akin to a common view on economic and social issues has been forged and coalitions have been consolidated between opposing parties. This approach has also been expressed in political speeches in the Chamber of Deputies and reported on by the editors of the main media outlets.

Luxembourg has never set up its own supervisory, planning, forecasting or strategic analysis bodies, believing that its small size makes it insignificant and prone to being swept along on the tide of history. However, this conflicts with its leaders' ambitions of playing a unifying role as an intermediary between large countries and different cultures.

8.3 Research into small States: taking up the challenge

This school of thought on small countries developed in the early 1980s, in an era which pre-dates the establishment of the University and public research centres, i.e. a time where no professional academic research was taking place. Instead, discussion forums and study centres (such as IUIL and CREA) gave practitioners opportunities to develop tools for weighing up the success factors for small economies. The concept of cashing in on sovereignty emerged from these platforms. Perhaps the excesses which this doctrine generated over the years can be attributed to a loss of bearings, and to the difficulty of analysing the starkly complex environment in which small countries develop. A change has taken place since the economic and financial crisis of 2008, that 'great recession' characterised by rising inequality, fear of globalisation, xenophobic sentiment and the rampant disintegration of the European Union. Public opinion is also obsessed with the notions of transparency and fair play, due to a feeling of being deceived or abandoned by the 'elites'. A victim of its own success, Luxembourg, whose governance system was never modernised during its golden years, has found itself lacking in the intellectual department. Fortunately, this void can still be filled!

The standards of scientific research in Luxembourg have changed a great deal. It has become crucial to produce papers which are intended for publication in famous scientific journals, a process which put an end to local research carried out by amateurs in the early 1980s. Research into the topic of small States (and small economies), although an internationally-renowned field with a scientific, university-based, comparative and multi-disciplinary dynamic, was neglected by new scientific institutions (University of Luxembourg and public research centres). This void is all the more regrettable considering that economic literature on small economies has attracted the attention of world-renowned researchers, as proven by a simple consultation of those erudite works published by North Holland, the *'Handbooks'*, a seminal work for economists. One of the tomes, on the topic of growth, includes a specific chapter on small countries (Alesina et al., 2005)[3]. This research, which was begun in the late 1990s (Alesina and Spolaore 1997) has not been further developed by Luxembourg's scientific community and the work of Professor Briguglio on the vulnerability of States has suffered the same fate.

Any research paper worthy of its salt should not approach the small scale as a useful, ad hoc hypothesis for understanding Luxembourg's supposed unique traits, but instead begin with a typology of micro, small and medium-sized States around the world and attempt to validate the distinguishing properties of the functioning of small economies or States based on numerous economic, social, political, cultural, historical and environmental criteria. We should have paid more attention to the effects of interdependency, asymmetry and informal power in the context of monetary, economic and customs unions. Comparisons with the spatial or regional economy would surely have been fruitful, both because of the concepts employed and the econometric methods used. Researchers from different disciplines should work together and make use of the wealth of data compiled by Eurostat, the OECD, the IMF and the UN on countries all around the world. The research agenda should also explore the theoretical framework and prioritise the issues of asymmetrical information, moral hazards and interactions between countries.

However, it is never too late to get things right. In 2017, a major European conference will be held in Luxembourg which should provide an opportunity to broaden knowledge in this domain and set out a research agenda (with the involvement of Professor Briguglio). We can only hope that this project will bring together as many stakeholders as possible to discuss such topics of international relevance.

[3] Handbook, chapter 23, vol 1B in Aghion and Durlauf.

Bibliography

ADAM, FERDY, XAVIER TIMBEAU, AND SERGE ALLEGREZZA. 2007
Cahier des variantes Modux. 104. http://www.statistiques.public.lu/fr/actualites/economie-finances/conjoncture/2009/02/20090220/03CahierVariantesModux.pdf (August 16, 2016).

ALESINA, ALBERTO, AND ENRICO SPOLAORE. 1997
On the Number and Size of Nations. The Quarterly Journal of Economics 112(4): 1027–56.

ALESINA, ALBERTO, ENRICO SPOLAORE, AND ROMAN WACZIARG. 2005
Trade, Growth and the Size of Countries. In Handbook of Economic Growth, North Holland. http://proquestcombo.safaribooksonline.com.proxy.bnl.lu/book/economics/9780444520432/part-v-trade-and-geography/23_trade_growth_and_the_size_o (August 12, 2016).

ALLEGREZZA, SERGE. 2016
The Economy of Luxembourg. In Small States and the European Union: Economic Perspectives, ed. Lino Briguglio. Routledge.

BRIGUGLIO, LINO. 2014
The Vulnerability Resilience Framework,. https://www.um.edu.mt/__data/assets/pdf_file/0007/215692/Briguglio_The_Vulnerability_Resilience_Framework,_23_Mar_2014.pdf (August 3, 2016).

BRIGUGLIO, LINO. 2016
Small States and the European Union: Economic Perspectives. Routledge.

HAAG, ÉMILE. 2015
The Rise of Luxembourg from Independence to Success. http://www.editions.lu/the-rise-of-luxembourg-from-independence-to-success.html?___store=uk&___from_store=fr (August 20, 2015).

HAN, YUTAO, PATRICE PIERETTI, SKERDILAJDA ZANAJ, AND BENTENG ZOU. 2014
Asymmetric Competition among Nation States: A Differential Game Approach. Journal of Public Economics 119: 71–79.

REINESCH, GASTON. 1985
Fonctionnement d'une petite économie. In Théories économiques des petits espaces économiques, Institut Universitaire International Luxembourg, 236.

ROMAIN KIRT
Der Kleinstaat, Plädoyers Gegen Vorurteile - Éditions Le Phare http://www.phare.lu/politique/70-romain-kirt-der-kleinstaat-pladoyers-gegen-vorurteile.html (August 9, 2016).

STEINMETZ, ROBERT, AND ANDERS WIVEL. 2010
Small States in Europe: Challenges and Opportunities. Farnham, England ; Burlington, VT: Routledge.

TRAUSCH, GÉRARD. 2009
La société luxembourgeoise depuis le milieu du 19e siècle dans une perspective économique et sociale. Cahiers économique s (108): 156.

TRAUSCH, GILBERT. 1991
L'économie luxembourgeoise au 20e siècle. Le Phare éditions. Luxembourg. http://www.phare.lu/economie/66-l-economie-luxembourgeoise-au-20ieme-siecle-.html (August 4, 2015).

9 Wage Competitiveness in Luxembourg

Preface

An important component of competitiveness is the unit labour cost (ULC), which belongs to the 'Productivity and Labour Costs' category. As an unsolvable and lasting debate was pitting the advocates of nominal unit labour cost against those of real unit labour cost, the *Observatoire* asked an expert, Professor Stefan Collignon, to provide a different approach to address this difficult issue.

The *Observatoire de la compétitivité* dedicated a text box in its 2012 Report in order to distinguish between both notions, which are indeed measuring fundamentally different aspects, even though those concepts seem very close related. Real ULC compares real labour cost and productivity in volume, it implies a 'price setter' behaviour and is identical to the wage share in GDP (*'Lohnquote'*). Using nominal ULC, which is mostly supported by employers, is justified assuming that in a very open economy undertakings have a 'price taker' behaviour, which means that any increase in labour cost can only be offset by an increase in productivity. In Luxembourg we note that both statistical series differ. The *Observatoire de la compétitivité* has consistently preferred the real effective exchange rate, much more satisfying in many aspects than the unit labour cost analysed at national level. Which of the two indicators delivers the best information on cost competitiveness in Luxembourg? Professor Collignon provides a new approach by reinterpreting those notions.

In their study *'Wage balances in the European Market'*, Stefan Collignon and Pierre Esposito provide a new method to measure cost competitiveness. Their main criticism of ULCs is that they are, by construction, indicators which deliver no information on wage levels. The idea is to compute an equilibrium wage level, while assuming the capital is allocated in the European country where it provides the highest returns so that, in equilibrium, the rates of return on capital tend to equate in the euro area. The *equilibrium wage* is the level of remuneration of labour that equates the return on average equity in the euro area. By comparing observed labour cost and equilibrium wage, we may evaluate the adequacy of the labour cost level. This approach has been applied to Luxembourg data at sectoral level and it delivers sometimes unexpected results.

Wage Competitiveness in Luxembourg

Stefan Collignon and Piero Esposito

A Study engaged by the Government of the Grand Duchy of Luxembourg
In respect of the Project

Wage Imbalances in the European Labour Market.

London, 29 September 2016

Abstract

We propose a new method for estimating the competitiveness of wages in levels and not as usually done by unit labour indices. We define a new measure for equilibrium wages and find that overall the average labour cost level in Luxembourg was nearly EUR 30,000 per year below this equilibrium.

We then analyse sectoral wages. It appears that the competitive advantage in Luxembourg is concentrated in ITC, financial and public administration sectors. The manufacturing sector seems to be handicapped when compared to the average return of the Luxembourg macroeconomy, but when it is compared to the European manufacturing sector, it is very close to equilibrium.

We conclude by asking some questions about the future evolution of the Luxembourg model.

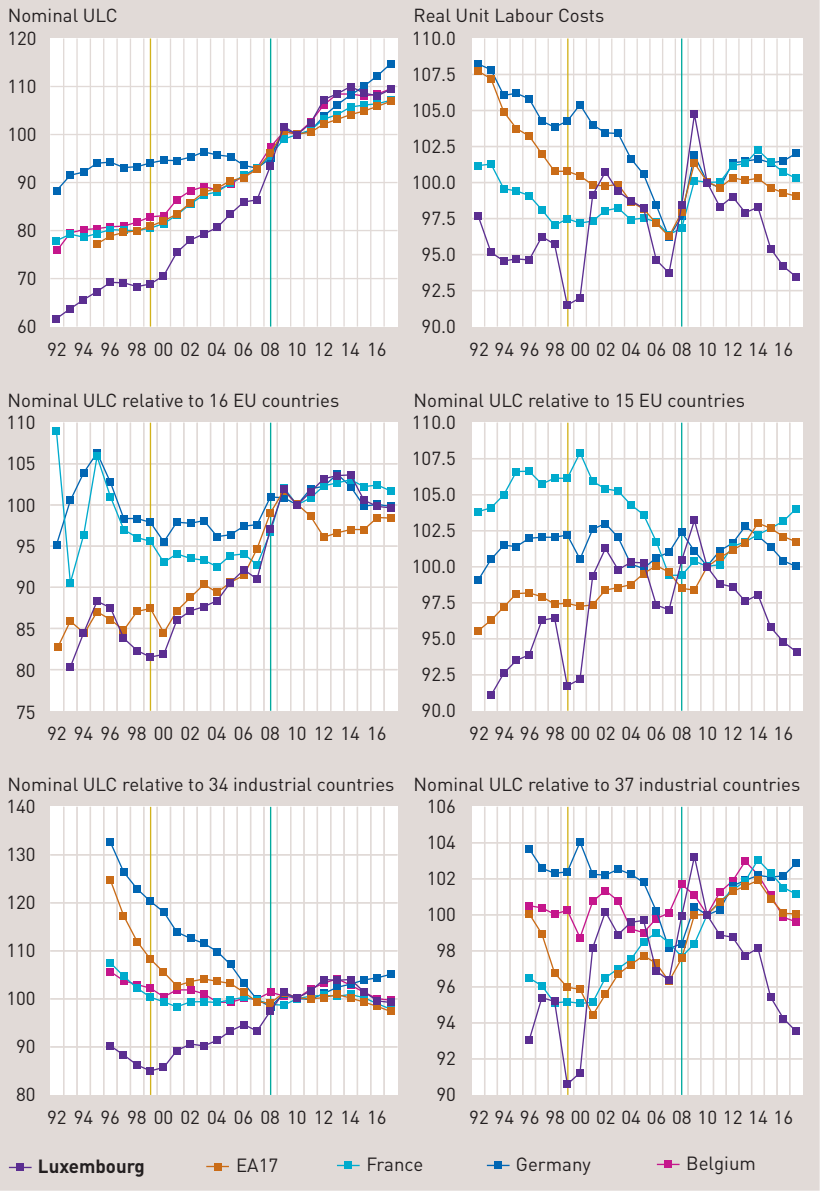
9.1 Introduction

The debate about the competitiveness of member states in the euro area has become more intense, and more controversial, since the Global Financial Crisis and the subsequent euro crisis. Improving competitiveness is often seen as synonymous with wage cuts and austerity. However, lower wage costs do not always improve competitiveness. First of all, competitiveness can improve even when wages are rising, provided productivity improves as well. Second, when austerity reduces effective demand, productivity will slow down and this may cause a deterioration of competitiveness. Hence, assessing an economy's labour cost competitiveness requires a more comprehensive analysis that integrates wage bargaining with productivity and growth theory.

Measuring wage competitiveness is difficult. Eurostat produces a number of indicators based on nominal and real unit labour costs and compares them to other countries or country groups, but their informational content is uncertain and even sometimes contradictory. Chart 1 shows the unit labour cost (ULC) indices for Luxembourg and its immediate neighbours France, Germany and Belgium as published by the European Commission's AMECO data base. All time series are based on the year 2010. It looks as if *nominal* unit labour costs have increased much more rapidly in Luxembourg than in neighbouring countries since the start of European Monetary Union in 1999. Hence, one would conclude that the Grand Duchy has *lost competitiveness* against the 16 most important EU member states and against 34 industrialized countries. By contrast, Germany and the euro area in general seem to have improved their relative positions. After the financial crisis in 2008, wage increases have slowed down. In nominal terms the competitiveness loss for Luxembourg relative to the euro area is similar to most neighbouring countries, although German wages are now increasing much faster. However, when we look at real unit labour costs, which are the same as the wage share, the picture is inverted. If we discard the peeks and shocks of the financial crisis, there is a broad i*mprovement in the labour cost competitiveness* of Luxembourg because the wage share has fallen and the profit share has increased. So which index gives a better picture of these competitive developments?

In this paper we look at a new method for assessing the competitiveness of labour costs in the euro area and apply it to the case of Luxembourg. We define a new measure for equilibrium wage levels and find that overall the average labour cost level in Luxembourg was nearly EUR 30,000 per year below this equilibrium. This is dramatic. We then analyse sectoral wages. It appears that the competitive advantage in Luxembourg is concentrated in ITC, financial and public administration sectors. The manufacturing sector seems to be handicapped when compared to the average return of the Luxembourg macroeconomy, but when it is compared to the European manufacturing sector, it is very close to equilibrium. We conclude by making some suggestions how to deal with this situation.

Chart 1
Nominal and real Unit Labour Indexes (2010=100). Absolute and relative measures



Source: own elaboration on Eurostat

9.2 A new measure for wage cost competitiveness

The trouble with measuring labour cost competitiveness by ULC indices as in Chart 1 is the arbitrariness of the base year of the index. Because we do not know whether a particular economy was in equilibrium in the base year, this can lead to misleading judgements if the index indicates rapid increases, when the country started out from an undervalued or overvalued position. We therefore need a benchmark for wage *levels* and not for the wage *dynamics*.

Starting with the simple assumption that in a market economy competition allocates capital to where it generates the highest return so that in equilibrium the rates of return on capital ought to be at the same level, we define the equilibrium wage as the total labour compensation level, at which the average return on the capital stock is equal to the average return in the euro area as a whole. We will calculate this relative return with respect to the economy of Luxembourg as a whole, or for given sectors such as manufacturing or financial services. It is important to emphasise right from the beginning that this equilibrium wage is a benchmark derived from capital market theory, and does not reflect a labour market clearing equilibrium wage. However, there is no automaticity that the equilibrium prevails in the short run, as the *Varieties of Capitalism* literature (Hall, Peter A. und David Soskice, 2001) has demonstrated.

The gross return on capital is the ratio of non-wage value added relative to the historic value of the aggregate capital stock of a country or sector. It also includes the part of value added that is used to substitute the consumed capital. In order to obtain a measure of net return on capital, which is what matters from the point of view of an investor, consumption of fixed capital (*cfc*) is subtracted from non-wage value added.

$$(1) \qquad RoC = \frac{Py - cfc - wL}{P_k K}$$

Where *PY* is nominal GDP, *w* is average wage compensation, *L* is the employment level, P_k is the capital stock deflator and *K* is the capital stock in constant prices. We also define nominal labour productivity as nominal output per person employed

$$(1b) \qquad \lambda = \frac{Py}{L}$$

By multiplying and dividing equation (1) by nominal GDP, the return on capital can be expressed as the product of the net capital share and the average capital efficiency (ACE):

$$(2) \qquad RoC = \frac{Py - cfc - wL}{Py}\frac{Py}{P_k K} = \sigma_k ACE$$

Where σk is the net capital share and ACE is the ratio of nominal GDP to nominal capital stock.

Our equilibrium condition is that a country's or sector's net return on capital is equal to the average level in the euro area:

$$(3) \qquad \sigma_{kx} ACE_x = \sigma_{k€} ACE_€$$

The equilibrium wage share of a country or sector is then:

$$(4) \qquad \sigma^*_{wx} = \frac{w^*_x L_x}{py_x} = 1 - \frac{cfc_x}{py_x} - \sigma_{k€} \frac{ACE_€}{ACE_x}$$

The wage share is identical with real unit labour costs,[1] so that equation (4) also represents a country's equilibrium real unit labour costs. Thus, if a country's capital productivity is higher than the average European capital productivity, so that $\frac{ACE_€}{ACE_x}$<1, its equilibrium wage share (and therefore in equilibrium a country's real unit labour costs) will be above the Euro Area's. This is the same as saying that a larger share of value added can be used to remunerate labour because capital is more productive. On the other hand, if in some countries the labour share has fallen over time, this may simply reflect lower capital productivity. Assuming equilibrium as a starting position, voluntarist increase in wages, as suggested by wage-led growth theorists,[2] would only generate deviations from equilibrium and harm competitiveness.

We can now solve equation (4) to obtain the equilibrium nominal wage level w*:

$$(5) \qquad w^* = \lambda \sigma_w{}^* = \lambda\left(1 - \frac{cfc_x}{py_x} - \sigma_{k€} \frac{ACE_€}{ACE_x}\right) = \lambda\left(1 - \frac{cfc_x}{py_x} - \left(1 - \frac{cfc_€}{py_€} - \sigma_{w€}\right) \frac{ACE_€}{ACE_x}\right)$$

where $\lambda = \frac{Py}{L}$

It is clear that the equilibrium wage so defined is a function of the average wage share in the euro area, national or sector specific labour productivity and the relative development of nominal capital productivity, i.e. relative prices of goods and capital and the national (or sectoral) capital-output ratio relative to the euro area's. An additional factor is the consumption of fixed capital, but this depends on the level of economic activity and on the nature of the capital stock, hence we can consider it as derived from the other variables in the equation. Nevertheless, because the destruction (write-off) of capital during a crisis may cause significant reductions in equilibrium wages, as is evident from Chart 2 (cf. 2000 and 2008-9), equilibrium wages can be rather volatile.

[1] Unit labour costs are defined as the wage costs per unit of output:
$ULC = \frac{wL}{y} = \frac{w}{\lambda}$.
Hence real unit labour costs are
$RULC = \frac{ULC}{P} = \frac{wL}{Py} = \sigma_w$

[2] See: (Stockhammer, 2015)

To measure competitiveness, we will match the actual labour compensation against the equilibrium wage. We calculate an index of relative competitiveness as a ratio and show absolute competitiveness as the gap between actual and equilibrium wages. If actual wages are higher than the equilibrium wage, the return on capital in a particular country or industry will be lower than the Euro-average. We interpret this as a competitive disadvantage, for lower profitability is likely to deter investment until the return on capital is improved, while highly competitive sectors and countries would attract capital and boost economic growth until over-accumulation reduces the return. Hence, wage cost competitiveness depends on actual wages as they emerge from wage negotiations *and* on structural factors that shift the equilibrium wage. It also depends on the average wage share of the euro area, i.e. on how aggregate wages develop relative to inflation and productivity in the euro area as a whole. If a particular region or industry deviates from the average performance, it will gain or lose competitiveness. This means that if wage increases are slowing down in the euro area as a whole, all countries will have to follow suit if they wish to remain competitive. This was the case during the first decade of Monetary Union, as Chart 1 shows, because German wage restraint kept the average wage costs in the euro area down, although this has changed during the euro crisis.

Our concept of equilibrium wage defines the limits for wage increases that are consistent for stimulating demand and pursuing a wage-led growth strategy. The famous *Rehn-Meidner rule* recommended that nominal wages ought to increase at the rate of labour productivity plus inflation, so that the wage share remains constant. In the euro area that has been amended to say that wage increases should take into account labour productivity and the inflation target of the ECB.[3] However, this rule ignores the impact of capital productivity on equilibrium wages. Balanced growth across countries and sectors would require that nominal wages are equal to equilibrium wages.

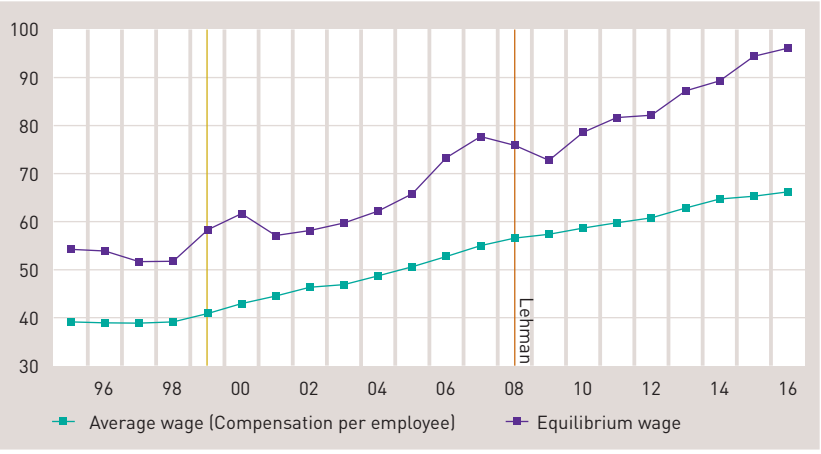
As equation (5) shows, the effect of capital productivity on equilibrium wages is far from trivial. Even if all countries had exactly the same rate of nominal wage increases in line with the *Rehn-Meidner rule*, their competitiveness could still be distorted by diverging capital productivity developments. Such divergence may be a consequence of broad country-specific factors, such as infrastructure, R&D, skill building, etc., but it may also reflect different weights of economic sectors with diverse capital-output ratios. For example, it is well-known that productivity is more likely to improve in manufacturing than in most service industries, so that an industrial hub like Germany is prone to reap larger competitive advantages than service intensive economies. For this reason, it is important not only to analyse aggregate but also sectoral equilibrium wages.

[3] See (Koll, 2005) (Commission, 2005)

9.3 Aggregate values and comparison with other EU countries

Chart 2 shows the evolution of wages costs in Luxembourg. Actual wages are structurally below the equilibrium level and the comparative advantage has increased after the Global Financial Crisis and during the euro crisis. Actual wages are more stable than the equilibrium wage, which reflects changes in capital productivity, as we will explain below.

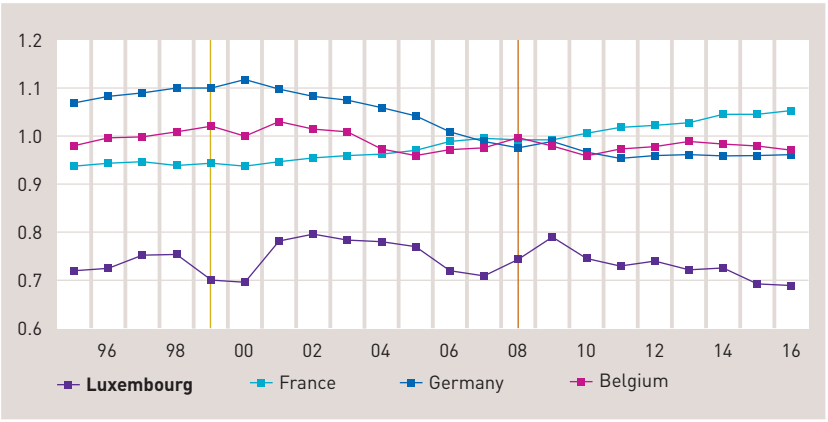
Chart 2
Luxembourg: actual and equilibrium wage



Source: own elaboration on STATEC, Eurostat

Chart 3 shows the competitiveness index, defined as the ratio of actual to equilibrium wage levels, for the aggregate economies of Luxembourg, France, Germany and Belgium. With small oscillations, wages in Luxembourg have kept a stable gap of 30 percent below equilibrium for the last 20 years. This is different for the neighbouring economies. In Germany, wage costs were 12% above equilibrium in 2000, but have since fallen below equilibrium stabilizing around minus 4%. By contrast, France has lost its initial competitive advantage of 6% below equilibrium and is now 6% above. Thus the shifts in competitiveness are a deterioration of 12% in France and an improvement of 16% in Germany since monetary union started. In Belgium, wage levels have stabilized slightly below but close to equilibrium.

Chart 3
Labour cost competitiveness index



Source: own elaboration on STATEC, Eurostat

We summarize this information for the European Union in Table 1 and distinguish between euro area and EU member states and also show data for some non-EU countries. In terms of relative competitiveness, i.e. in terms of the ratio of actual to equilibrium wages, Luxembourg in 2015 is the third most competitive economy in the euro area after Lithuania and Slovakia, although Luxembourg's equilibrium wage is by far the highest wage in the EU with nearly EUR 95,000 per annum. However, actual wages are EUR 29,610 below equilibrium, and German equilibrium wages are only half of Luxembourg's; in France they are even less. We also note that with the exception of the UK and Switzerland, all countries outside the euro area have wage levels below equilibrium, which implies that their return on capital is higher than in the euro area. This reflects the dissatisfactory developments in some Euro member states, especially in the south.

Table 1
Equilibrium wages and competitiveness: EU-wide comparison (EUR 000)

		Relative competitiveness			Equilibrium wages			Absolute competitiveness		
Area	**Country**	**1999**	**2007**	**2015**	**1999**	**2007**	**2015**	**1999**	**2007**	**2015**
EA	LTU	0.86	0.71	0.67	4.39	14.16	19.71	-0.62	-4.17	-6.55
EA	SVK	0.81	0.65	0.69	5.22	16.39	22.41	-1.01	-5.73	-7.04
EA	**LUX**	**0.71**	**0.72**	**0.69**	**57.71**	**75.95**	**94.89**	**-16.87**	**-20.97**	**-29.61**
EA	IRL	0.75	0.82	0.71	37.25	54.38	65.42	-9.30	-9.83	-19.30
EA	LVA	0.95	0.74	0.72	3.89	14.25	18.79	-0.18	-3.74	-5.26
EA	MLT	0.82	0.75	0.72	16.09	24.12	30.81	-2.95	-5.96	-8.47
EA	CYP	0.79	0.79	0.80	21.07	29.78	30.03	-4.46	-6.35	-6.05
EA	PRT	1.01	1.03	0.89	14.38	18.83	22.89	0.10	0.62	-2.60
EA	EST	0.82	0.80	0.90	5.67	15.81	19.57	-0.99	-3.20	-1.91
EA	DEU	1.09	1.00	0.97	28.13	33.41	40.80	2.64	0.03	-1.04
EA	NLD	1.03	0.98	0.97	29.95	40.18	46.65	0.86	-0.85	-1.19
EA	SVN	0.97	0.94	0.99	14.70	22.50	25.07	-0.44	-1.27	-0.21
EA	ITA	0.89	0.96	1.00	30.27	34.62	35.90	-3.39	-1.51	-0.15
EA	FIN	0.96	0.96	1.02	31.56	40.63	46.02	-1.25	-1.79	0.70
EA	ESP	1.00	1.09	1.03	21.95	26.08	30.93	0.04	2.35	0.92
EA	FRA	0.95	1.01	1.05	33.00	39.39	44.12	-1.60	0.36	2.14
EA	BEL	1.06	1.04	1.05	34.86	44.20	51.59	2.15	1.84	2.58
EA	AUT	1.11	1.05	1.07	28.13	35.46	40.83	2.97	1.65	2.87
EA	GRC	1.07	1.04	1.11	15.02	23.94	19.31	1.09	0.95	2.04
EU	HUN	0.63	0.60	0.55	8.84	20.31	21.24	-3.26	-8.11	-9.57
EU	POL	0.72	0.58	0.56	8.72	17.11	22.72	-2.48	-7.26	-9.91
EU	CZE	0.59	0.59	0.60	9.41	21.39	24.91	-3.85	-8.80	-10.05
EU	ROM	0.84	0.67	0.60	2.32	10.71	14.07	-0.37	-3.58	-5.66
EU	SWE	0.58	0.59	0.62	49.15	63.81	73.90	-20.85	-26.34	-28.02
EU	DNK	0.69	0.70	0.71	49.35	64.42	75.96	-15.10	-19.16	-22.23
EU	BGR	0.70	0.57	0.74	2.86	6.72	9.77	-0.86	-2.91	-2.50
EU	GBR	1.05	1.05	0.91	29.85	41.71	51.66	1.44	2.01	-4.59
Extra EU	NOR	0.65	0.55	0.61	52.35	95.38	103.21	-18.22	-43.26	-40.00
Extra EU	JPN	0.82	0.74	0.75	49.90	38.03	44.61	-8.77	-9.78	-11.13
Extra EU	USA	0.88	0.89	0.83	45.77	46.99	74.19	-5.32	-5.14	-12.66
Extra EU	CHE	1.17	1.09	1.07	37.29	45.11	74.23	6.32	4.13	5.45

Source: own elaboration on AMECO

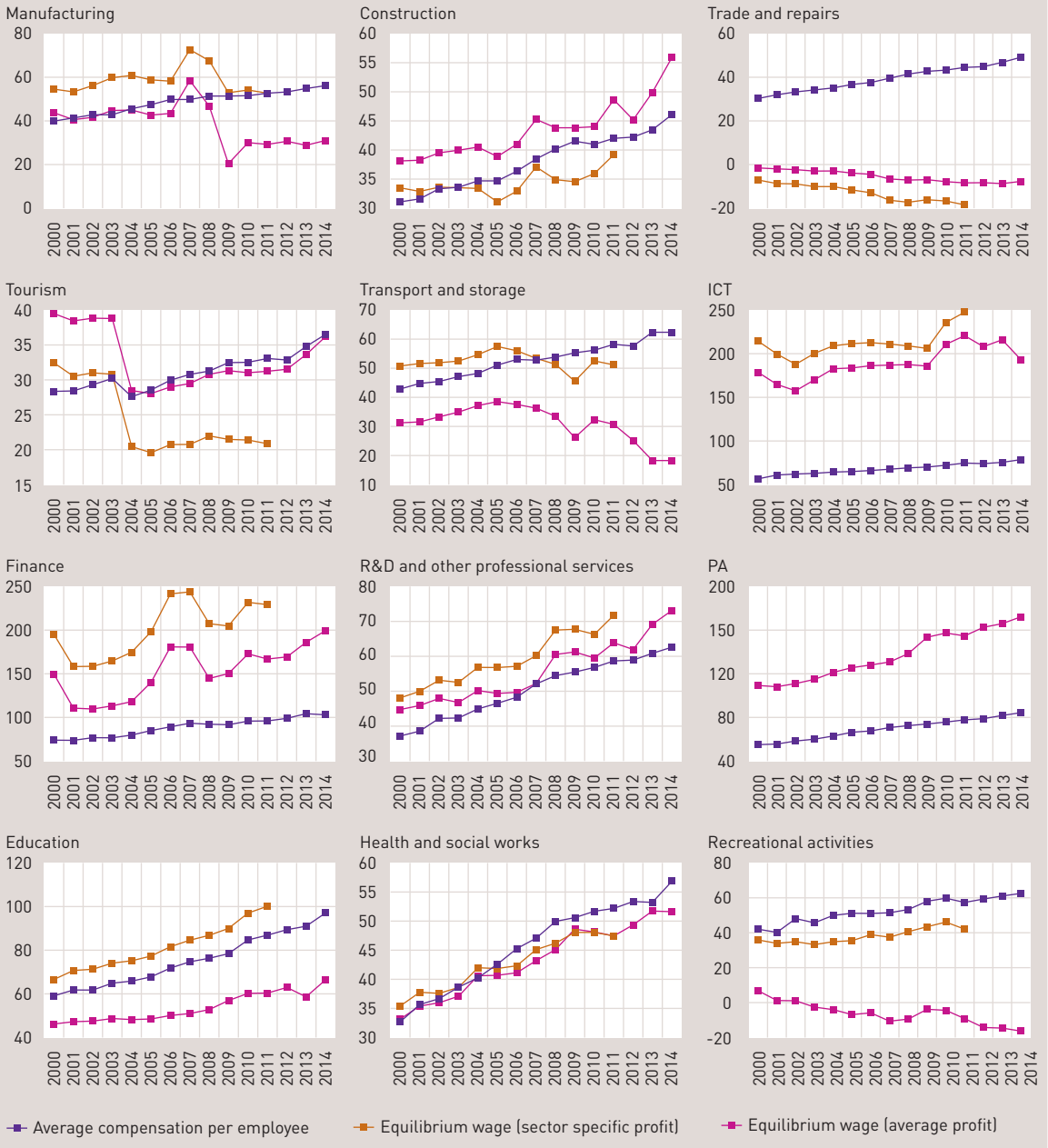
9.4 Sectoral breakdown

The fact that wage costs in the richest member state of the European Union are 30% below their equilibrium is remarkable. One way to explain it is to look at the sectoral distribution of competitive advantages. We calculate two measures for sectoral competitiveness. The first represents the ratio of actual wages of a sector to the equilibrium calculated on the basis of the European average capital efficiency (ACE) of the specific sector; the second is based on the benchmark of the average return on capital in the euro area as a whole, hence on European ACE for the total economy. The first measure indicates how competitive a country's industry is relative to the same industry in other member states. The second measure shows how far a particular sector deviates from the equilibrium in the euro area as a whole, all sectors taken together. For the sector specific measure, data stop in 2011 due to lack of sectoral data for the capital stock whereas the second measure, which uses the average capital stock for the total economy, data are provided for the years 2000-2014.

Chart 4 shows the sector breakdown of the two equilibrium measures and actual wage costs for 12 sectors in Luxembourg. When the orange line for the sector specific equilibrium wage stands above the pink average wage line, the sector is potentially more profitable than the average return of capital in the country, so that in equilibrium the sector can pay higher wages. The inverse is true if it is below the pink line. Such sectoral advantages can be observed in Manufacturing, Transport, ICT, Finance, Professional services, Education and Recreational activities. By contrast, Trade and Tourism are structurally handicapped sectors, where the low capital productivity would require low wages in equilibrium.

However, whether this potential is realised depends on the actual wages (purple line). We find that in Manufacturing, wages are in equilibrium with the industry at the European scale, but they are too high for Manufacturing yielding a return on capital comparable to the rest of the Luxembourg economy. This is so because the financial sector dominates the Luxembourg economy. Wages are also above equilibrium in Tourism and Transport. The sources of Luxembourg's competitiveness are clearly ICT, Finance, Professional Services and Public administration. In all these sectors actual wages are well below equilibrium, therefore yielding above average rates of return on capital for the economy as a whole. The opposite is true for Trade, Tourism, Transport, Health and social works and Recreational activities. However, because these sectors are relatively small, while Finance and related supportive services are important, the overall competitiveness effect is driven by the wage undervaluation in these sectors.

Chart 4
Luxembourg: actual and equilibrium wage



Source: own elaboration on STATEC, Eurostat

Table 2 gives further details. The three columns under "Relative competitiveness" show the ratio of actual to equilibrium wages; "Absolute competitiveness" shows the gap between actual and equilibrium wages in thousands of euros. We also show the weights of each sector in terms of employment and value added. The equilibrium wage varies enormously between different sectors, reflecting differences in productivity, as well as the sectoral shares in both employment and value added.[4] For example, in Tourism it is EUR 20,000 per year, but in finance nearly EUR 230,000. Disadvantages ranging between EUR 3,000 and EUR 15,000 exist for Health, Transport and storage, and Tourism, while the stronger advantages are in Finance (EUR 133,900 below equilibrium) and in ICT (EUR 174,000 below equilibrium).

Table 2
Equilibrium wages and competitiveness (sector specific return on capital)

	Relative competitiveness			Equilibrium wages			Absolute competitiveness			Empl. share	GDP share
	2000	2007	2011	2000	2007	2011	2000	2007	2011		
ICT	0.3	0.3	0.3	214	211	248	-159	-144	-174	3.8	10.1
Finance	0.4	0.4	0.4	195	244	229	-122	-151	-134	12.1	35.4
Professional services	0.8	0.9	0.8	48.0	60.0	71.8	-11.0	-8.0	-13.2	13.3	9.8
Education	0.9	0.9	0.9	66.7	84.6	100	-7.6	-9.9	-13.2	4.5	3.9
Manufacturing	0.7	0.7	1.0	54.7	72.9	52.8	-14.8	-23.0	-0.1	10.1	7.3
Construction	0.9	1.0	1.1	33.4	37.0	39.1	-2.4	1.5	2.8	10.9	5.8
Transport and storage	0.8	1.0	1.1	50.9	53.4	51.1	-8.0	-0.5	7.2	6.6	4.7
Health and social works	0.9	1.0	1.1	39.4	47.6	49.6	-2.3	1.6	4.0	8.4	5.1
Recreative activities	1.2	1.4	1.4	36.0	37.3	42.1	5.9	14.1	15.3	0.9	0.7
Tourism	0.9	1.5	1.6	32.4	20.7	20.8	-4.1	10.0	12.3	4.7	2.1
Trade and repairs	-4.2	-2.4	-2.4	-7.3	-16.5	-18.8	37.6	56.1	63.3	12.9	0.9

Source: own elaboration on STATEC, Eurostat. Note: employment and GDP shares are calculated as averages over 2000-2011

Table 3 indicates the competitiveness gaps with respect to an equilibrium wage that would yield the same rate of return on capital as the aggregate of these sectors in the euro area. The ranking of sectors according to the absolute competitive gap is fairly unchanged.

[4] Tables 2 and 3 show the most relevant sectors. In table A1 and A2 in the Appendix, we show data for some manufacturing industries. Due to the small number of firms and the low share in both employment and value added, data for these sectors are not reliable. Further, for Trade and repairs, equilibrium wages are negative due to the excessive difference between Luxembourg ACE and the EA ACE. Such distortions are likely to be the result of a small number of SMEs, which do not easily compare with large and capital intensive companies in other countries.

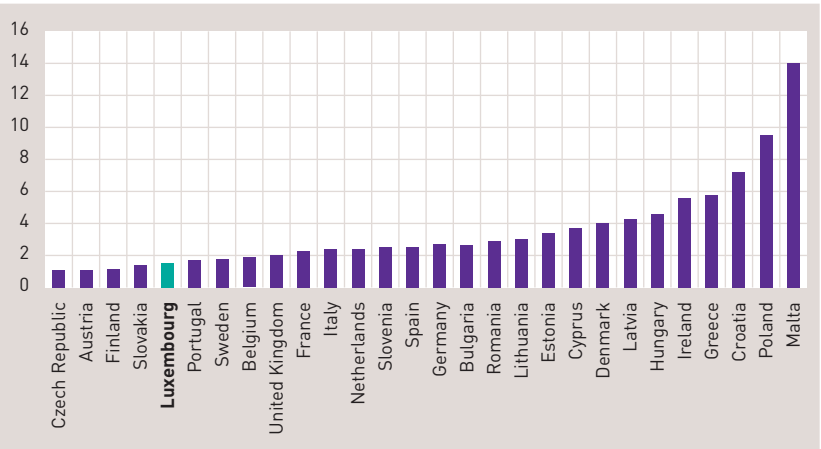
Table 3
Equilibrium wages and competitiveness (average return on capital)

	Relative competitiveness				Equilibrium wages				Absolute competitiveness			
	2000	2007	2011	2014	2000	2007	2011	2014	2000	2007	2011	2014
ICT	0.3	0.4	0.3	0.4	178.6	187.3	221.0	193.5	-122.8	-120.1	-147.0	-115.4
Finance	0.5	0.5	0.6	0.5	149.7	180.5	166.8	199.1	-76.2	-87.5	-71.1	-96.4
Public Administration	0.5	0.5	0.5	0.5	109.1	130.7	154.7	172.3	-54.4	-60.3	-77.4	-88.1
Construction	0.8	0.8	0.9	0.8	38.1	45.3	48.7	56.0	-7.1	-6.8	-6.8	-9.9
Professional services	0.8	1.0	0.9	0.9	44.6	52.2	63.8	73.1	-7.6	-0.2	-5.2	-10.5
Recreative activities	0.8	0.9	1.0	0.9	51.5	60.5	62.4	68.7	-8.5	-5.5	-2.7	-4.0
Tourism	0.7	1.0	1.1	1.0	39.5	29.5	31.3	36.2	-11.2	1.3	1.8	0.3
Health and social works	1.0	1.1	1.1	1.1	37.6	46.0	49.5	53.1	-0.4	3.3	4.0	4.3
Education	1.3	1.5	1.4	1.5	46.0	50.7	60.2	66.4	13.1	24.0	26.7	30.9
Manufacturing	0.9	0.9	1.8	1.8	43.7	58.6	29.2	30.8	-3.8	-8.7	23.5	25.5
Transport and storage	1.4	1.5	1.9	3.5	31.1	36.2	30.4	18.1	11.8	16.6	27.9	44.4
Trade and repairs	-18.9	-5.5	-5.0	-6.2	-1.6	-6.8	-8.6	-7.9	31.9	44.5	52.0	57.3

Source: own elaboration on STATEC, Eurostat

The variation of relative capital efficiency – and not nominal wages – determines the sectoral differences in equilibrium wages. This is clear when we look at the coefficient of variation for actual wage compensation across Europe. See Chart 5. Luxembourg has one of the most homogenous sectoral wage distributions, while the equilibrium wages vary substantially because they reflect differences in capital productivity. It is remarkable that this wage homogeneity is not the consequence of centralised wage bargaining in Luxembourg, but it is probably due to a relatively high degree of social consensus. This generates sectoral rents that affect the overall aggregate competitiveness position of Luxembourg.

Chart 5
Coefficient of variation in wages' growth across 64 industries (average 2000-2014)

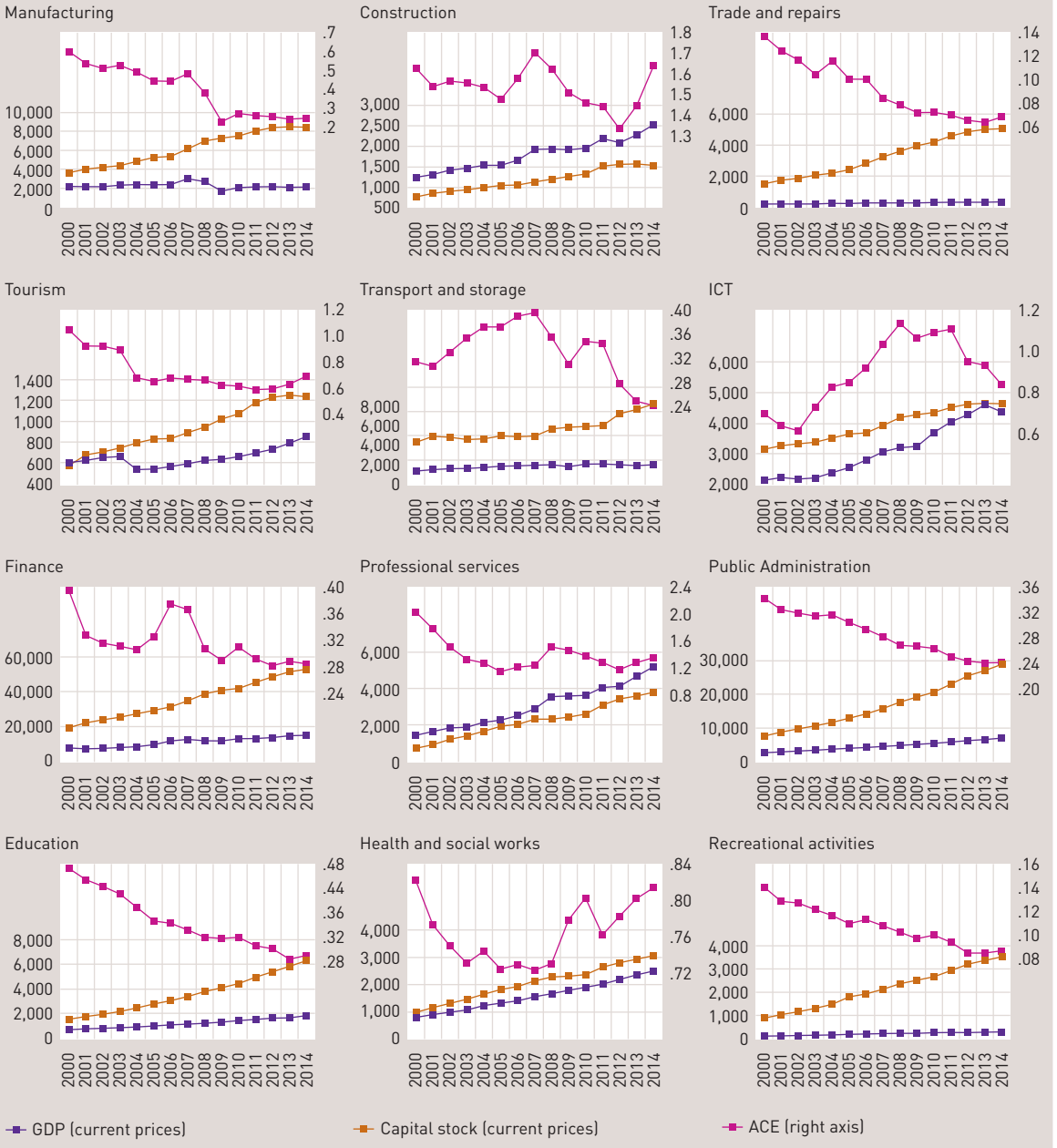


Source: own elaboration on STATEC, Eurostat

Chart 6 shows the components of Luxembourg's sectoral equilibrium wages. The average capital efficiency has remained stagnant (Construction, Trade, Finance, Tourism, Health) or fallen (Manufacturing, Transport and Storage, Recreational Activities); it has only increased in ITC and Transport before the financial crisis. However, the sectors where ACE has fallen most are less important as a share of the total, so that the aggregate competitiveness has remained fairly stable. The deterioration in ACE is due to the fact that the growth of output has been less rapid than the accumulation of capital in all sectors except in Construction, R&D and ICT.

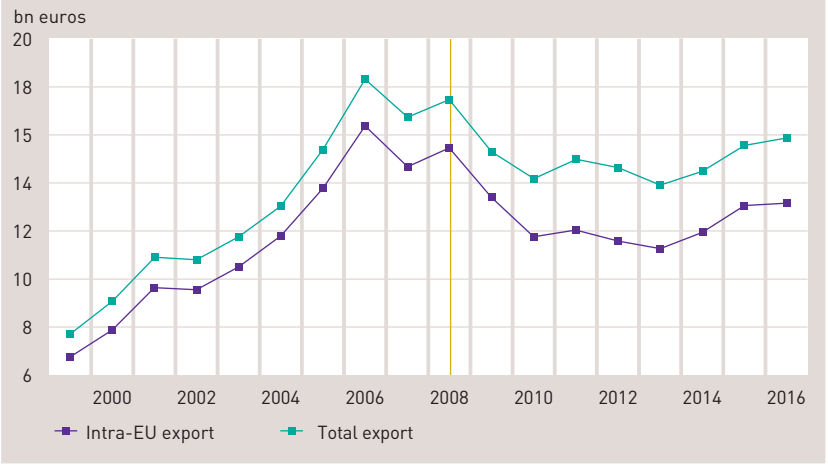
Nevertheless, the manufacturing sector experienced a significant drop in average capital efficiency after the financial crisis and during the euro crisis. This is primarily caused by the stagnation of demand. Given the small size of Luxembourg, this demand deficiency reflects lower exports to the neighbours in the euro area. Chart 7 shows the collapse of exports of goods after the financial crisis and its acceleration during the euro crisis; it is also evident that the drop of exports was more pronounced for intra-EU trade than for overall exports.

Chart 6
Domestic components of equilibrium wages



Source: own elaboration on STATEC, Eurostat

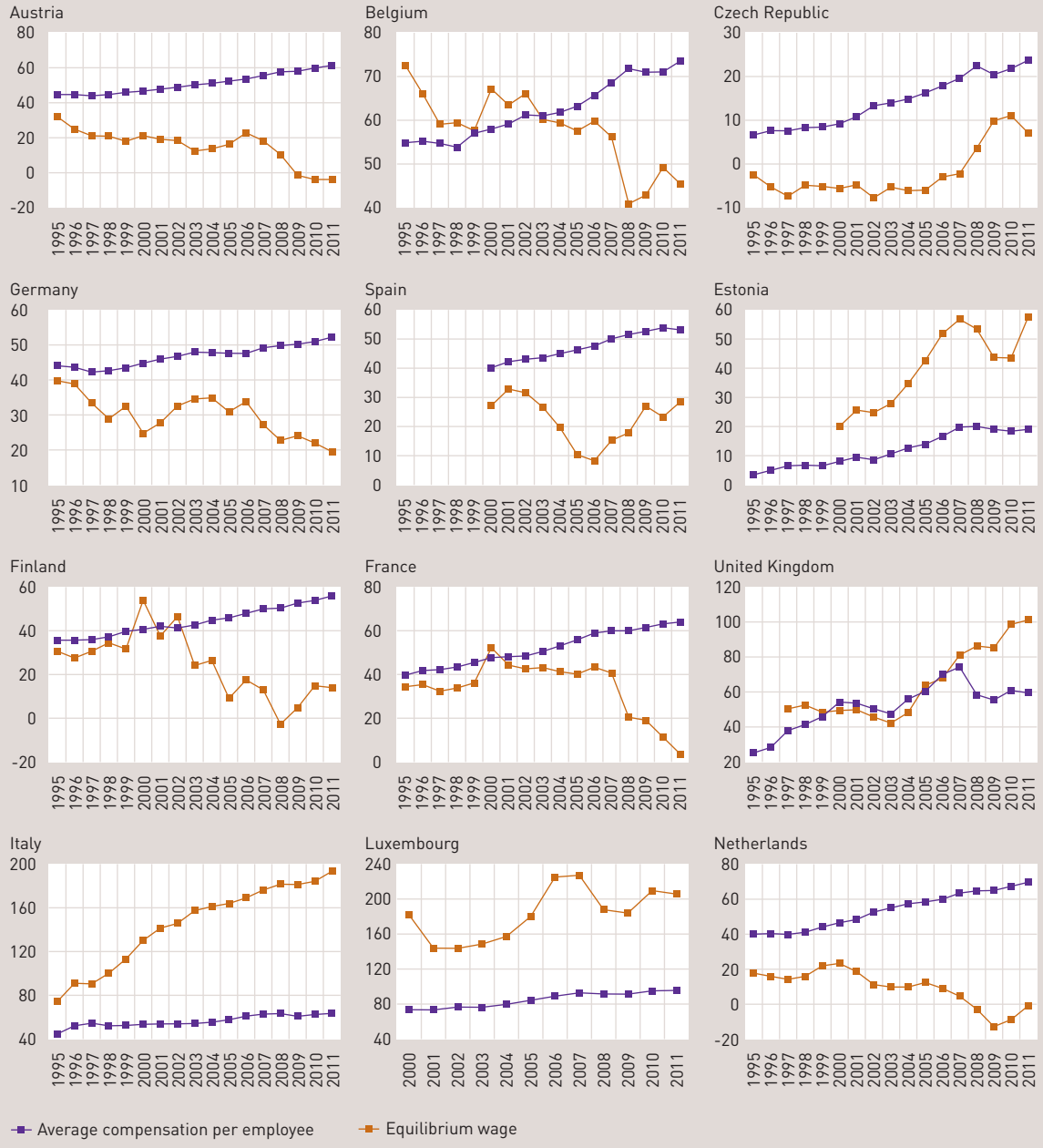
Chart 7
Luxembourg exports



Source: Ameco

Finally, given the importance of the financial sector for the Luxembourg economy, we present in Chart 8 the actual and the sectoral equilibrium wages for the financial sectors in 12 member states. Other than Luxembourg, only Estonia and Italy, and in recent years the UK, have comparative advantages; in all other countries actual wages in the financial sector are higher than equilibrium, therefore yielding below average returns. The competitiveness in Luxembourg is the second highest in Europe, after Italy.

Chart 8
Competitiveness in the financial sector



Source: own elaboration on STATEC, Eurostat

9.5 Conclusions

Our novel methodology to measure competitiveness of wage levels by taking the return on capital as the benchmark permits interesting insights. In general, Luxembourg has a significant comparative advantage which means that the average capital stock in this country yields a return that is higher than the average of the euro area. However, disaggregating into sectors reveals that this is largely due to the important role of the financial sector and its support services (ICT and professional services) and because the public administration is efficient. Finance, ICT and Professional services represent 29.2 percent of employment and 55.3 percent of GDP. However, other service sectors like Tourism, Recreational Activities and Health and social works are not competitive. Given that these are mainly businesses in the non-tradable sector, the wage costs in these sectors give less cause for concern from the point of view of trade, but they are less attractive for investment.

The financial sector dominates the economy with high rates of return. In principle, wages in this sector could be EUR 100,000 p. a. higher without losing competitiveness. However, this would greatly increase the inequality in wages across the economy. Luxembourg has a remarkable homogeneity in wage costs, even though there is no centralized wage bargaining procedure. This homogeneity generates profitable rents for some sectors, and in particular for the financial sector, which are likely to attract more investment. These advantages sustain general welfare, although they distort the economy. This seems to be a model that works well for Luxembourg, although it is hardly possible to copy it in less prosperous countries.

The high wage undervaluation in the (broad) financial sector (i.e. a much higher return on capital than the average for the EU) might be due to the fact that many financial corporation have their headquarter in Luxembourg, which generates a high level of value added (and hence labour productivity), but it may also be the result of profit transfers from other countries together with the fact that employment is mainly made of workers at the top of the skill classification (some of which may not even live in Luxembourg). This means that the competitiveness indicator might be upward biased for this sector, with obvious consequences on the assessment for the country as a whole.

Manufacturing and some non-tradable services are overvalued and relatively uncompetitive with respect to Luxembourg as a whole, but not with respect to manufacturing in other euro area member states. As a small country, Luxembourg is an open economy and it is therefore negatively affected by austerity and lack of demand in neighbouring countries. Competitiveness in this sector would require increasing productivity which means slowing down capital accumulation when output is demand restrained.

As for services, in Transport and Recreational activities the competitive loss is due to a fall of equilibrium wages, which, as in the case of manufacturing, is mostly due to an excessive speed of capital accumulation with respect to less pronounced GDP growth. It appears that capital accumulation has made these sectors more modern without, however, improving productivity. This would require further analysis, for it is not clear to us what drives the rapid capital accumulation in the Luxembourg economy.

Finally, the data for Trade and repairs seem strange and indicate the limitations of our methodology. From equation (5) we know that when the capital productivity (ACE) in a country's sector is significantly lower than in the euro area as a whole, the equilibrium wage can turn negative. For large countries with many large firms this is not a problem as the averages of ACE are relatively comparable and consistent. However, given the small number of firms in some of Luxembourg's industrial sectors with very specific production methods, the sectoral capital productivity is not fully comparable with the euro area averages. For this reason, we have shown small sectors in the Annex and not in the main text.

The competitive performance of Luxembourg is typical for the model of Rhineland Capitalism or Coordinated Market Economy (Hall, Peter A. and David Soskice, 2001): wage spreads are relatively low, which leads to large productivity rents in the successful sectors and a wide spread in rates of return on capital. This is the opposite of the liberal market economy model in Anglo-Saxon countries, where high wage spreads are acceptable, but capital markets eliminate excess returns and innovation rents.

We would therefore like to raise some policy relevant questions, which transcend the analytic part of our report.

- To what degree does the excessive weight of the financial sector pose risks for the future? Luxembourg has been extremely successful in watering the Global Financial Crisis, but there is no guarantee that Luxembourg's financial industry will always remain on the winning side. Italy is an example for a country where serious banking problems have appeared despite very high wage competitiveness in the financial sector. Diversification is usually thought of as a matter of prudence.

- Attempts to diversify the Luxembourg economy are handicapped by the excess returns on capital in the financial and related sectors, because other sectors like manufacturing or construction are less attractive to investors. Should this lead to a more "liberal" model whereby higher wage spreads are socially accepted, or should one use taxes and subsidies to rebalance the returns on capital?

- What could be done to improve the productivity of capital outside the financial and ICT sectors? One of the main features of Luxembourg's competitiveness disadvantages is rapid capital accumulation with diminishing returns. This feature was also observed, although to a different degree, in the Southern European economies before the crisis. The driver of this process was catch-up growth in the south, but this is clearly not applicable to Luxembourg.

These questions require political answers.

9.6 Annex - Equilibrium wages for selected manufacturing industries and Trade and repairs.

Table A1
Equilibrium wages and competitiveness (sector specific return on capital): unreliable data

	Relative competitiveness			Equilibrium wages			Absolute competitiveness			Empl. share	GDP share
	2000	2007	2011	2000	2007	2011	2000	2007	2011		
Transport equipment	0.5	0.3	0.3	68.7	131.3	122.0	-33.0	-94.2	-80.4	0.1	0.1
Chemicals	0.5	0.8	0.6	80.1	62.2	78.4	-42.1	-12.8	-34.9	0.3	0.3
Plastics and minerals	0.6	0.8	1.1	69.1	65.6	49.8	-24.5	-14.0	7.1	2.1	1.7
Metals	0.9	0.7	2.3	44.8	83.4	25.1	-2.7	-25.3	33.1	2.9	2.0
Trade and repairs	-4.2	-2.4	-2.4	-7.3	-16.5	-18.8	37.6	56.1	63.3	12.9	0.9

Source: own elaboration on STATEC, Eurostat

Table A2
Equilibrium wages and competitiveness (average return on capital): unreliable data

	Relative competitiveness				Equilibrium wages				Absolute competitiveness				Empl. share	GDP share
	2000	2007	2011	2014	2000	2007	2011	2014	2000	2007	2011	2014		
Transport equipment	1.8	0.5	0.7	0.5	20.0	75.8	60.7	85.1	15.7	-38.7	-19.0	-40.6	0.1	0.1
Wood, paper, printing	1.0	1.3	1.6	1.3	36.7	33.9	32.3	41.1	0.3	10.0	18.5	12.2	0.64	0.45
Textiles	0.4	0.6	0.9	1.4	145.4	88.7	74.5	51.1	-83.6	-33.9	-8.3	20.3	1.49	n.a.
Chemicals	0.7	1.9	1.5	1.5	55.0	25.6	29.0	32.1	-17.0	23.8	14.5	15.6	0.3	0.3
Plastics and minerals	0.8	1.1	2.6	2.1	56.9	48.4	21.6	27.8	-12.3	3.2	35.3	31.9	2.1	1.7
Metals	1.1	0.7	5.8	52.3	37.8	82.9	10.1	1.2	4.3	-24.9	48.1	63.6	2.9	2.0
Trade and repairs	-18.9	-5.5	-5.0	-6.2	-1.6	-6.8	-8.6	-7.9	31.9	44.5	52.0	57.3	12.9	0.9

9.7 Works Cited

COMMISSION, E. (2005)
Communication To The Spring European Council: Working together for growth and jobs. Brussels. Retrieved 03 01, 2012, from http://europa.eu.int/growthandjobs/

HALL, PETER A. UND DAVID SOSKICE. (2001)
Hall, Peter A. und David Soskice (2001) Varieties of Capitalism: The Institutional Foundations of Comparative Advantage. Oxford: Oxford University Press.

KOLL, W. (2005)
Macroeconomic Dialogue development and intentions. In S. a. Hein, Macroeconomic policy coordination in Europe and the role of the trade unions (pp. 175–212.). ETUI and WSI.

STOCKHAMMER, E. (2015, APRIL)
Wage-led Growth.

10 Appendix Competitiveness Scoreboard Definitions

A Macroeconomic performance

A stable macroeconomic environment is a guarantee for high economic performance. The principal role of the State in establishing this type of environment is to guarantee superior and stable levels of economic growth and employment. An economic policy is adequate when it encourages companies to invest in the short and medium term and, if productivity and economic growth are stimulated, over the long term. An unstable economic environment dissuades private investment and limits economic growth, thus restricting well-being of a country's population. A stable macroeconomic setting is a necessary condition for good productivity trends, and consequently for competitiveness. Macroeconomic performance indicators are the key indicators for determining the role of economic policy with relation to the competitiveness of a nation.

A1 Gross National Income per inhabitant

Gross National Income (GNI) is the Gross Domestic Product (GDP) plus net receipts of primary incomes, less income paid out. The level of GDP per inhabitant is often absorbed into a standard of living indicator. However, in the case of Luxembourg, which is largely open to cross-border flows of factors and corresponding incomes, this notion leads to biased comparisons. For this reason, it is preferable to base comparisons on GNI per inhabitant, which take into account the remuneration of labour and capital of all others. Comparisons are made in PPS to account for the different pricing between countries. The principal role of the State is to increase the well-being of the population. GNI is one measure of well-being and is used in comparisons over time and among countries.

A2 Real growth rate of GDP

GDP is a measure of economic activity. It is defined as the sum of added values, meaning the value of all goods and services produced from which are deducted the value of goods and services used to create them. Growth rates are calculated at constant prices because this way it is possible to identify high volume movements and thus obtain an indication of real growth. Calculating yearly rates of GDP growth at constant prices is intended to allow comparisons of economic development dynamics both over time and between different sized economies.

A3 Growth in domestic employment

National employment represents the labour force used by companies established in Luxembourg to produce their range of goods and services. As such, it includes cross-border workers' production and excludes that of residents who work abroad. This indicator reflects utilization of labour. National employment includes all persons working on Luxembourg territory regardless of country of residence. Its growth rate reflects the capacity of a country to utilize additional resource to meet increases in the demand of goods and services. GDP potential of a country can be impacted if there is a structural increase in employment, which can reflect an economy's gains in competitiveness.

A4 Unemployment rate

The unemployment rate is the percentage of unemployed persons with relation to the entire labour force. The labour force is comprised of employed and unemployed persons. Unemployed persons are 'those persons aged between 15 and 64 who, during a reference week had no employment, who were available to start work as a salaried or unsalaried employee within the next two weeks and had actively sought employment through specific steps to find a salaried or unsalaried position within four weeks ending at the end of the reference week. It also includes those who had no job but who had found one to start later, meaning within a period of no greater than three months.' Social consequences of high unemployment aside, the rate of unemployment is a measure of unutilized labour potential of a country. A distinction is commonly drawn between two major categories of unemployment. The first arises from a deficiency of overall demand and the second is a result of features in the way the labour market functions. While the first type of unemployment may reduced by recovery in the economy, the second is due to structural factors, such as inadequate skills of the workforce or the cost of labour. The unemployment rate is an important measure of the efficiency of the labour market, and is telling of the adequacy of supply to the demand for work.

A5 Inflation rate

The Harmonized Consumer Price Index (HCPI) was conceived as a means of international comparison of inflation in consumer prices. Inflation reflects tensions between supply and demand. Inflation can have its origins in salaries that reflect the tensions between supply and demand on the labour market, but it is often imported. This imported component is an extremely important aspect because Luxembourg has a very open economy. Thus imported inflation can have an impact on consumer prices, either directly via the importing of consumer goods or indirectly via the production chain. In the area of competitiveness, all inflationary trends have a repercussion on the terms of trade.

A6 Public balance

The requirement or capacity for financing, i.e. a deficit or surplus in public administrations, is the difference between income and expenditures of public administrations. The public administration sector includes sub segments of the central administration, the administrations of Federated States, local municipality administrations and social security administrations. For purposes of international comparisons, public balances are expressed with relation to GDP at market prices. Successive deficits have a significant impact on public debt and therefore on a nation's budgetary margin of manoeuvre.

A7 Public debt

The public sector includes sub segments of the central administration, the administrations of Federated States, local municipality administrations and social security administrations. GDP used as the denominator is gross domestic product at market prices. Debt is evaluated at nominal face value and debt in foreign currency is converted into the national currency using end of year commercial exchange rates. National data for the public sector is consolidated among sub segments. Base data are in the national currency, converted into Euros by using the end of year exchange rate for the euro. The debt ratio gives an estimate of public debt as a whole with relation to gross domestic product, as well as debt servicing capacity and the repayment capacity of public administrations. This indicator plays an important role in the area of competitiveness since it determines the budgetary margin of manoeuvre of the State in its operations.

A8 Gross fixed capital formation

In the European System of Accounts SEC 95, gross fixed capital formation is equal to acquisitions less sales of fixed assets by resident producers over a reference period, augmented by capital gains of non-produced assets arising from production activities of production or institutional entities. Public investments are used to create, enlarge and modernize infrastructure necessary to growth. High quality public infrastructure promotes growth and productivity of companies and bolsters their competitive positions.

A9 Terms of trade

The terms of trade indicator relates the export price index of a country to its import price index. Terms of trade improve over time from T>100 if an economy exports a lesser quantity of merchandise to procure the same quantity of imported goods—in other words, a like quantity of exported goods can procure a larger quantity of imported goods. In the opposite case, terms of trade deteriorate to T<100.

A10 Real effective exchange rate

Calculations of the real effective exchange rate use a weighting system based on a double weighting principle that accounts for relative market share held by a given country's competitors on shared markets, including the domestic market of the given country, as well as the significance of these markets to that given country. A decrease in the real effective exchange rate indicates an improvement in a country's competitive position. Real effective exchange rates are chain indices with the base year as 1995. Percent change in the index is calculated by comparing changes in the index based on consumer prices in a given country, expressed in US dollars at the market exchange rate, to a weighted average of changes in indices of competitor countries, also expressed in US dollars, using the weighting matrix for the current year. Real effective exchange rate indices are then calculated from an initial period by cumulating percentages of change. This produces a group of real effective exchange rate indices based on mobile weightings. The base year used for these calculations is 1995. A drop in REER indicates that domestic goods and services have become more competitive in relation to foreign goods and services, while an increase indicates that they are less competitive.

A11 Diversification

The entropy indicator used here refers to the level of an economy's diversification through its weight of diverse branches in gross added value. The branches are those in the NACE-10 classification system as follows: Agriculture, forestry and fishing; Manufacturing (except Construction); Construction; Wholesale and retail trade, transportation, accommodation and food service activities; Information and communication; Financial and insurance activities; Real estate activities; Professional, scientific and technical activities; Administrative and support service activities; Public administration, defence, compulsory social security, education, human health and social work activities; Arts, entertainment and recreation; Other services activities; Activities of households and of extraterritorial organisations and bodies. Where distribution is uniform, the entropy coefficient has a maximum value of 1, whereas if everything is concentrated on one point, the entropy coefficient has a value of 0. The closer a value nears 0, the less diversified is the economy. The more an economy is diversified, meaning the lower its dependence on a specific sector, the more sheltered it is from asymmetrical shock. Thus, all things else being equal, the advantage of a diversified economy is that it reduces vulnerability to specific sector-related shocks that could put the entire macroeconomic system's stability at risk.

A12 FDI inflows and outflows

Foreign direct investment (FDI) designates those investments by a resident entity of a given economy, a direct investor, made with the objective of acquiring a lasting stake in a company that is established in another economy. FDI flows are the sum of the following elements: capital contributions by the direct investor through purchases of stock, shares, capital increases or company start-ups, loans between the direct investor and the company targeted by the direct investment and income re-invested to or from abroad. While direct investment inflows can create new jobs, investment outflows eliminate them, especially in the case of relocations to take advantage of lower production costs. Yet these flows can indicate the expertise of Luxembourg's companies. The net balance of jobs lost or created cannot be determined in such a simplistic manner. One must take account of the indirect repercussions of FDI on employment, especially via international exchanges. The complementary nature between FDI and international exchanges that has come to light through certain studies foreshadows indirect impacts on jobs. FDI inflows and outflows can impact Luxembourg imports of finished products originating with a foreign subsidy or from a third country or company, and exert an impact on Luxembourg exports of primary or intermediate goods to a foreign subsidiary or a third country or company. Implications on domestic employment or on the economy as a whole must then be evaluated. However, Luxembourg must be considered from the perspective of an economy that acts as a platform for international financial intermediation services. FDI statistics for Luxembourg show that the essential feature of its economy is that surplus funds are collected from non-resident entities, which are then distributed, to non-resident entities in deficit or that are seeking financing. In other words, Luxembourg's FDI inflows are reinvested abroad, with the greater majority passing through specialized financial institutions such as holding companies or SOPARFI, financial auxiliaries or other financial intermediaries (see BCL, 2004). This choice place for Luxembourg among the international FDI flows is immediately apparent through the preponderance of SPE transactions. In addition, the FDI flows in terms of SPE are part of multinational corporations' strategic plans that aim to optimally utilize the differences between countries in the areas of financial infrastructure, institutional vehicles and fiscal regimes. As a result, FDI statistics for Luxembourg must be approached with care when compared to international statistics. EUROSTAT calculated a 'Market integration' indicator that measures the intensity of direct foreign investments by taking the average of direct foreign investment inflows and outflows divided by GDP, then multiplied by 100.

B Employment

Employment is a determinant of the efficiency of a socio-economic system and therefore can be considered an important indicator for competitiveness. Some indicators from the Employment category are already present in the Macroeconomic Performance category. Indeed, employment and unemployment are macroeconomic indicators. However, under-utilization of human resources, especially in the long term, is not only a formula for unfavourable economic consequences but can also sap the vitality of social cohesion, for example, by increasing the risk of poverty. This category of indicators is particularly important in view of the high rate of unemployment in Europe and the structural difficulties of European countries in achieving full employment. A growing part of unemployment is arising from structural problems in the labour market, such as inadequate qualifications for jobs or long periods of inactivity.

B1 B2 B3 Employment rate (T, H, F)

The employment rate is defined as the relationship between the population with a job and the entire working age population of persons between the ages of 15-64. Since this is a national concept, it takes into account only the resident population. The employment rate is an important indicator for measuring the gap between the performances of an economy in relation to its potential. It provides a good explanation for the growth differential between one country and another. A rising employment rate is a key factor in achieving improvements in standards of living. In the same way, an increase in the employment rate means new job creation, vitality within the economy and flexibility in its labour market. Furthermore, the employment rate is an important factor in maintaining social protection systems in the long term. This indicator has been integrated into the Lisbon strategy (target of 70% in 2010 and an employment rate of 60% for women). Since then, in the Europe 2020 strategy, the age range of 20-64 is considered in order to reduce potential conflicts between employment policies and education policies. The Luxembourg target is 73% by 2020 (71.5% by 2015).

B4 B5 B6 Employment rate of persons aged 55-64 (T, H, F)

The rate of employment of persons aged 55-64 is obtained by comparing the number of persons employed in that age group to the overall population of people of this segment. The working population of this age group includes persons who, during a reference week, performed work for remuneration or profit for at least one hour, or who did not work but had a job from which they were temporarily absent. A high employment rate of persons aged 55-64 is an important factor of competitiveness in many domains. Notably, it is a determinant for the viability of general pension insurance schemes in the long term, especially given the aging of Europe's population. According to the Lisbon Strategy, the objective is to achieve an employment rate of 50% among persons aged 55-64 by 2010.

B7 Unemployment rate of persons under 25

The unemployment rate of persons under 25, unadjusted for seasonal variations, represents the percentage of unemployed persons between the ages of 15 and 24 with relation to the active reference population, this being the total number of persons with a job and the number of unemployed persons in this age range. During the Luxembourg Employment Summit of November 1997, from which emerged the European employment strategy, the EU decided that each young European should have the opportunity to work, to complete a training program or retrain for a new job before being unemployed for a period of six months. In addition, it was stated that young people should learn and develop a culture of entrepreneurship and develop the ability to adapt more rapidly to changing realities in the labour market. The unemployment rate of persons under 25 is a means of evaluating the results of efforts undertaken to date in achieving the objectives of the 1997 Summit. It is among young people that unemployment, and chiefly long-term unemployment, can produce harmful consequences that can cause them to be excluded from the labour market permanently, thus depriving the country of human resources.

B8 Long-term unemployment rate

EUROSTAT deems that a long-term unemployed person is one who has been without work for more that twelve months, is at least fifteen years old, does not live in a collective household, has not been employed for two weeks following the reference period, is available to begin work in the next two weeks and is actively seeking a job, meaning that the person has actively sought work over the four previous weeks or is not seeking work because he or she has found it and will begin to work later. Social consequence of high unemployment rates aside, the unemployment rate is a measure of unutilized labour potential of a country. Long-term unemployment depends above all on structural factors, such as inadequate skills of the workforce or the cost of labour. In addition, long-term inactivity not only gives rise to unfavourable economic consequences but it risks weakening social cohesion.

B9 Persons holding a part-time job

The definition of persons with jobs designates those persons who, during a reference week, performed work for remuneration or profit during at least one hour, or who did not work but had a job from which they were temporarily absent. Family workers are included under this heading. A distinction is drawn between full time and part time work based on spontaneous responses of persons surveyed. It is impossible to make a more precise distinction between full and part time work because of differences in working hours among Member States and the professional sectors. The choice of whether work is part time may be decided on the initiative of an employer or an employee. Part time work is supposed to render work schedules more flexible. Working time will be more flexible if it varies as a function of company requirements and the wishes of workers. Improving flexibility of working hours can contribute greatly to lowering unemployment and, more generally, to improving the employment rate. Nevertheless, when workers are obliged to take part time work it may be considered an indicator of under-utilization of available resources.

C Productivity and labor costs

The cost of the factors of production, especially the cost of labour, is a key component of nation competitiveness. The cost competitiveness component is the one most readily cited in comparisons of national economies because of its size and simplicity. Nevertheless, costs should not be considered separate from productivity. Increasing domestic productivity is one of the areas in which economic policies can influence the macroeconomic competitiveness of a country by stimulating economic growth in the medium and long term.

C1 Trends in total factor productivity

Total factor productivity (TFP) is defined as the overall efficiency with which the factors of production, work and capital, are transformed into products. Changes in this indicator are measured over time by the average annual rate of change. An increase in TFP can spark increased competitiveness and may be interpreted in two ways; either in terms of an increase in production for a given utilization of factors, or in terms of lowered costs for a given production operation. A drop in TFP does indicate a loss of competitiveness.

C2 Trends in apparent work productivity

The average annual rate of change in apparent work productivity links changes in volumes of gross added value production of a given year for the preceding year with changes over the same period in the number of hours worked. Changes in the productivity of work measure the change of production per worker over successive units of time. When progress is achieved in this area, it results either from more intensive use of capital, the introduction of technology or an improvement in an entity's work plan. Productivity is an essential factor in standard of living as evinced through GNI per inhabitant, and by cost competitiveness through its influence on unit labour costs. Changes in labour productivity provide a standard of measurement for evaluating possible changes in the cost of labour. Increases in the apparent productivity of work can bring on an improvement in competitiveness, while a drop in this indicator could result in a loss of competitiveness.

C3 Productivity per hour worked as a percentage of US figures

This indicator measures the hourly productivity of work with relation to the levels achieved in the United States, which is the benchmark having a nominal value of 100. The differences among countries in the area of hourly productivity reflect existing structural differences such as part time work, standard number of hours worked weekly and the number of paid holidays per year. Over recent years, the United States has been considered the benchmark for numerous macroeconomic indicators in view of the high performance that has been achieved in numerous domains. Nonetheless, this indicator should be compared using like conditions in terms of employment and unemployment rates. Indeed, by eliminating the least productive workers from the labour market, hourly productivity will increase. The United States has an employment rate much higher Europe's leaders—who moreover have high unemployment rates shorter work hours—thus avoiding losing the benefit of economies of scale.

C4 Changes in unit labour costs

The unit labour cost (ULC) represents the cost of labour per unit of added value produced. It is determined by the relationship between payroll coasts and added value at market prices. It should be noted that the indicator for unit labour costs includes two different aspects of competitiveness to be distinguished between: cost of wages and apparent work productivity. Thus, an increase in ULC can result in higher wages or a drop in productivity. In order to evaluate cost competitiveness, it is not sufficient to compare salaries and payroll deductions; changes in these elements must be monitored over time. Thus comparing increases in labour costs over time provides a supplementary indication of changes in the competitive position of an economy. If changes in wages are not compensated by a change in levels of productivity, unit labour costs rise, causing competitiveness to fall.

C5 Costs/Revenue ratio in the banking sector (removed from Competitiveness Scoreboard)

This indicator is defined as the relationship between total costs incurred in the banking sector—to include personnel costs, administrative costs and depreciation—and banking income, including income from interest charges, commissions and financial transactions. Taxes on banking sector operations are included in this ratio that is also linked to consolidated revenue. This indicator gives information about the relationship between expenses and income in the banking sector, i.e. operating expenses as a percentage of operating income. It is useful to monitor this ratio over time in order to analyze profitability of the banking sector. This is especially the case for Luxembourg's economy, which is dominated by the banking sector. Thus, this sector indicator can be considered as a competitiveness indicator for the Luxembourg economy.

D Market operations

The purpose of this category is to illustrate the potential rigidities and constraints that could still exist in some markets. Indeed, many opportunities remain to be exploited in various domains of the economy that can make companies more competitive, especially involving markets for intermediate consumer products, that thus directly influence cost competitiveness of companies. Studies on the determinants of productivity growth underscore the role of market operations. Improvements in the way markets function generally lead to increases in the quality of goods and services, to economic growth and to competitiveness and job creation. In this respect, implementing the Lisbon agenda is of primordial importance. In fact, it is a means of liberating the full potential of growth and job creation.

D1 Percentage of full-time workers on minimum wage (removed from Competitiveness Scoreboard)

The minimum wage in effect is the social minimum monthly wage for labour and it is based on legal figures published monthly on the national level. Minimum wages apply to the majority of full-time salaries throughout each nation's territorial holdings. Other minimum wages may be applicable to certain categories that take into account a recipient's age, seniority, skill set and physical/mental capabilities or the economic situation of the company. The minimum wage is a gross sum, meaning the amount paid before deducting income tax and social charges. These deductions vary from country to country. Comparisons based on net wages can change the relative position of a country, depending on what family situation is considered. A rather high portion of employment at the minimum wage level in a country may indicate a weakness in the system with relation to its objectives of redistribution to low productivity employees—redistribution is effective when it is targeted—in may also infer that disadvantages outweigh advantages.

D2 Price of electricity for industrial users

This indicator provides information on electricity prices invoiced to industrial end users as follows: annual usage of 2,000 MWh, maximum power of 500 kW and annual load of 4,000 hours. Prices are in Euros, ex-VAT, per 100 kW and are applicable as from 1 January of each year. Production costs are a competitive factor par excellence for all companies. Energy consumption is one of the intermediary consumption items used by companies in their production processes. Electricity used by companies in their manufacturing processes is entered as a cost factor in final prices for their goods or services. All other things being equal, a reduction in electricity prices will improve competitiveness, while price increases will lower it.

D3 Price of gas for industrial users

This indicator provides information on gas prices as invoiced to industrial end users as follows: annual usage of 41,860 GJ and a load charge of 200 days or 1,600 hours. Prices are in Euros, ex-VAT, per GJ and are applicable as from 1 January of each year. Together with electricity prices, gas prices are a second basic variable that have a significant impact on costs of industrial companies. Natural gas used by companies in their manufacturing processes is entered as a cost factor in final prices for their goods or services. All other things being equal, a reduction in gas prices will improve competitiveness, while price increases will lower it.

D4 Market share of the primary operator in the cellular telephone market

This indicator measures market share of the main mobile telephone operator with relation to the total number of subscribers. The objective of this indicator is to determine to what degree the process of liberalization has advanced in the mobile telecommunications market and how extensive competition is in this market. A dominating position by the primary telephony operator can put a brake on the spread of new communications technologies, its involvement in the new economy and achieving gains in productivity. In the same manner, there could be an impact on the price of services offered, which could also have an impact on companies' production costs.

D5 (removed from Competitiveness Scoreboard)

D6 Composite basket of fixed and cellular telecommunications

The composite basket of fixed and mobile telecommunications contains two individual indicators calculated by the OECD: the 'Composite OECD basket of telephone charges for professional subscribers, excluding VAT, in USD' and the 'OECD basket of mobile telephone charges for large-scale users, VAT included, in USD'. The composition of the baskets is regularly adjusted to reflect the changing means of communication. The first indicator is calculated to compare professional rates in different countries and includes local calls, international calls and calls to mobile networks. The second indicator provides a breakdown for mobile communications at different times of the day and over the entire week, for a total of 900 calls per month. The indicator also shows them by destinations: calls to fixed lines, calls to other subscribers using the same network and calls to users on other mobile networks. Several short text message services and 2 GB of data transfer are also included for each subscriber. Surveys were carried out comparing several mobile networks in every country, with the lowest cost option selected as the most appropriate usage method. Prices of telecommunications services that are used by companies in their manufacturing or services processes are cost factors in the end user price for their products and services. This cost competitiveness indicator has growing importance with relation to costs of other intermediate consumption items, especially for companies operating in the services sector.

D7 Broad band internet access rates in US $ PPP/MB

Many applications in the information society are dependent on high-speed data transfer. A market that is receptive to broadband connectivity promotes the dissemination of information, and allows both consumers and businesses (especially SMEs) to benefit from an increase in the supply of services. Prices are in USD (excl. VAT).

D8 Basket of domestic royalties for 2Mbit leased lines

This indicator presents annual prices for a basket of domestic fees charged for 2Mbit leased lines with 100 circuits, broken down on a distance basis. Prices are expressed in USD, excluding tax. Leased or private lines are key factor in business to business electronic trade. They can be used by large companies that need to send large volumes of data at rates lower than those of public switched telephone networks. These companies can also better manage their telecommunications equipment and traffic on these types of lines. This is therefore an important price competitiveness indicator that has repercussions on production costs of companies.

D9 Value of public contracts using open procedure procurement

Data on public contracts are based on the information contained in bid tenders and procurement notices published in Supplement S to the Official Journal of the European Union. The numerator for this indicator is the value of public contracts awarded using the open procedure. For each of the sectors 'Works', 'Supplies' and 'Services' the number of tender bids published is multiplied by an average based in general on the gamut of prices provided in the awards notices for public contracts published in the Official journal for the year concerned. The denominator in the equation is GDP. 'Public contracts' is one of the areas of the domestic market where liberalization has not yet taken root as extensively as had been hoped. Improving the functioning of public contracts cannot only potentially lead to increases in the quality of public services, economic growth, competitiveness and job creations, but could also spark an increase in transparency. An increase in competition via the open procedure can be beneficial from the competitiveness of local companies and can also assist these in taking advantage of public contracts in other European regions. It should be noted that in Luxembourg, public contracts awarded are often lower in value than the thresholds set in the Official Journal.

D10 Total State aid excluding horizontal objectives

The numerator in this equation is the total of all State aid to specific sectors such as agriculture, fishing, manufacturing, coal, non-rail transportation and other services, as well as Stat aid granted on an ad hoc basis to individual companies, for example in the event of a bail out or restructuring. These types of aid are deemed potentially the most likely to distort the free play of competition. The denominator is GDP. A State subsidy is a form of state intervention that is used to promote a set economic activity. The granting of state aid can be perceived as favouritism for certain sectors or economic activities and distorts competition through discrimination among the companies that receive aid. It is appropriate to keep in mind the distinction between State aid and general economic support measures such as employment or training. From the perspective of competitiveness, a large portion of State aid to companies leaves the way open to conclude that the economy is working on less than perfect levels within the domestic market.

D11 Market share of the former primary operator in the fixed telephone market (removed from Competitiveness Scoreboard)

The former primary operator is the company operating on the market just prior to liberalization of telecommunications markets. This operator's share in the market corresponds to income generated by retail sales in the market throughout the entire marketplace, including internet connections. In fixed telephony, the operator's market share is calculated by means of telecommunications minutes this operator controls as a part of all connection minutes. The objective of this indicator is to determine to what degree the process of liberalization has advanced in the fixed and local telecommunications market and how extensive competition is in this market. A dominating position by the former primary telephony operator can put a brake on the spread of new communications technologies, its involvement in the new economy and achieving gains in productivity. In the same manner, there could be an impact on the price of services offered, which could also have an impact on companies' production costs.

E Institutional and regulatory framework

The institutional and regulatory framework within which economic activities are carried out affects the way in which resources are distributed, investments decisions are guided and creativity and innovation are stimulated. Among the framework conditions brought to the forefront is taxation. On one hand, this affects investment and on the other hand, it affects consumption. The regulatory framework also influences the proper operation of markets for goods, services, capital and labour. The regulatory quality of these markets influences allocation of resources and productivity. The institutional framework also contributes to the stability and security of decisions taken by economic agents. The more stable the institutional framework is the more consequences of economic decisions are quantifiable.

E1 Corporate taxes

Corporate taxes are direct taxes calculated on the basis of net income of companies. This basis is set with relation to what is considered taxable. An advantageous tax policy in the area of corporate taxation can stimulate investment in the private sector. For example, low tax rates result in better margins for companies, which can in turn incite them to reinvest profits. Foreign investors are also attracted to establishing operations in countries with a favourable tax regime.

E2 Taxes on physical persons

Income tax on physical persons is a direct tax calculated on income earned by households. This tax is progressive, meaning that the rate of taxation increases parallel to income. Taxable income includes income from transferable securities, real estate income, professional income and income from miscellaneous sources. An advantageous physical persons income tax scheme can stimulate demand. For example, low withholding tax rates give households more net disposable income that they can use for consumer goods.

E3 VAT rate

The value added tax (VAT) is an indirect tax on consumer goods. VAT is collected by companies that invoice their customers for a VAT amount as an integral part of the price for products and services. The difference between VAT rates in various countries can benefit companies and consumers, because all other things being equal, the final price paid for a product or service will be lower in a country that uses lower VAT rates. Lower prices also increase purchasing power. This influences a consumer's choice to spend income in one country rather than in another, especially in border regions. A company's choice of location can also be influenced by a favourable VAT rate for cross-border commercial transactions. This is the case in the domain of electronic commerce where the principle of country of origin applies.

E4 E5 Tax wedge (unmarried, no children; married, two children, one wage-earner)

The tax wedge measures the rate of social security and tax contributions that bear on labour input through the difference between total employer costs and employees' net salary. This indicator is defined as income taxes plus employer and employee social contributions as a percentage of labour costs, less benefits paid, by family category and salary.

E6 Administration efficiency index

This aggregate indicator gathers information on the quality of public services and the bureaucracy, the skill level of government service and its independence with relation to political pressure, as well as on the degree of credibility of governmental policies. A high index level denotes a high degree of efficiency in a government. The institutional framework exerts a strong influence on companies, so a stable and consistent institutional framework imparts confidence to companies in engaging in long term investments. An efficient administration is an important determinant of economic growth.

E7 Rule of law index

This aggregate index measures the efficiency and predictability of a country's legal system as well as the perceptions prevalent concerning the degree of personal security in the country. A high index score denotes a high degree of observance for the law. A predictable legal system is an important determinant of economic growth.

E8 Regulation quality index

This aggregate indicator measures prevalence of unfavourable policies such as price controls, inadequate supervision of the financial sector, or the perception of charges levied through excessive regulations in areas like foreign trade and business development. A high index ranking denotes high quality regulatory structures. Proper market operation plays a fundamental role in increasing productivity. Markets that operate under competitive pressure are among the most innovative and dynamic. Competition is reflected in the lowering of prices and a large choice of products for consumers. The State plays an important role in ensuring the proper functioning of markets.

E9 Degree of sophistication of online public services

This indicator measures the degree of sophistication of basic public services that can be accessed on line. These public services are divided into two categories, for individuals and companies, and some twenty sub-categories. Services extended to individuals should include information about income taxes, job searches, social security benefits, personal documentation, registering vehicles, construction permits, declarations to the police, public libraries, birth and marriage certificates, enrolment in universities, moving announcements and health services. Companies should be able to receive services in the areas of social security contributions, corporate taxes, VAT, registering start ups, providing national statistics data, customs declarations, environmental permits and public procurement. There is a five-level assessment grille. Stage A0, 0-24% indicates that a site is non-existent or useless on the practical level, Stage A1, 25-49%, offers a purely informational site, Stage A2, 50-74%, indicates a one-way information flow, Stage A3, 75-99%, for a bilateral interactive site and Stage A4 at 100% indicating a fully interactive site with no supplementary off-line interaction required. Electronic administration is a means for public administrations to improve its efficiency in providing public services. Through information and communications technologies, public administrations can both reduce operating costs considerably and improve the quality of its services.

E10 Public services fully available online

This indicator measures the percentage of public services that are fully available online with relation to all services analyzed in CAD 09 above. It is comprised of two sub-categories, the first containing the number of number of public services that are completely unavailable online, i.e. the first four Stages A0-A3 mentioned in CAD 09, and the second containing those public services that are fully available on line, or the last Stage A4. The aggregate indicator of public services fully available online is then calculated by means of a ratio between the number of public services fully available online and the total of public services online that were analyzed. Having public services entirely available online allows administrations to both optimize their operating costs and increase the quality of their services. In addition, these services also make it possible for companies and individuals to benefit from the information society and to render their interaction time with public administrations more efficient.

E11 Public sector payroll costs (removed form Competitiveness Scoreboard)

This indicator represents labour costs in the public sector as a percentage of domestic GDP. According to the OECD, the concept of public sector varies depending on country. The public sector is defined on the basis of employees paid using public funds, either directly by the Government or on the basis of Government allocated budgets to departments or agencies.

F Entrepreneurship

Developing entrepreneurialism is currently a major preoccupation of the social, political and economic agenda in many countries. Indeed, empirical data has shown that a significant relationship exists between entrepreneurial activities and productivity and growth in an economy. Analyses of company policies should therefore be carried out along the lines of a continuous analysis of competitiveness. Both the European Commission and the OECD believe that entrepreneurial activities are fundamental for the proper functioning of market economies and that these make up one of the key components in generating, applying and disseminating new ideas. Neither heightened levels of knowledge nor a functioning domestic market can alone provide the environment for exploiting the full potential for innovation capacities and driving competitiveness and economic growth. From these entrepreneurial activities emanate new economic activities, producing new products and services that require investment, thus constituting a motor for job creation.

F1 Propensity for entrepreneurialism

This indicator was derived from a qualitative public opinion survey on professional status, for which the key sampling question was: 'If you could choose from among a variety of professions, would you prefer to be a salaried employee or a self-employed worker?' This indicator provides us with information of the attitudes of people regarding entrepreneurial activities. The propensity of people for Entrepreneurship reflects attitudes shaped by tradition, the image of a CEO and economic opportunity as well as the way that the advantages of working as a self-employed contractor are perceived.

F2 Self-employed jobs as a percentage of total employment

This indicator records self-employed jobs as a percentage of the workforce in all economic activities. Self-employed workers are persons who are sole proprietors or co-proprietors of companies that have no legal personality in which they work, except for companies without a legal personality that are classified as quasi-corporate enterprises. Self-employed persons are classified as such if they do not simultaneously hold a salaried job as their principal source of income, which would classify them as 'employees'. Self-employed persons also include the following categories of persons: unsalaried family workers, persons who work at home and persons who engage individually or collectively in production activities exclusively for own final consumption or capital formation. A high proportion of self-employed persons in a work force can constitute an important determinant for the generation, application and dissemination of new ideas.

F3 Net change in the number of companies

The net change in the number of companies is calculated by taking the number of start-ups les the number of companies winding up with relation to the overall population of companies. A positive figure indicates that start-ups in a given year outnumber wind-ups, and therefore the total number of companies increases. This type of increase can be the source of optimized reallocation of resources and a supplementary increase in jobs.

F4 Volatility among companies

The volatility rate among companies adds the start-up rate of companies to the rate of companies winding up their affairs in relation to the overall population of companies. A high rate of volatility in a given year indicates that the population of companies in a country is subject to significant fluctuations and therefore to a constant turnover of employees. If many companies are formed and many go out of business, there is a high degree of renewal among the global population of companies. A high degree of renewal of the fabric of companies can signify a certain extent of flexibility in the economy of a country and can indicate a high level of destructive creation, which results in reallocation of resources to more competitive sectors. A dynamic population of companies, reflected by a high volatility level, is a feature of economic activities linked to clusters.

G Education and training

Changes in economic and social conditions have progressively conferred a foremost role to education in the success of individuals and nations. While it has been firmly established that developing human capital must be the focal point of an effective struggle against unemployment and low salaries, there is conclusive proof that this development is also a determining factor in economic growth. Knowledge and expertise are the raw materials for a knowledge-based economy and they play a fundamental role in engendering and maintaining knowledge. The concepts present in the new or knowledge economy are difficult to precisely define, but they underscore the fact that the overall dynamic of an economy resides more and more in knowledge and learning skills. Education, or in a more all-encompassing manner, training, is a key dimension of the crucial factor that immaterial investment has become for the level of competitiveness of a company or a country. For training programs to be adequately linked, skills must be developed and maintained up to date. It is necessary to both mobilize all available human resources and increase their potential by stimulating creativity and ensuring that skills are renewed and improved.

G1 Annual cost per student in public educational facilities

Costs per student at public educational facilities assess amounts spent per student by central, regional and municipal governments, private households, religious institutions and companies. These include personnel costs, costs for equipment and other expenditures. In order to perform well, schools must be able to count on qualified and high quality teachers, proper establishments, updated equipment and motivated students who are pre-disposed to learning. Annual costs per student therefore comprise a representative indicator of the effort expended to train students under proper conditions. The effectiveness of the use of resources, in particular in terms of academic results and educational attainment, must provide further information on the resources allocated.

G2 Portion of the population aged 25–64 with a secondary education

This indicator shows the percentage of the adult population between the ages of 25 and 64 that completed secondary school. It aims to measure the portion of the population that has the minimum qualifications necessary for taking an active part in social and economic life. To take advantage of the opportunities available through globalization and new technologies, companies need skilled employees that are capable of initiating and managing new ideas and that know how to adapt to new production methods and management practices. Skills acquired during secondary education cycles are high factors of productivity and facilitate learning and adaptation to new market requirements.

G3 Portion of the population aged 25-34 with a university education (removed from Competitiveness Scoreboard)

The ratio of persons that have earned a degree shows the current rate that advanced knowledge is produced by each country's educational system. Countries with the highest rate of university degrees have great potential for comprising and maintaining a highly qualified working population. Statistics on how much education persons have gives an insight to how much advanced knowledge a population possesses. The ratio of university degrees in a working population is an important indicator of innovation potential of the labour market. The requirement for higher levels of qualification on the labour market, the increase in unemployment rates over recent years and higher expectations on the part of both individuals and society have resulted in more young people earning at least one university degree. This evolution indicates an across the board increase in the number of high level skills in the adult population. It should be noted that the rate of university degrees depends both on the access rate to this level of studies and the increase of qualifications sought on the labour market.

G4 Percentage of human resources in scientific and technological fields (HRST) in the labour force

Human resources in science and technology are defined according to the Canberra Manual (OECD and Eurostat, 1995) as persons having graduated at the tertiary level of education, or persons employed in an S&T occupation without having obtained such degrees, for which a high qualification is normally required and the innovation potential is high. Data relating to scientific and technological human resources that is reported here concern professionals and technicians as defined in the International Standard Classification of Occupations (ISCO 88) or 'Technicians and Associate Professionals'. A high percentage of human resources in scientific and technological fields results in increasing the creation and dissemination of knowledge and innovation in technologies.

G5 Life-long learning

Life-long learning refers to persons aged between 25 and 64 who stated that they were enrolled in an educational program or training course during the four weeks immediately preceding the survey. The denominator here is total population of the same age group, excluding all who did not respond to the 'Training or educational program' question of the survey. Data collected relates to all the forms of training or education, regardless of whether they were pertinent to a current or future job held by the respondent. Continuing education is essential if the population is to acquire or maintain skills in such areas as information technologies, technological knowledge, entrepreneurialism or even certain social skills. Updating and continued development of skills and knowledge are factors of growth and productivity. They make it possible to strengthen the dynamic innovation processes of a company. Life-long learning may be considered not only as an essential course for ensuring long-term employability but also as a short-term option for training qualified personnel in areas where skills are required.

G6 Secondary school dropouts

Young people who drop out of school early are persons aged 18-24 that meet two conditions. They are persons whose highest level of education reached was the lower cycle of secondary school and who declare not being enrolled in any learning or training program during the four weeks preceding the survey. The denominator here is total population of the same age group, excluding all who did not respond to the 'Level of learning or training achieved' and 'Educational or training program enrolled in' questions of the survey. A high percentage of young people who leave school early is worrisome, because this harms their capacity to adapt to structural changes and to integrate into society. In order to participate in the knowledge society, one must possess a minimum knowledge base. In consequence, young people without any certificate or diploma will have fewer chances of efficiently deriving benefits from life-long learning programs. They risk becoming cast-offs in today's society, which is moreover becoming increasingly competitive. For this reason, it is essential to decrease the number of young people leaving school early if full employment and subsequent social cohesion is to be achieved.

G7 Percentage of foreign nationals in scientific and technological fields (removed from Competitiveness Scoreboard)

This indicator shows the percentage of foreign national human resources in scientific and technological fields. This proportion is determined using Major Groups 2 (Scientific and Intellectual Professionals) and 3 (Technicians and Associate Professionals) of the International Standard Classification of Occupations, ISCO-88. Over recent years, international mobility and highly qualified labour has come under the increasing attention of public policy makers and the media. Foreign skills are suitable for filling vacant positions. This labour base should allow host countries to catch up on lagging progress and pursue their development by means of this contribution of human capital. Nevertheless, major differences between countries may become apparent. Luxembourg is concerned in terms of percentages of human resources in scientific and technological fields because of the size of its banking sector, the tightness of its labour market and the presence of numerous European institutions.

G8 Percentage of highly qualified workers (ICT) in total employment figures (removed from Competitiveness Scoreboard)

In general, only several sections of the ISCO-88 nomenclature refer to highly skilled workers in the area of ICT since the correlation of nomenclature with the United States has not yet been formally established. Some that may be cited include IT specialists such as systems designers and analysts, computer operators and other computer equipment operators including computer assistants, computer equipment technicians and industrial robot technicians, and optic or electronic technicians such as photographers, imagery equipment technicians, radio, television and telecommunications emissions equipment technicians, medical equipment technicians, etc. The role played by highly qualified labour in the performance of a company, a sector or a country is an established fact and is recognized by a number of observers. Activities related to these persons' knowledge, transmission, production, interpretation and utilization are highly important in the very functioning of economic activity and the structure of employment. In order to maintain and improve a company's well-being it is imperative to continue along this path, ensuring that the large number of highly qualified workers is regenerated in every field.

H Knowledge economy

In recent years, there has been upheaval in the industrial landscape of the developed world. Free trade principles have transformed telecommunications, the spectacular development of the Internet and the progressive accessing of companies and individuals to the communications network are telling of one unique and uniform phenomenon, the advent of the information age. The success of the information society is an essential element for achieving the Lisbon objective of making the European Union the most competitive and vital economy in the world by 2010. Knowledge is the base ingredient of the innovation business. Innovation is principally the result of complex and interactive processes, through which companies access complementary knowledge originating with other organizations and institutions. In addition, innovation is often supported by new managerial and organizational methods based on ICT and on investment in new equipment and new skills. Innovation therefore constitutes one of the principle drivers of economic growth in the long term. The decisive impact of technology on industrial performance and on international competitiveness signifies that this continuous improvement of the innovation process is essential in order to achieve gains in productivity, job creation, economic growth and standards of well-being.

H1 Internal R & D expenditure

The internal R & D expenditure, DIRD, quantifies R & D expenditures carried out within a statistical unit and within a nation's borders during a given year. As such, it includes all R & D related work performed in each organization within a country's borders. It includes R & D expenditures financed by other countries but does not account for payments in exchange for work performed abroad or outside of an organization, as in the case of sub-contracted work. According to the Frascati manual methodological reference, 'Experimental R & D encompasses creative work undertaken in a systematic manner that is expected to increase the sum of knowledge, including the knowledge of men, culture and society and the use of this store of knowledge for new applications'. R & D activities are characterized by massive transfers of resources between units, organizations and sectors that it is important to observe. R & D expenditures by companies are an ex-ante indicator of their propensity for innovation. A high propensity for innovation is a factor of competitiveness through its improvement of productive process, i.e. cost competitiveness as well as through the introduction of new or improved products that will win new markets. According to the Europe 2020 strategy, the Luxembourg target is from 2.3 to 2.6% by 2020.

H2 Public R & D budget credits

Public R & D budget credits are all R & D credits entered in the budgets of all governments. They correspond to R & D budget allocations by central or federal administrations. Unless otherwise indicated, they include operating expenses and cost of equipment. They include not only R & D financed by public funds that is carried out in public institutions, but also that financed by public administrations in the private business sector, private non-profit organizations and higher education institutions, as well as R & D done abroad, meaning in international organizations whose activities are solely or principally dedicated to R & D. In summary, the credits cover R & D financed by the State but carried out in all sectors, including abroad and in international organizations. The Governments is a key investor in R & D and maintains a major role in upholding the scientific and technological acumen of a country. Its action consists in financing research in public institutions and not for profit research in the private sector. This indicator is used to concisely take into consideration policies conducted or to be conducted in the area of scientific research. Public budgetary credits can be considered a State-originated support measure for R & D activities and serve to specify what priorities governments place on public financing. It is an indicator of long-term public commitment.

H3 Portion of public research financed by the private sector

Public research is an important complement to the R & D effort of the private sector. It generally covers areas where short-term profitability is not assured and in which private investment cannot be justified. Public research expenditures have inherent external influences of a significant nature, so a substantial public R & D effort will stimulate transfers of technology and innovation to the private sector. To the extent that work of government laboratories jibes with market requirements, these entities offer a potential for ideas and discoveries that companies can profit from in a concrete manner. How closely these R & D installations function with industry is traditionally measured by the proportion of the contribution of companies to financing research carried out in the State DIRDET sector. R & D performed in public laboratories contributes to increased knowledge and can result in major industrial advances.

H4 Percentage of sales allocated to the introduction of new products on the market (removed from Competitiveness Scoreboard)

This indicator measures the portion of sales allocated to new or significantly improved products that are new to the market. The portion of sales of new or significantly improved products is an important indicator of the success of innovation. While patent applications are proof of the intensity of research and innovation efforts, conversion of discoveries to marketable units is far from automatic. Although innovation is often cited as an important element in increasing competitiveness, the lion's share of revenue of the great majority of companies is derived from products that have undergone no or only slight modifications. Companies that introduce a relatively high number of new products can do so because of the rapid rate of development in the markets in which they operate. Companies that derive a high portion of revenue from new products are probably those that are the most flexible in adapting their manufacturing processes to changing requirements, or those that concentrate their attention on changing demand of consumers. The lack of innovation and new products is reflected over time by a lowering of market share.

H5 Number of researchers per 1,000 employed persons (public and private sectors taken together)

Researchers, from the perspective of the OECD, may be defined as professionals engaged in the design and creation of new knowledge, products, processes, methods and systems that are directly associated with the management of projects. Titles and categories may vary from one research institution to another, but the work undertaken by such laboratory personnel is not fundamentally different. Changes in numbers of researchers in an economy are closely linked with its capacity for research and efforts in innovation. This indicator measures the percentage of researchers in a working economy. Through this indicator, the number of researchers is expressed in terms of R & D full-time equivalents (FTE), meaning that a person that works one half the time of a full-time worker is counted as a half person working full time. The indicator refers to teams working over the course of one year. FTE data give an indication of the research programs in a country and is different from the count of researchers that shows the pool of researchers in jobs.

H6 Scientific publications per million inhabitants (removed from Competitiveness Scoreboard)

The count of scientific research articles is based on scientific and technical articles in around 5,000 major scientific and technical journals published the world over. Articles are counted in fractions when they authored by two persons from different countries. In this case, an article is worth one-half an article for each of the countries involved. In-depth fundamental scientific research is essential in developed economies, both as a source of research and expertise and as a testing ground for scientific and technical personnel of the future. Fundamental science is consequently a key resource for shoring up innovations, which is the foundation for creating wealth and new jobs. Scientific publications are the principal vehicles for disseminating results of research activities and are one of the forms through which the work of researchers can be validated. The ratio of publication volumes to a given population is therefore an indicator of the vitality and performance of scientific research in a given country.

H7 H8 Number of patent applications (OEB) and patents awarded (USPTO) per million inhabitants

Patents are the means of protecting intellectual property of a discovery that has commercial potential. In an economy that is based on innovation, the number of patents awarded may be considered an index of the robustness of R & D work and of the country's overall technological innovation potential, which is a key element of competitiveness. The two indicators used in this category provide information both on patent applications submitted to the European Patent Office (EPO) and on patents awarded by the U.S. Patent and Trademark Office (USPTO). With regard to applications submitted to EPO, that data refers to applications registered directly under the European Patent Convention or to applications registered under the Patent Cooperation Treaty in the area of patents that designate the EPO. Patent applications are counted according to the year in which they were registered at EPO and are distributed according the International Patent Classification system (IPC). Fractional units are used in the event of shared patents or of patents in several IPC categories to avoid double counting. With patents awarded by the USPTO, data refers to patents awarded as opposed to applications submitted, as deemed by EPO patent data. Data are registered according the year of publication as opposed to the year in which the patent was actually registered, as considered by EPO data. Patents are broken down according to country of inventor, using the fractional method where several inventors from different countries are involved.

H9 Use of broad band internet by companies

The indicator used here states an estimate of the number of companies in member countries that are connected to and use broad band connections. Broad band service or connections are used for transmitting significant volumes of data. According to EUROSTAT the definition of broad band involves the xDSL technology, with its ADSL and SDSL types of subscriber lines, or services that provide speeds in excess of 2Mbits, which allows more rapid data transmission than telephone lines. Internet and electronic business linked practices are strongly associated with the new economy. They allow companies to carry out information searches rapidly, monitor the competition, carry out financial transactions, perform targeted marketing operation, broaden the customer base, etc. These new business practices are at the centre of a genuine revolution in the business world. Individual and business users must have an offer of broad band access to the Internet if they are to develop new applications and take part in economic activities.

H10 Investment in public communications as a percentage of GFCF

The International Telecommunications Union, (ITU) defines the public telecommunications sector as the infrastructure and telecommunications services available to the general public through this infrastructure. This includes telecommunications networks for telephone, telex, telegraph and data services that are made up of exchanges between which transmission circuits connect domestic subscribers with each other and subscribers abroad. Since everyone can access the network, the term 'public' denotes the provisions for accessing the network rather than ownership of the network. The public telecommunications sector does not include private networks, which are not automatically connected to the public network or to which admission is subject to certain restrictions. The public telecommunications sector also excludes manufacturing of equipment for telecommunications or broadcasting use. The internet, electronic trade and requesting internet access at prices allowing for permanent connections play a primary role in changes to telecommunications policies. The potential contribution of telecommunications to economic growth in the light of developing electronic commerce is appearing increasingly important with the passage of time.

H11 Percentage of households that have Internet access at home

Information and Communications Technologies provide a massive flow of information. Use of internet by households illustrates the access private individuals enjoy to the multiple potential offered by ICT and reflects, after a fashion, the entry of civilians into the new economy. In the future, these consumers will regularly use the internet to take advantage of goods and services available through it. Simultaneously, the existence of a network like internet is in itself a creator of products of a new type, online products, which engender new needs. Even non-commercial uses of the medium by households can result in indirect effects on their consumption through changes in their habits and lifestyles.

H12 Number of cell phones per 100 inhabitants

This indicator shows the access per 100 inhabitants to telecommunications. These include subscribers to cell phone networks. In the past, landline penetration provided a reasonable indication of the number of basic telecommunications connections that were available to consumers. Now, the use of landlines gives flawed information about the development of a network. To evaluate the overall telecommunications penetration throughout the OECD zone it is increasingly necessary to account for the development of mobile transmission networks.

H13 Percentage of households that have broad band Internet access

Broad band internet access used as a reference includes xDSL, ADSL, SDSL and other all connections that offer bands over 2Mbit/s. The degree of use of internet services, the quality of the use and the functionalities of online services depend on band width available. For this reason there is growing interest in arraying broad band access networks and the rate of spreading of broad band access technologies. It is important to provide broad band internet access if new applications and their associated economic activities are to be developed.

H14 Number of secure web servers

Servers are computers that host content of the worldwide web, in other words, web sites. A secure server is a server that has secure socket layer software, which protects information during business transactions carried out over the internet. In order to complete purchases and sales on the internet and other networks, electronic business infrastructure requires secure paths. Secure servers make up some of the infrastructure used to carry out secure electronic transactions. They support available content intended for sales and other business uses. As such they can be considered indicators of access to electronic commerce and of the offer of this type of service, in other words an indicator of supply and demand of commercial content on line. This indicator is furnished via the SSL survey carried out by Netcraft and published by the OECD. The number of secure servers is in ratio to the population of the country, per 100,000 inhabitants.

H15 Percentage of total employment in medium or high technology sectors

The percentage of employment in medium-high and high technology manufacturing sectors is an indicator of the part of the manufacturing economy based on continuous innovation through creative and inventive activities. The indicator used takes into account the percentage of jobs in high and medium-high technology sectors as a part of all jobs. The high and medium-high technologies sectors are defined as those sectors requiring a relatively high degree of R & D intensity. They included a certain number of sectors including aircraft and aerospace construction, the pharmaceutical industry, manufacturing of office and computer equipment, electronics and communication and scientific instruments for high technology. Medium-high technology includes the manufacture of machines, electrical equipment, the automobile industry, the chemical industry—except for the pharmaceutical industry, the manufacture of other transportation equipment and the manufacture of non-electrical machinery and equipment.

I Social cohesion

There are numerous dimensions to the degree of competitiveness displayed by an economy, of which social cohesion is one of the pillars. Social cohesion is an important feature because it provides underlying social stability by fostering a feeling of security and belonging and because it can improve the development potential of a country. In addition to the quantitative and monetary aspects of competitiveness, a country's capacity for growth depends largely on the motivation of its human capital, which requires a proper working environment and a feeling of strong cohesion that is itself dependent on the efficient functioning of the country's social system. Competitiveness should not be considered as an end in itself, but rather one of several ways to achieve the shared objective of well-being in the population.

I1 Gini coefficient

The Gini coefficient measures inequality of household incomes. The values of the coefficient move from 0, representing full equality, to 1 for the maximum degree of inequality. Moreover, full equality of incomes can be damaging to the efficiency of an economy, because if no private benefits exist and differences among salaries are minimal, individuals are not motivated to perform better at work or to take up an entrepreneurial path. In contrast, excessive disparities tend to exert a negative effect on individuals' lives. Very inequitable differences in income can have repercussions on certain essential factors of economic growth such as the political stability of a country, educational levels of labour, or adherence to certain rules of conduct on the part of economic agents. All of these factors have the effect of slowing the economy and putting the brakes on growth.

I2 At risk of poverty rate after social transfers

The 'At risk of poverty rate after social transfers' measures the proportion of persons whose equivalised disposable income is below the 'at risk of poverty line,' which is set at 60% of the median equivalised disposable income of a country, after social transfers. A high rate in this indicator reveals inefficiency in the social protection system that could have damaging repercussions throughout the economy. As an example, the impact of poverty can be such as to hobble education levels or contribute to crime, which in turn increases the level of social instability in a country, thus causing its development potential to shrink.

I3 At persistent risk of poverty rate

The 'At persistent risk of poverty rate' measures the proportion of persons whose equivalised disposable income is below the 'at risk of poverty line' during the current year and has been for at least two of the previous three years. Persistent poverty can indicate inefficiency in the social protection system that could have damaging repercussions throughout the economy. As an example, the impact of poverty can be such as to hobble education levels or contribute to crime, which in turn increases the level of social instability in a country, thus causing its development potential to shrink.

I4 Life expectancy of a child less than one year old

The life expectancy indicator measures the number of years that a child younger than one year can expect to live assuming, at each age of its life, its chances of survival were consistent with those prevalent in its corresponding age group at the year of its birth. Changes in this indicator reflect the onset of changes in the general state of health of a country's population, living conditions and the quality of health care. Because of this, life expectancy may be considered as an overall indicator of social cohesion that takes into account all the measures implemented to ensure a high degree of social cohesion.

I5 Wage gap between men and women

The wage gap between men and women is the gap in average gross hourly wages between male and female employees as a percentage of the average gross hourly wage of male employees. The survey population includes all salaried workers between the ages of 16 and 64 who work a minimum of 15 hours per week. The wage gap between women and men may discourage women from entering the labour market, thus depriving the economy of human capital. This inequality in the breakdown of incomes goes against the principle of equal opportunities, which is an important factor in maintaining social cohesion.

I6 Serious work accidents (removed from Competitiveness Scoreboard)

This index shows changes in the rate of serious accidents at work since 1998. The rate of occurrence is the number of non-fatal work accidents involving more than three working days of absence in the survey population. A work accident is an 'event of short duration occurring during the course of a professional activity that causes physical or psychological harm to a person'. Included in this figure are accidents occurring away from a company's premises during a victim's working hours, even those caused by third parties or severe poisoning. Excluded from this figure are accidents occurring on the way to and from work, solely medical causes and occupational illnesses. A high rate of serious work accidents can indicate improper working conditions, which can hinder the productivity of employees.

J Environment

Another requirement for making an economy more competitive is that all economic agents commit to progress in the area of improving the environment, in line with a framework supporting sustainable development. It is important to promote growth while simultaneously guaranteeing a viable economic, social and ecological environment for future generations. The fundamental concept used to evaluate environmental performance is eco-efficiency or environmental productivity of industry. Eco-efficiency is the relationship between economic production and environmental pressures—expressed in terms of pollutants releases or resources consumed—that result from such production. It also furnishes information on the efforts expended by companies to promote productivity while operating in a manner intended to respect the environment.

J1 J2 Number of ISO 14001 and 90001 certificates per million inhabitants

The indicators of ISO 14001 and 90001 certification give us information on the involvement of companies in environmentally responsible activities. ISO standard 14001 is an international standard for managing the environment. ISO standard 90001 is the environmental management and audit system. In order to render European data comparable, the data have been weighted by number of inhabitants of each Member state, in light of the lack of statistics relative to the number of companies.

J3 Total greenhouse gas emissions (Kyoto)

The Kyoto protocol sets limits of greenhouse gas emissions for countries that signed the international agreement. As a part of this protocol, Europe accepted a reduction of 8% in its greenhouse gas emissions using 1990 as a base year with a benchmark figure of 100 in 2008-2012. Emissions of six greenhouse gases specified in the protocol are weighted by overall warming potential and added together to give total CO2 emissions. Total emissions appear in indices with the year 1990 as the benchmark. The fact that the Kyoto protocol compels nations to reduce quotas of greenhouse gas emissions risks harming the cost-competitiveness situation of European companies with relation to other competitor countries that are not subject to limits, through increased labour costs. These costs could cause some companies to no longer be profitable, thus leading to loss of jobs. This indicator is also an important factor in the choice of policies intended to achieve targeted objectives and the objectives subscribed to in the Kyoto protocol. According to the Lisbon strategy, the EU has agreed to reduce greenhouse gas emissions by 8% below base year 1990 levels in 2008-2012.

J4 Percentage of renewable energy sources

The share of renewable energy is the ratio between electricity produced from renewable energy sources and gross national consumption of electricity figured over a calendar year. This indicator measures the contribution of electricity produced from renewable energy sources in national electricity consumption. Electricity produced using renewable sources includes that produced by hydraulic plants, exclusive of pumping, wind energy, solar energy, geothermic energy and gases derived from biomass waste. Gross domestic consumption of electricity includes total gross domestic production of electricity generated by fuels, including self generation and also including imports of electricity, less exports of electricity. This indicator measures the will of an economy to commit itself to a sustainable development program with environmental concerns to the forefront.

J5 Volume of municipal waste collected per person per year

This indicator shows the quantity of waste generated. It includes waste collected by or for municipal authorities that are subsequently eliminated by the waste management system for these entities. The greater part of these waste flows comes from households, although it also includes similar waste sources such as from stores, offices and public institutions. In areas not benefiting from where no municipal waste management system exists, estimates of waste quantities have been made. The quantity generated is expressed in kg per inhabitant per year.

J6 Energy intensity of the economy

Energy intensity of the economy is the ratio between gross domestic consumption of energy and the gross domestic product calculated over a given calendar year. This indicator measures the consumption of energy in an economy and its overall energy efficiency. Gross domestic consumption of energy is calculated as the sum of gross domestic consumption of five energy types, including coal, electricity, oil, natural gas and renewable energy sources. GDP figures are considered at like prices to avoid the effect of inflation, and the base year used is 1995. The rate of energy intensity is the result of dividing gross domestic consumption by GDP. Since gross domestic consumption is measured in kilograms of oil equivalent and GDP in millions of Euros, this rate is measured in kilograms of oil equivalent per thousand Euros. Energy intensity reflects the degree of dependence an economy has with relation to the energy factor as well as the productivity of this factor and its efficiency of use. A high energy intensity score shows that an economy is more vulnerable to an increase in energy prices. Energy intensity is also an important factor in selecting policies intended to achieve objective commitments in the Kyoto framework.

J7 Modal split in transportation choice – percentage of car users as transportation method

The modal split in transportation methods of travellers is defined as the ratio between domestic passenger traffic and GDP at like prices of 1995. The unit used is passenger kilometre to represent the transport of one passenger over the distance of one kilometre. The indicator covers transportation in automobiles, buses, cars and trains. All data must be based on movements within national borders, regardless of nationality of a vehicle. However, the collection of data in not harmonized for countries within the EU. In accordance with the strategy of sustainable development, the share of movements by transportation mode must be reduced if we are to efficiently and ecologically master the problem of mobility. Moreover, this type of re-balancing will contribute to the diminishing of CO2 released into the air through road traffic.

New Objectives and Indicators for the Europe 2020 Strategy	
EU2020-1	Employment rate by gender, age group 20-64
EU2020-2	Gross domestic expenditure on R&D (GERD)
EU2020-3	Greenhouse gas emissions, base year 1990
EU2020-4	Share of renewable energy in gross final energy consumption
EU2020-5	Primary energy consumption (Mtoe)
EU2020-6	Early leavers from education and training by gender
EU2020-7	Tertiary educational attainment by gender, age group 30-34
EU2020-8	Population at risk of poverty or exclusion
EU2020-9	Persons living in households with very low work intensity
EU2020-10	Persons at risk of poverty after social transfers
EU2020-11	Severely materially deprived persons

Source: http://epp.eurostat.ec.europa.eu/portal/page/portal/europe_2020_indicators/headline_indicators