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2012 COMPETITIVENESS REPORT

Headwinds

MINISTÈRE DE L'ÉCONOMIE
ET DU COMMERCE EXTÉRIEUR
Observatoire de la compétitivité

2012 COMPETITIVENESS REPORT

Headwinds

The "Perspectives de Politique Économique" series includes reports, studies, research results or summaries of conferences commanded by or carried out by employees of the Ministry of Economy and Foreign Trade or by experts of associated institutions.

The opinions expressed in these publications are those of the authors and do not necessarily correspond with those of the Ministry of Economy and Foreign Trade.

For any request or suggestion, please contact the *Observatoire de la Compétitivité* of the Ministry of Economy and Foreign Trade of the Grand Duchy of Luxembourg.

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2012 Competitiveness Report

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Preface

The Great Recession triggered by the global financial crisis, has finally and heavily hit the European economy. Despite a coordinated recovery, the eurozone did not withstand the deterioration of the international situation, and especially the violent centrifugal forces arising from the divergent evolution of the countries at the heart of Europe and of those in its periphery. Without new rules and supranational governance institutions, it will not be possible to restore businesses' and investors' confidence in Europe and in the world.

Luxembourg has not overcome the crisis! This year, with a little luck, the GDP of Luxembourg's economy will regain the level of 2008. In subsequent years growth will be modest, far too modest to talk about this crisis as a hiccup.

Luxembourg must face a period of difficult and even painful transformations. The recent problems of some large traditional industries remind us of this harsh truth. These challenges cannot be dealt with by implementing dramatic cost cuts. The focus should be on stimulating innovation and quality upgrading of exports, which can ensure a lasting performance. Although Luxembourg has a productivity level which is among the highest in the world, this advantage is eroding with the slowdown in productivity gains. The national strategic plan "Luxembourg 2020" submitted to the Community authorities in the framework of the Europe 2020 strategy outlines the priorities and objectives for a "smart, sustainable and inclusive" growth.

Is Luxembourg competitive?

The *Observatoire de la compétitivité* provides a thorough and methodical response to this question in this new 2012 edition of the Competitiveness Report.

First, the *Observatoire* presents and dissects dozens of rankings and benchmarks established by major international institutions. The media coverage of these rankings shapes the image of our country and can influence the perception of foreign investors.

However, these international studies do not sufficiently take national specificities into account, namely those of a small and very open economy integrated into the European internal market and with global ambitions. In order to circumvent these methodological deficits, the Tripartite Coordination Committee had in 2003 recognized the need for a national scoreboard. In 2004, Professor Lionel Fontagné proposed such a scoreboard based on a balanced set of economic, structural, social and ecological criteria. After long discussions, this scoreboard has been accepted by the social partners.

The Competitiveness Report of Luxembourg shows the strengths and weaknesses of our economy. I do not want the discussion of a subject as complex as our competitive position to be reduced to a number, that of Luxembourg's rank. I would rather want we look more closely at the detail of what the dozens of indicators reveal about the specific problems in each area, in each sector, for each actor.

The Chamber of Deputies, the Government and the social partners need an instrument like the Competitiveness Report in order to think about reforms and to assess their impact.

Wishing you a good read.

Etienne SCHNEIDER
Minister of the Economy and Foreign Trade

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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 Job creation (Lisbon strategy and Europe 2020 strategy).

1.2 From the Lisbon strategy to Europe 2020 strategy

Within the Government, the Minister of the Economy and Foreign Trade is responsible for coordinating the implementation of the European strategy for growth and job creation 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[1], 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 Luxembourg 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[2]. 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 PNR draft to the Commission, and the Government Council finally decided on the finalized PNR for Luxembourg in April 2011 which was then submitted to the European Commission, along with the SGP 2011-2014.

During the second European semester, in March 2012, a consultation debate took place in the Chamber of Deputies[3]. Luxembourg's finalized NRP was sent to the European Commission in April 2012, along with the SGP 2012-2015[4]. In July 2012, based on the NRP and the SGP, the Council issued country-specific recommendations for Luxembourg[5], for consideration during the national discussions to be conducted about the 2013 draft budget[6].

1 For additional details: http://www.odc.public.lu/publications/pnr/index.html

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

3 For additional details: http://www.odc.public.lu/actualites/2012/03/debat_PNR_2012/index.html

4 For additional details: http://www.odc.public.lu/actualites/2012/04/PNR_Luxembourg_2020/index.htmll

5 For additional details: http://register.consilium.europa.eu/pdf/fr/12/st11/st11263.fr12.pdf

6 Chapter 4 will discuss the European semester and Europe 2020 in more detail.

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 are carried out among others by the *Observatoire de la compétitivité* in collaboration with STATEC.

For 2012, 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 2012 remains structured around the three pillars of applied research, namely growth and productivity, innovation and performance, entrepreneurship and profitability.

1.4 Events and publications in 2011-2012

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 organizing public events (seminars, conferences, etc.) and publishing analytical documents relating to 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 Lisbon strategy. The organization of public events is a part of this mission.

Les Journées de l'Économie[7]

In February 2012, the sixth *Journées de l'Économie* have analysed in depth the challenges but also the opportunities that are currently emerging in the EU's difficult economic context. Entrepreneurs, economists and representatives of public authorities of Luxembourg and of the Greater Region reflected together on the actions necessary to promote the development of companies. They shared their experiences and views on the driving forces of the Luxembourg economy, such as innovation and re-industrialization projects. They also discussed the strategy of exporting companies.

The conference "Competitiveness Luxembourg-Singapore: partners or rivals?"[8]

In June 2012 the *Observatoire de la compétitivité* and the Chamber of Commerce, in collaboration with the company InSyDe, organized a conference called "Competitiveness Luxembourg-Singapore: partners or rivals? ". At this conference a comparative study which was conducted by the company InSyDe on the determinants of competitiveness of the two countries was presented. Chapter 6 of the Report is devoted to this conference.

The conference "Wealth and inheritance in the long run"[9]

The conference "Wealth and inheritance in the long run" was organized in July 2012 by the Luxembourg Income Study and the Ministry of Economy and Foreign Trade, with guest speaker Thomas Piketty, Director of Studies at the EHESS and Professor at the Paris School of Economics.

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 Economy and Foreign Trade 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[10].

[7] For additional details: http://www.odc.public.lu/actualites/2012/02/Journees_economie_2012/index.html

[8] For additional details: http://www.odc.public.lu/actualites/2012/06/Conference_Luxembourg-Singapore/index.html

[9] For additional details: http://www.odc.public.lu/actualites/2012/07/Conference_ Wealth_and_inheritance_in_the_long_run/index.html

[10] All editions of "Perspectives de Politique Économique" can be downloaded from the website http://www.odc.public.lu/publications/perspectives/index.html

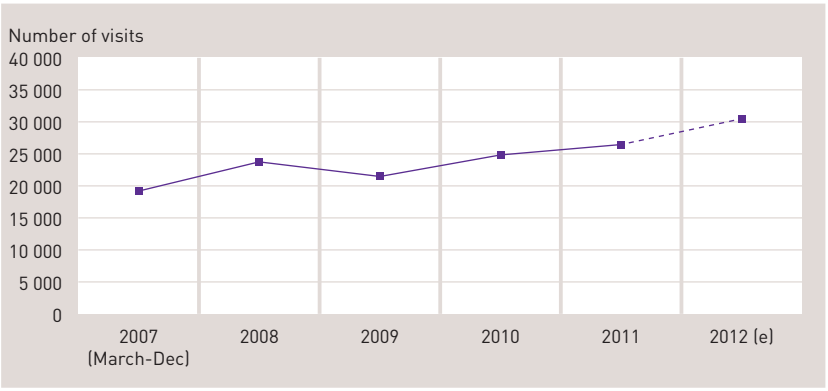
1.4.3 Information summary: The *Observatoire de la compétitivité* Newsletter

Whilst the purpose of the "Perspectives de Politique Économique" publication is a detailed analysis of scientific issues, the newsletter's purpose is to inform the general public about the work undertaken in the *Observatoire de la compétitivité*. This publication is intended both for economic players and for a wider audience[11].

1.4.4 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 Lisbon 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. The number of visits to the site has grown significantly in recent years.

Chart 1
Number of visitors to the *Observatoire de la compétitivité* website



Note: 2012 extrapolation based on data from January-September 2012

[11] The *Observatoire de la compétitivité* newsletters can be downloaded from the website http://www.odc.public.lu/publications/lettre_observatoire/index.html

1.5 An overview of the 2012 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 Competitiveness Scoreboard indicators. The calculation of a composite indicator of competitiveness based on the scoreboard allows us to understand the relative competitive position of Luxembourg.

Chapter 4 aims on the one hand at providing an overview of the European Semester, and, on the other hand, at presenting the priorities and objectives of the structural component (thematic coordination) of the Europe 2020 strategy.

Chapter 5 describes the scoreboard which has been developed within the framework of macroeconomic surveillance in Europe 2020 ("MIP" Macroeconomic imbalances procedure).

Chapter 6 deals with the conference "Competitiveness Luxembourg-Singapore: partners or rivals?" which took place in June 2012.

Chapter 7 reports on the monitoring of the *PIBien-être* ("GDProsperity") project, which was launched by the *Observatoire de la compétitivité* in 2009 in conjunction with the Economic and Social Council (ESC) and the Higher Council for Sustainable Development (CSDD).

Finally, **Chapter 8** summarizes the main results of studies commissioned as part of the research agreement between ANEC, STATEC and the *Observatoire de la compétitivité*.

2 Benchmarks and comparative competitiveness analysis

2.1 Introduction

We live in an age of statistics, indicators and international comparisons where it became easier to compare how countries, regions or even cities have managed to define and ensure their competitiveness and growth potential. This debate on territorial competitiveness is regularly revived through the publication and dissemination in media of rankings, although, since September 2008, "crisis rankings" which bring together the countries most affected by the weakening outlook for growth and the fragility of public finances have taken over. Since 2010, sovereign debt and the solvency of countries as well as financial institution stability[1], are in fact making the headlines.

It is important for governments to bring public deficits and public debt under control but this must not be the one and only purpose of economic policy. The current account imbalances due to the spiralling costs of production in some countries remind us of the importance of the concept of "cost competitiveness". The debt level decreases sufficiently only if growth resumes. Supply policies and structural issues are therefore essential in the long term to increase sustainable growth and employment, and particularly in a world economy that is becoming increasingly globalized and integrated. The concept of territorial competitiveness is in fact the result of a world that is constantly changing.

Benchmarks and composite indices allow to compare international best practices, in particular in order to learn from them. Compared to individual indicators, composite indicators used in this type of comparison can consolidate various data in a single value figure[2] that aggregates a variety of characteristics. Such composite indices also provide a rough overall image in a comparative perspective. These benchmarks remain therefore an important hot topic because they provide useful information to both public authorities and business leaders, and are also helpful to better understand why some countries are doing better than others in a globalized environment.

The aim of this chapter is to provide a descriptive overview of a series of these benchmarks published since the previous edition of the Report (2011)[3]. The interpretation of the results of such studies goes further than the mere ranking of countries on a scale of virtue, which is the most highly publicized element. Despite methodological limitations, the monitoring of these benchmarks proved to be especially important because of their media resonance, on national and international level, and their significant impact on the country image that can influence investors perception.

1 For example, see the ranking of banking institutions by Global Finance: http://www.gfmag.com/

2 For more information on composite indicators, see the website of the Joint Research Centre of the European Commission: http://composite-indicators.jrc.ec.europa.eu/

3 A list of Luxembourg's classification can be found on the website of the Observatoire de la compétitivité at the following link: 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[4].

2.2.1 WEF, IMD, Heritage Foundation and the European Commission

a. Growth Competitiveness Index

The World Economic Forum (WEF) has published its 2012-2013 comparative study of competitiveness of countries around the world, the "Global competitiveness report", which assesses the potential of the world's economies potential to achieve sustainable growth in the medium and long term[5]. In this study competitiveness is defined as "the set of institutions, policies and factors that determine the level of productivity of a country."

Frame 1
Links between competitiveness and wealth/well-being

The magazine *The Economist* has studied the link between competitiveness and well-being[6] by examining the correlation between the competitiveness index calculated by the WEF and the GDP per capita: "competitiveness brings wealth, but rich countries can most easily afford competitiveness. They can also squander it though. Outliers on the chart include countries that are more wealthy than their competitiveness suggests - or even vice-versa". On the graph, we see that Luxembourg is one of those countries that is (much) richer than its competitiveness level would suggest. However, one must keep in mind that, in this case, wealth is measured by the indicator GDP per capita, which strongly overstates wealth in Luxembourg because it does not take into account, in the denominator, the number of cross-border workers who contribute to the GDP but who are not part of the resident population. Thus for Luxembourg, instead of using this indicator, it would be more appropriate to use the GNI per capita indicator[7] that, in the numerator, only considers the domestic factors of production. This implies that the wealth created in Luxembourg is more closely aligned to its competitiveness level as measured by the WEF (Luxembourg is closer to the vertical axis of the curve estimated by *The Economist*).

[4] See Chapter 2.2.2. For more information: http://www.odc.public.lu/indicateurs/benchmarks_internationaux/index.html

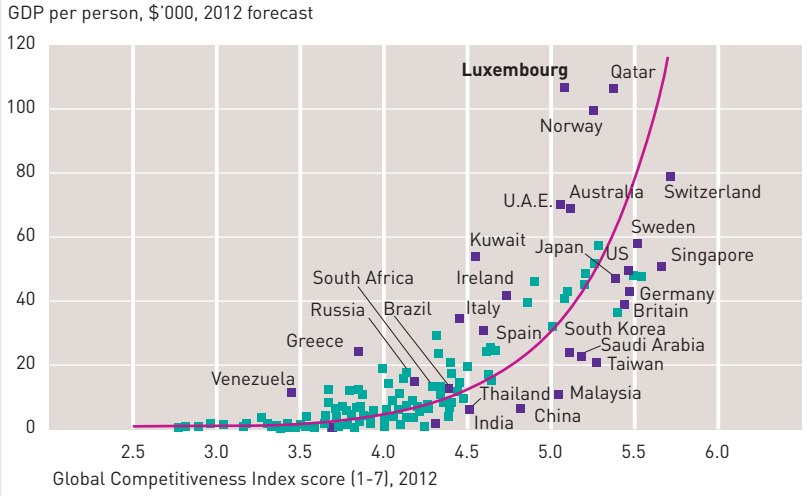
[5] For additional information: http://www.weforum.org/issues/global-competitiveness

[6] For additional details: http://www.economist.com/blogs/graphicdetail/2012/09/daily-chart-2?fsrc=gn_ep

[7] The Gross National Income (GNI) is defined as GDP plus primary income, minus income paid to the rest of the world. The level of GDP per capita is often considered to be an indicator of standard of living. However, for Luxembourg, with wide-open cross-border flows of factors and corresponding revenues, this concept leads to biased comparisons. That is why it is preferable to base comparisons on GNI per capita, which reflects the remuneration of the factors in the rest of the world.

Frame 1
Continued

Global competitiveness and GDP per person, 2012



Source: *The Economist*

The study measures the competitiveness level of 144 countries worldwide on the basis of about a hundred indicators. These indicators are split into three fundamental growth and competitiveness "pillars": the basic requirements of competitiveness (through the subcategories: institutions, infrastructure, macroeconomic environment, health and basic education), efficiency enhancers (through the subcategories: higher education and training, goods market efficiency, labour market efficiency, financial market development, technological development, market size) and innovation and sophistication factors (through the subcategories: business environment sophistication and innovation). The study takes into account the fact that countries are not at the same level of economic development, and therefore that the relative importance of the various factors of competitiveness is dependent on initial conditions. The composite index Growth Competitiveness Index (GCI), calculated to rank countries, is established using a mix of statistical data and survey results, including the annual survey of business leaders, led by the WEF in collaboration with its network of partner institutes.

In this new 2012-2013 edition of the study, the global ranking is led by Switzerland, followed by Singapore and Finland. In all, there are six European countries amongst this edition's top 10. Luxembourg is ranked 22nd in the world ranking and climbs thus one position in relation to the previous 2011-2012 report. The Netherlands occupy the 5th position, Germany is in the 6th position, Belgium ranks 17th and France 21st. The EU ranking is led by Finland, Sweden and the Netherlands, and Luxembourg is the 10th in this EU ranking.

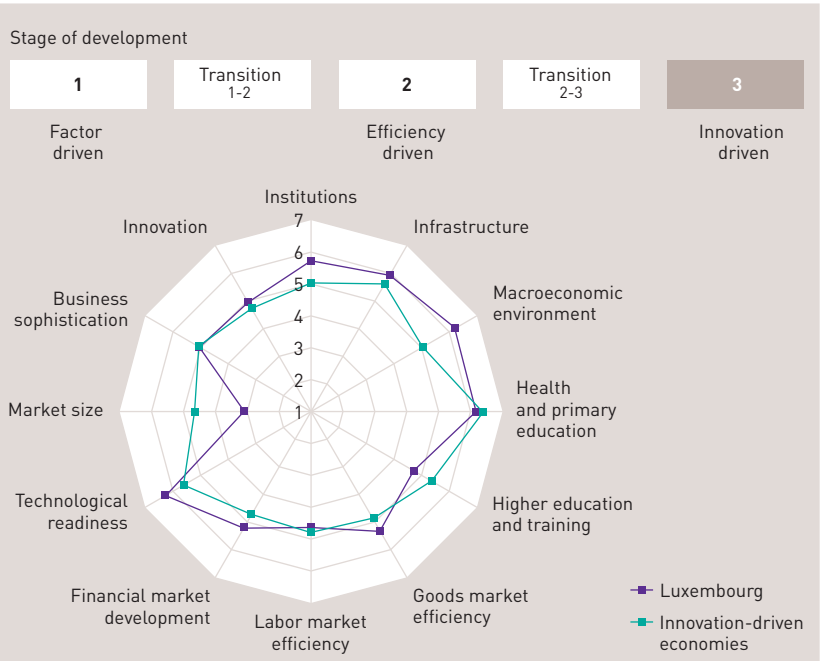
Regarding the rankings for the three fundamental pillars:

- Luxembourg is in the 8th place with regards to the basic requirements of competitiveness: within this pillar, Luxembourg is ranked 9th in terms of institutions, 12th for infrastructure, 12th for macroeconomic environment and 28th in terms of health and basic education;

- Luxembourg is in the 24th rank for efficiency enhancers: 44th for higher education and training, 4th for goods market efficiency, 37th for labour market efficiency, 12th for financial market development, 2nd for technological development and 92nd for market size;

- Luxembourg is ranked 19th place for the innovation and sophistication factors: the country is 23rd for the level of sophistication of commercial activity and, finally, 18th in terms of innovation.

Chart 1
Luxembourg's position according to the GCI (2012-2013)

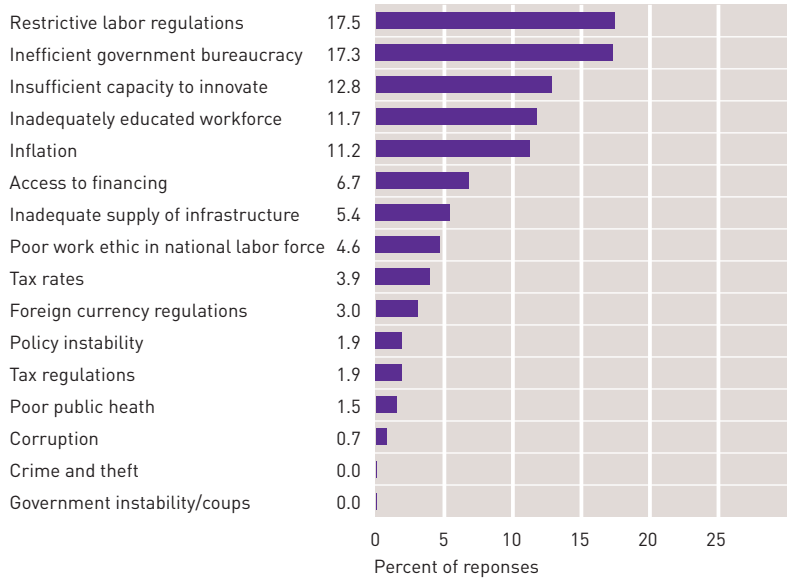


Source: WEF

Frame 2
Results of the survey made in Luxembourg (WEF survey)

A survey is conducted annually among business leaders to identify the main factors that hamper national competitiveness. More particularly, with regards to Luxembourg's survey results, it appears that the labour regulations, bureaucracy, innovation capacity, inadequately educated workforce and inflation are considered as the five most problematic factors for doing business in Luxembourg.

The most problematic factors for doing business



Source: IMD
Note: From the list of factors above, respondents were asked to select the 5 most problematic for doing business in their country and to rank them between 1 (most problematic) and 5. The figures in this chart show the responses weighted according to their ranking.

b. Global Competitiveness Index

The International Institute for Management Development (IMD) analyses on a yearly basis the countries' capacity to create and maintain an environment that supports the competitiveness of companies[8]. Wealth creation is supposed to happen at the level of companies that operate in a domestic environment, which either facilitates or hampers competitiveness. In this new edition, 59 countries are analysed through more than 300 criteria. The analysis is based on both quantitative indicators (about 2/3 of the total weight) and on the results of a yearly opinion survey. As in previous years, the IMD ranking is based on the analysis of four types of indicators: economic performance, government efficiency, business environment and quality of infrastructure.

[8] For additional details: http://www.imd.org/research/publications/wcy/index.cfm

Table 1
The overall IMD ranking (2012)

Rank 2012	Rank 2011	Country	Score 2012	Rank 2012	Rank 2011	Country	Score 2012
1	1	Hong Kong	100.00	31	33	Estonia	66.95
2	1	USA	97.75	32	36	Kazakhstan	66.89
3	5	Switzerland	96.68	33	30	Czech Republic	66.19
4	3	Singapore	95.92	34	34	Poland	64.18
5	4	Sweden	91.39	35	32	India	63.60
6	7	Canada	90.29	36	45	Lithuania	63.42
7	6	Taiwan	89.96	37	38	Mexico	63.18
8	13	Norway	89.67	38	39	Turkey	62.24
9	10	Germany	89.26	39	35	Spain	61.12
10	8	Qatar	88.48	40	42	Italy	60.64
11	14	Netherlands	87.16	41	40	Portugal	60.38
12	11	Luxembourg	86.05	42	37	Indonesia	59.50
13	12	Denmark	84.88	43	41	Philippines	59.27
14	16	Malysia	84.22	44	43	Peru	58.71
15	9	Australia	83.18	45	47	Hungary	57.34
16	28	UAE	82.49	46	44	Brazil	56.52
17	15	Finland	82.47	47	48	Slovak Republic	55.67
18	20	United Kingdom	80.14	48	49	Russia	55.16
19	17	Israel	78.57	49	53	Jordan	53.23
20	24	Ireland	78.47	50	52	South Africa	53.16
21	18	Austria	77.67	51	51	Slovenia	52.96
22	22	Korea	76.75	52	46	Colombia	51.89
23	19	China Mainland	75.77	53	50	Romania	48.93
24	21	New Zealand	74.88	54	55	Bulgaria	48.45
25	23	Belgium	73.48	55	54	Argentina	48.20
26	31	Iceland	71.54	56	57	Ukraine	46.88
27	26	Japan	71.35	57	58	Croatia	45.30
28	25	Chile	71.28	58	56	Greece	43.05
29	29	France	70.00	59	59	Venezuela	31.45
30	27	Thailand	69.00				

Source: IMD (2012)

The 2012 ranking is led by Hong Kong, the United States and Switzerland. Luxembourg is ranked 12th in the overall ranking, and the neighbouring countries of Luxembourg are ranked in 9th place (Germany), 25th place (Belgium) and 29th place (France). In a temporal perspective, Luxembourg lost 1 position compared to the 2011 and 2010 editions of the report, and 7 positions compared to 2008 when the country was still in 5th place.

Regarding the four categories that make up the composite GCI index, Luxembourg is ranked as follows:

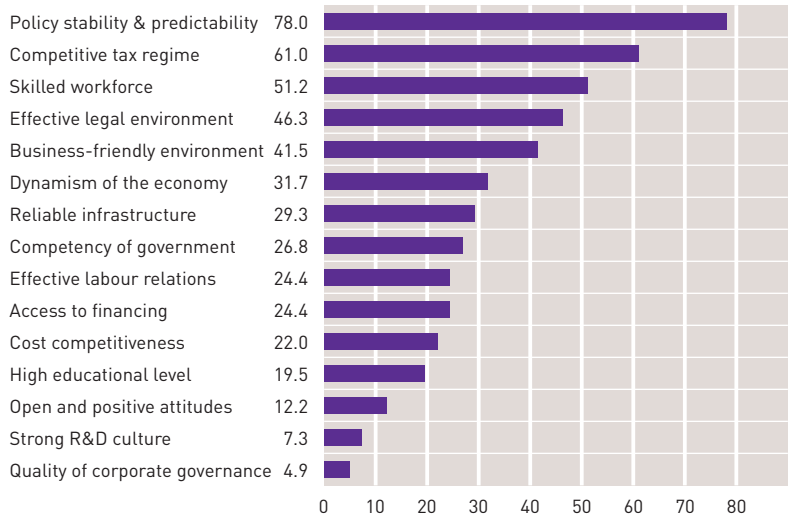
- For the first pillar of macroeconomic performance, Luxembourg climbed three positions and is in 6th place in 2012;
- For the second pillar, the effectiveness of public authorities, Luxembourg moved to 16th place and lost one position in relation to 2011;
- For the third pillar, the business environment, Luxembourg goes from 9th position in 2011 to 12th position in 2012;
- For the fourth pillar, Luxembourg drops one place since 2011 and is ranked 23rd in 2012.

Frame 3
Luxembourg's main attractiveness factors (IMD survey)

From a list of fifteen indicators, respondents in the annual survey conducted by IMD had to select the five they perceived as the key attractiveness indicators of the domestic economy in Luxembourg.

The five most frequently mentioned responses are policy stability and predictability (78%), the tax regime (61%), skilled workforce (51.2%), the legal environment (46.3%) and the business-friendly environment (41.5%).

Key attractiveness indicators



Source: IMD

As challenges for the coming years, the IMD advises Luxembourg to improve its cost competitiveness, to further diversify its economy and to restore fiscal balance with better targeted social spending and better investment planning, to reform the public sector and finally, to take measures on pensions and population aging expenditures.

c. Index of Economic Freedom

In early 2012 the Heritage Foundation published the new edition of its "Index of Economic Freedom"[9]. Economic freedom is defined as the absence of any government ability to coerce or constrain the production, supply or consumption of goods and services beyond what is necessary to protect and maintain the citizens' freedom. Economic freedom is measured through several indicators which are divided into four categories ("rule of law", "limited government", "regulatory efficiency" and "open markets"), themselves divided into sub-categories. Economic liberalism is supposed to stimulate productivity and thus growth, by encouraging entrepreneurship and creating so added value. The more open the economy (its index score is closer to 100), the fewer barriers there are to free trade, and the better ranked the country is.

Table 2
The European Heritage Foundation's Top 10 ranking

World Rank	Region Rank	Country	Overall Score	Change from 2011	Property Rights	Freedom from Corruption	Fiscal Freedom	Government Spending	Business Freedom	Labor Freedom	Monetary Freedom	Trade Freedom	Investment Freedom	Financial Freedom
5	1	Switzerland	81.1	-0.8	90.0	87.0	67.9	65.8	77.9	87.9	84.4	90.0	80.0	80.0
9	2	Ireland	76.9	-1.8	90.0	80.0	73.9	30.4	92.8	78.4	76.7	87.1	90.0	70.0
11	3	Denmark	76.2	-2.4	90.0	93.0	39.8	0.0	99.1	92.1	80.7	87.1	90.0	90.0
13	**4**	**Luxembourg**	**74.5**	**-1.7**	**90.0**	**85.0**	**63.6**	**46.6**	**75.9**	**40.9**	**81.3**	**87.1**	**95.0**	**80.0**
14	5	United Kingdom	74.1	-0.4	90.0	76.0	56.4	21.5	94.7	71.5	73.9	87.1	90.0	80.0
15	6	The Netherlands	73.3	-1.4	90.0	88.0	51.2	20.9	81.9	60.0	83.6	87.1	90.0	80.0
16	7	Estonia	73.2	-2.0	80.0	65.0	79.1	38.8	75.7	56.9	79.3	87.1	90.0	80.0
17	8	Finland	72.3	-1.7	90.0	92.0	65.4	5.2	94.9	42.4	81.3	87.1	85.0	80.0
20	9	Cyprus	71.8	-1.5	70.0	63.0	83.3	37.1	81.6	69.9	85.7	82.1	75.0	70.0
21	10	Sweden	71.7	-0.2	90.0	92.0	39.1	8.8	94.6	54.6	80.9	87.1	90.0	80.0

Source: The Heritage Foundation

The 2012 world ranking is led by Hong Kong, Singapore and Australia. Luxembourg is in 13th position among 184 countries analysed worldwide and gets a score of 74.5/100 in this 2012 edition. The country is thus considered "mostly free". Germany ranks 26th, Belgium 38th and France 67th. Within Europe, Luxembourg is in 4th position behind Switzerland, Ireland and Denmark. Within the eurozone, Luxembourg is 2nd after Ireland. Compared to the 2011 edition, the country has lost a little economic freedom.

[9] For additional details: http://www.heritage.org/index/

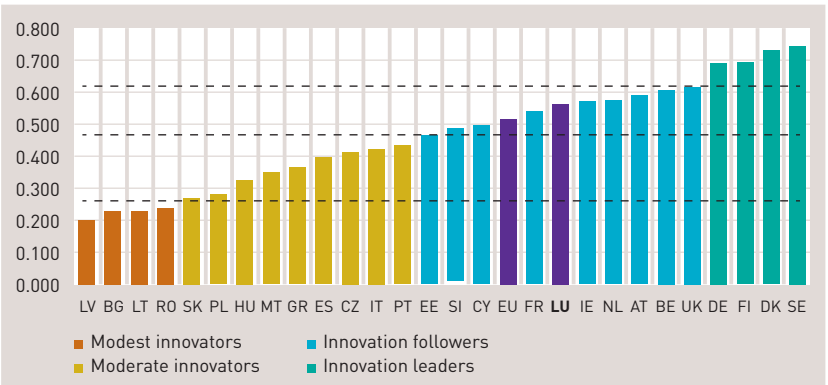
For the different subcategories, Luxembourg is characterized by:

- A very good performance in the "rule of law" category (2nd position for the "property" sub-category and 11th for "absence of corruption");
- Much more modest performances for the "limited government" category (158th for "tax regime" and 128th for "public expenditure");
- Weak performances for the category "regulatory efficiency" (50th for "business environment", 161st for "labour market" and 33rd for "monetary system");
- Very good performances in the "open markets" category (12th for trade, 1st for investment and fourth for the financial system).

d. European innovation union scoreboard

In early February 2012, the second edition of the European scoreboard "Innovation Union Scoreboard" (IUS) was unveiled[10]. This scoreboard succeeds to the European Innovation Scoreboard, which had been introduced during the Lisbon strategy (2000-2010). The purpose of this statistical tool, which is based on 25 underlying indicators divided into three sub-categories, is to monitor the implementation of the Europe 2020 strategy and in particular of the key initiative regarding innovation. It provides Member States with a comparative scoreboard of the 27 EU Member States' relative performance in terms of innovation as well as an analysis of the strengths and weaknesses of national research and innovation systems. A composite indicator is calculated using this scoreboard: the Summary Innovation Index (SII).

Chart 2
EU Member States IUS rankings (February 2012)



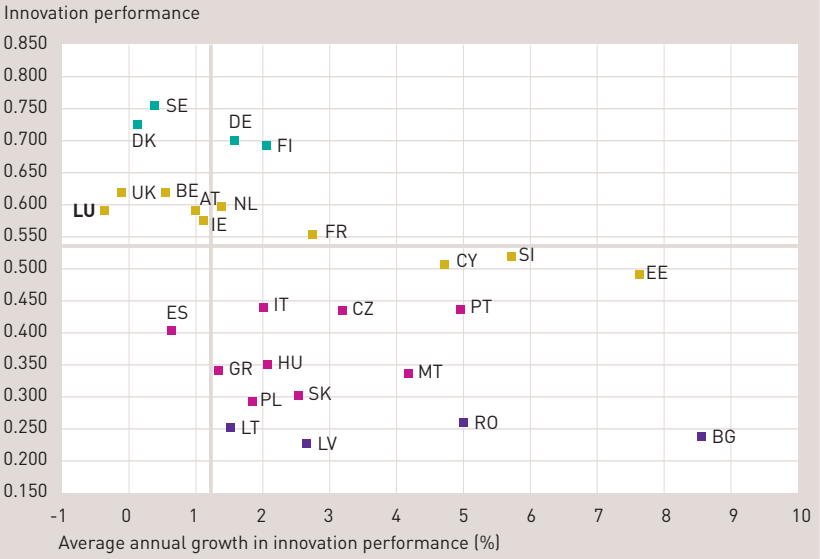
Source: IUS
Note: Average performance is measured using a composite indicator building on data for 24 indicators going from a lowest possible performance of 0 to a maximum possible performance of 1. Average performance in 2011 reflects performance in 2009/2010 due to a lag in data availability.

[10] For additional details: http://www.proinno-europe.eu/inno-metrics/page/innovation-union-scoreboard-2011

In this 2011 edition, EU Member States ranking is led by Sweden, followed by Denmark and Germany. Luxembourg is in the 9th position, Belgium in the 5th position and France in the 11th position. Luxembourg is among the countries considered as "innovation followers", displaying a better performance than the EU-27 average level, but not sufficiently effective to be among the "innovation leaders" category, reserved for countries which display innovation performances at least 20% higher than that of the EU-27 average.

The IUS scoreboard also analyses the evolution of the Member States' performances over the years. In this 2011 edition, Luxembourg is considered as part of the "slow growers", i.e. Member States with a low growth performance over the years.

Chart 3
Level and convergence in terms of performance



Source: IUS 2011

To conclude, in the 2011 edition, the relative strengths of Luxembourg are considered to be in the sub-categories relating to human resources and innovative actors. Its relative weaknesses include investments in companies, collaboration and entrepreneurship. There was some significant growth for Luxembourg in its performance relating to international co-publication, publications citations and public expenditure on R&D. A sharp decline in performance was observed in innovation expenditure not related to R&D as well as in sales of new products. Growth is estimated to have been above average in human resources, in the implementation of an open research system, that is excellence-oriented and attractive, in financing as well as in intellectual property.

e. Ranking comparison and correlation analysis

The table below shows, for illustrative purposes, the rankings of the four major composite indicators, in which Luxembourg is included, as well as the evolution of Luxembourg in relation to the previous edition[11]. It includes the twenty-five top-ranked countries for each of these rankings.

Table 3
Four major reports (published in 2012)

	N°	World Economic Forum	IMD	Heritage Foundation	European Commission
		GCI	**GCI**	**Economic freedom**	**SII**
+	1.	Switzerland	Hong Kong	Hong Kong	Switzerland
	2.	Singapore	United States	Singapore	Sweden
	3.	Finland	Switzerland	Australia	Denmark
	4.	Sweden	Singapore	New Zealand	Germany
	5.	Netherlands	Sweden	Switzerland	Finland
	6.	Germany	Canada	Canada	Belgium
	7.	United States	Taiwan	Chile	United Kingdom
	8.	United Kingdom	Norway	Mauritius	Iceland
	9.	Hong Kong	Germany	Ireland	Netherlands
	10.	Japan	Qatar	United States	**Austria / Luxembourg (-4)**
	11.	Qatar	Netherlands	Denmark	/
	12.	Denmark	**Luxembourg (-1)**	Bahrein	Ireland
	13.	Taiwan	Denmark	**Luxembourg (0)**	France
	14.	Canada	Malaysia	United Kingdom	Slovenia
	15.	Norway	Australia	Netherlands	Cyprus
	16.	Austria	United Arab Emirates	Estonia	Estonia
	17.	Belgium	Finland	Finland	Norway
	18.	Saudi Arabia	United Kingdom	Taiwan	Italy
	19.	South Korea	Israel	Macao	Portugal
	20.	Australia	Ireland	Cyprus	Czech Republic
	21.	France	Austria	Sweden	Spain
	22.	**Luxembourg (+1)**	South Korea	Japan	Hungary
	23.	New Zealand	China	Lithuania	Greece
	24.	United Arab Emirates	New Zealand	St. Lucia	Malta
-	25.	Malaysia	Belgium	Qatar	Croatia

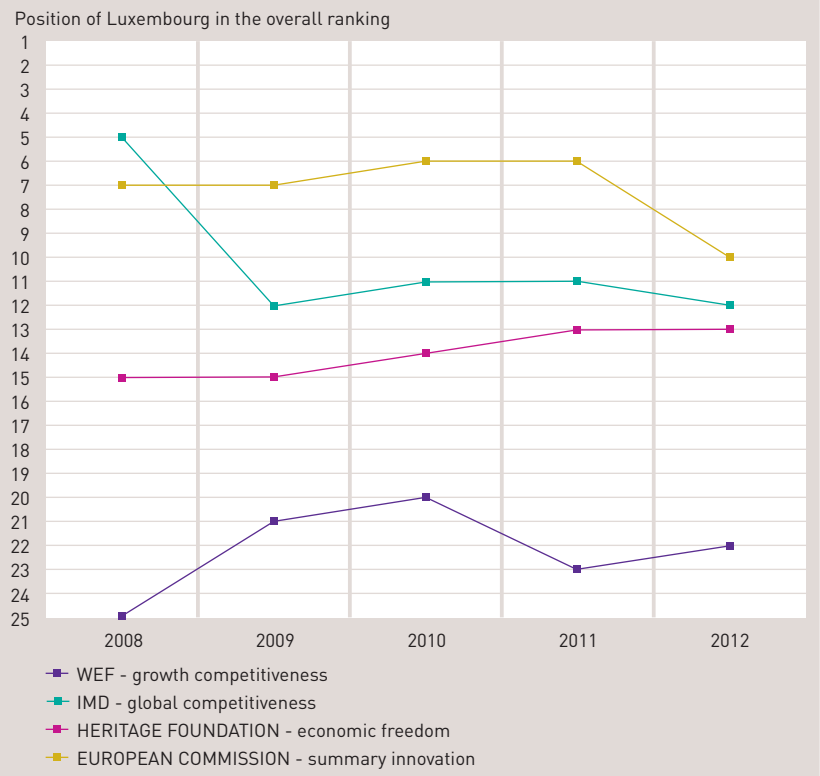
Notes: The figures in brackets describe the Luxembourg's evolution compared to the previous year; a plus or a minus sign refers to a favourable or unfavourable evolution, and the number 0 indicates the same rank as the previous edition.
Luxembourg's neighbouring countries (Germany, Belgium, France), and the Netherlands as member of the Benelux, are marked in green when their ranking is better than that of Luxembourg, and in red if the reverse occurs.

For these four major rankings, it is possible to make an analysis of Luxembourg's evolution[12]. For example, since the last edition of the Report (2011), i.e. in reports published between fall 2011 and fall 2012, Luxembourg has evolved as follows: in the overall WEF ranking, Luxembourg is ranked 22nd and climbed 1 position; in the world ranking IMD it ranks 12th with the loss of 1 position, in the Heritage Foundation's world ranking it is 13th and remains constant and, finally, in the IUS ranking it is ranked 10th and has lost 4 positions.

[11] Annual changes in country rankings are to be viewed with a certain caution, because methodological changes in the calculation of the indices may have occurred over the years without a recalculation of the ranks for all the years displayed on the table.

[12] The chronological series which show the ranking evolution of countries for different benchmarks are to be viewed with a certain caution. Methodological changes may have occurred in the calculation of the indices without a recalculation of the ranks for all the years displayed on the table, or the number of countries or cities compared may also have changed over the years.

Chart 4
Evolution of Luxembourg in the overall rankings (2008-2012)



Note: The time axis refers to the year of publication of the report

By extracting only the European countries[13] from these twenty-five best countries in the world rankings, it appears for example that Luxembourg ranks 12th in the WEF European rankings (10th within the EU), 6th in the IMD ranking (4th within the EU), 4th in the ranking of the Heritage Foundation (3rd within the EU)[14] and 10th in the ranking of the European Commission (8th within the EU).

Table 4
European ranking of key competitiveness and growth indicators

N°	World Economic Forum	IMD	Heritage Foundation	European Commission
1	Switzerland	Switzerland	Switzerland	Switzerland
2	Finland	Sweden	Ireland	Sweden
3	Sweden	Norway	Denmark	Denmark
4	Netherlands	Germany	**Luxembourg**	Germany
5	Germany	Netherlands	United Kingdom	Finland
6	United Kingdom	**Luxembourg**	Netherlands	Belgium
7	Denmark	Denmark	Estonia	United Kingdom
8	Norway	Finland	Finland	Iceland
9	Austria	United Kingdom	Cyprus	Netherlands
10	Belgium	Ireland	Sweden	**Austria / Luxembourg**
11	France	Austria	Lithuania	/
12	**Luxembourg**	Belgium	Germany	Ireland

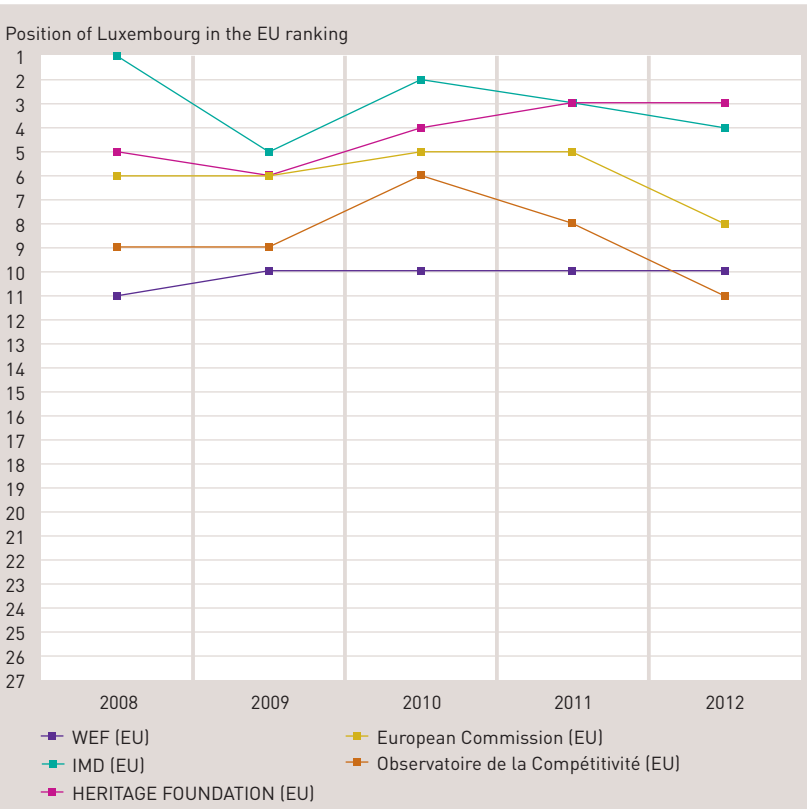
Source: Observatoire de la compétitivité

[13] All things being equal, without recalculating the indices.

[14] The European Commission ranking does not change, because only European countries are taken into account ahead of Luxembourg.

Within the EU, Luxembourg's position between 2011 and 2012 remained constant for two rankings (WEF and Heritage Foundation) and deteriorated for the other two (IMD and European Commission).

Chart 5
Luxembourg's evolution within the EU-27 rankings (2008-2012)



Note: The time axis refers to the report's year of publication
Calculations: Observatoire de la compétitivité

Since we have the annual temporal series for Luxembourg's evolution within these four major rankings, it is interesting to compare these four evolutions with that displayed in the competitiveness scoreboard[15] of the *Observatoire de la compétitivité*, which was established in 2004 and published annually since then under the present Competitiveness Report. Luxembourg's competitiveness within the EU-27 ranking has deteriorated since 2010, from 6th place in 2010 to 8th in 2011 and 11th place in the present Competitiveness Report 2012.

[15] For more details on this national composite index, see Chapter 3 of this 2012 Competitiveness Report.

Frame 4

Luxembourg's evolution within the total ranking and within the EU ranking

Calculations: Observatoire de la compétitivité

It is also interesting to analyse the correlation between these four major international rankings. Kendall's coefficient lends itself to this type of analysis. In fact, it measures the degree of agreement between the rankings made by several institutions (four, in this case). This correlation was calculated using the available EU countries in each of these four rankings[16]. Kendall's coefficient takes a value between 0 (when there is no relationship between the rankings) and 1 (when the rankings and judges correlate perfectly). In the previous Reports, there was a strong correlation between the rankings of the four major institutes.

Table 5
Adjusted ranking of EU Member States included in the four studies

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

Source: Observatoire de la compétitivité

In this 2012 edition, Kendall's coefficient is 0.83. So there is, as in previous years, a correlation between the rankings made by different institute[17]. So, even if the four institutes claimed to calculate different composite indicators, the rankings are, in general, strongly correlated.

[16] UThe EU-27 excluding Cyprus, Latvia and Malta.
Note: it is not the same list of countries as the one used in the previous Competitiveness Reports. In this 2011 edition, only EU Member States are taken into account.

[17] Kendall's coefficient for the same countries (27) was 0.86 for 2006, 0.83 for 2007, 0.86 for 2008, 0.87 for 2009, 0.84 for 2010 and 0.83 in 2011. Comparability between the results from 2011 and those from previous editions is therefore limited. On the one hand, another list of countries was used (only countries belonging to the EU), and secondly the SII indicator calculated by the European Commission from 2011 comes from the European Innovation Union Scoreboard (EIU) and not from the European Innovation Scoreboard (EIS).

2.2.2 Other benchmarks

Besides the four composite indicators reviewed in the previous section, there are a multitude of other composite indices and competitiveness rankings, or determinants of competitiveness. Some of these indices and rankings will be reviewed below.

a. General indicators of competitiveness

a.1 Euro Monitor

In December 2011 the company Allianz editiond a new edition of its study on the ability of each of the 17 eurozone Member States to develop sustainable growth, without macroeconomic imbalances, in order to contribute to the stability of the eurozone as a whole[18]. The study is based on a scoreboard which is made of fifteen quantitative indicators, split into four categories: public finances sustainability; competitiveness and domestic demand; employment, productivity and resource efficiency; private debt and foreign debt. The final score assigned to a country varies between 1 and 10: for each indicator, a score ranging from 1 to 4 is given to bad performances, a score between 5 and 7 for average performances and a score between 8 to 10 for good performances. According to the authors of this study, a good national performance in these four categories is essential for a country to earn the confidence of financial markets and ensure a degree of prosperity to its citizens.

Germany leads the overall ranking of this 2011 edition (overall score of 7.6), followed by Luxembourg (7.2) and Austria (7.0). As in the previous edition (2010), no country in the eurozone has really found its way to a totally sustainable, imbalanced growth.

Regarding the four analysed categories, on which the overall ranking is based:

- Luxembourg has demonstrated a good performance in terms of public finance sustainability (2nd place, score of 7.5), except for the indicator relating to expenditure on an ageing population, for which the country is in penultimate position;

- In terms of competitiveness and domestic demand, Luxembourg is in 5th position (with an overall score of 7.3). Luxembourg has performed well in general, but the study does also point out that Luxembourg could do better in terms of unit labour costs, for which the country is at the bottom of the table. In this second category, Luxembourg has also lost four positions in the overall ranking since 2006;

- Luxembourg is in 5th position overall (with a score of 6.3) for the category of employment, productivity and resource efficiency. Luxembourg has a relatively good performance for this category, with the exception of labour productivity growth, for which the country ranks last (annual average over the past five years);

- Luxembourg is not included in the overall ranking of the study for the category of private debt and foreign debt, due to lack of sufficient data on the national level.

[18] For additional details: https://www.allianz.com/de/economic_research/publikationen/spezialthemen/monitor11d.html

Table 6
Euro Monitor 2011 ranking

Rank 2011		EMU Member State	Average Rating 2011	Rank 2010	Average Rating 2010	Rank 2006	Average Rating 2006
1	DE	Germany	7.6	1	7.1	3	7.3
2	**LU**	**Luxembourg**	**7.2**	**2**	**7.1**	**1**	**8.0**
3	AT	Austria	7.0	3	6.7	2	7.5
4	NL	Netherlands	6.9	3	6.7	3	7.3
5	SK	Slovakia	6.3	5	6.0	10	6.3
6	FI	Finland	6.3	6	5.8	5	7.1
7	EE	Estonia	6.1	10	5.3		
8	BE	Belgium	6.0	8	5.5	8	6.6
9	MT	Malta	5.7	9	5.4	12	5.7
10	FR	France	5.7	11	5.3	8	6.6
11	SL	Slovenia	5.3	7	5.5	6	6.9
12	IT	Italy	4.9	13	4.9	11	5.9
13	ES	Spain	4.5	14	4.0	13	5.6
14	CY	Cyprus	4.3	12	4.9	13	5.6
15	PT	Portugal	3.9	15	3.9	16	4.7
16	IE	Ireland	3.7	16	3.5	6	6.9
17	GR	Greece	2.2	17	2.5	15	5.3

Source: Allianz

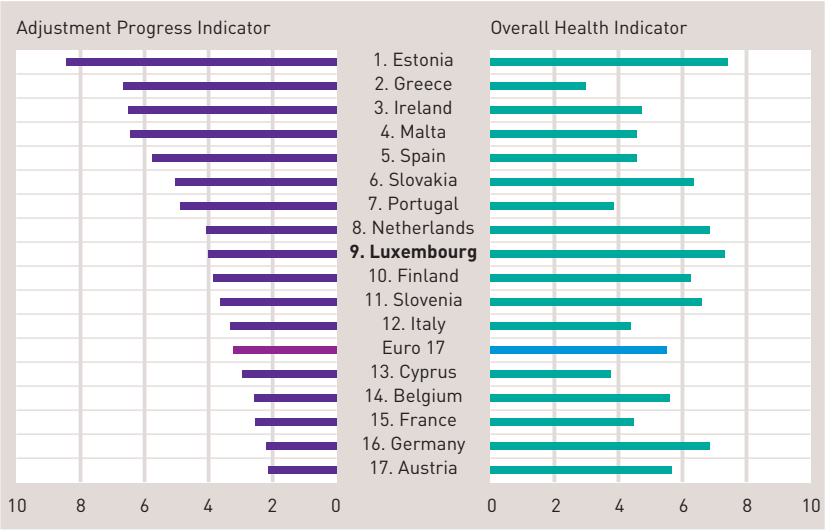
a.2 Euro plus monitor

German bank Berenberg Bank and the Brussels think tank The Lisbon Council have published a new study on the health status and potential development of eurozone Member State economies[19]. This paper analyses and classifies eurozone Member States according to two criteria: on one hand from the point of view of the overall health of their economy (using the overall health indicator), and secondly from the ability to adjust to the challenges that will arise in the coming years (adjustment progress indicator). The analysis is based on four categories of indicators: growth potential, competitiveness, public finance sustainability and recovery ability. Countries are then ranked by category and by underlying indicator on a virtue scale from 0 (bad) to 10 (good).

Overall, Luxembourg is much better placed in terms of the overall health of the economy (second, score 7.3) than for its ability to adjust to the challenges that will arise in the coming years (9th, score 4.0).

[19] For additional details: http://www.lisboncouncil.net/publication/publication/68-the-2011-euro-plus-monitor.html

Chart 6
Ranking of eurozone countries



Source: Berenberg Bank / The Lisbon Council

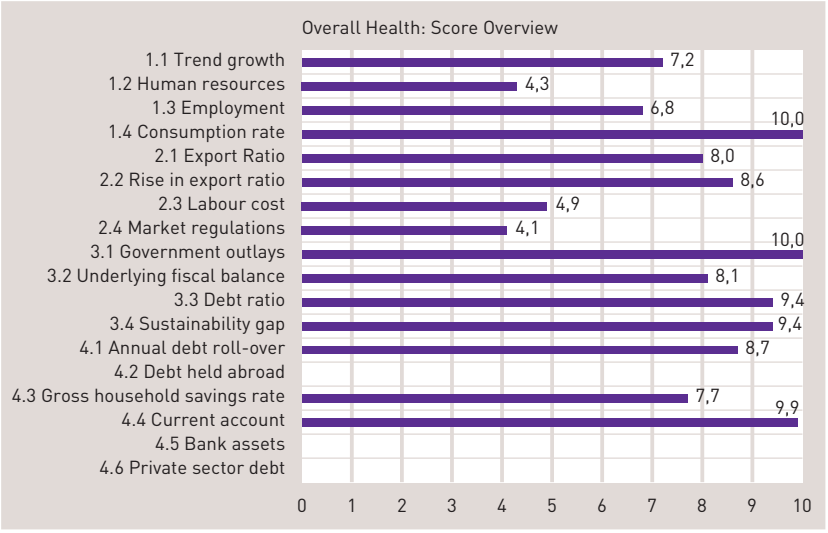
Regarding the health of the economy, Luxembourg's ranking is as follows:

- For growth potential, Luxembourg is ranked 2nd among eurozone Member States (score of 7.1);
- In terms of competitiveness, Luxembourg is ranked 8th (score of 6.4);
- In terms of public finances sustainability, Luxembourg is ranked 2nd (score of 9.2);
- For recovery ability, Luxembourg ranks 6th (score of 6.6).

Regarding the ability to adjust to future challenges, Luxembourg's ranking is as follows:

- Luxembourg is 10th in terms of external adjustment (score of 3.3);
- Luxembourg is 15th (score of 1.9) on situation and medium-term fiscal pressure;
- Luxembourg is 5th (score of 6.8) in terms of changes in real unit labour costs.

Chart 7
Overall assessment of Luxembourg



Source: Berenberg Bank / The Lisbon Council

Luxembourg's success is attributed to its openness and its important financial centre, two factors that allow the country to afford a high level of regulation (including in the labour market). The strength of its public finances, its strong growth potential compared to other eurozone Member States, its public balances and the low level of private and public consumption are regarded as being Luxembourg's strengths. The excessive regulation of services, a great dependence on the financial sector and a high level of protection on the labour market are regarded as the main weaknesses of the Luxembourg economy.

a.3 European cities and regions of the future

In February 2012, fDi Magazine (which belongs to the *Financial Times* group) published a new edition of its study that measures the attractiveness of European cities and regions for foreign investors[20]. This attractiveness is measured from incoming foreign investments, economic development and growth potential. The indicators are split into six categories: economic potential, human resources, cost, quality of life, infrastructure and business environment. A seventh category includes policies implemented to promote foreign investment. FDi Magazine's ranking is based partly on quantitative data and secondly on experts opinions. According to measured performances, cities and regions are rated on a scale of 1 to 10 (maximum). Overall, there are four different rankings categories, depending on the size of the cities analysed: a distinction is made between the cities considered "major", "large", "small" and "micro". In the ranking published in February 2012, Luxembourg City is one of the cities considered as belonging to the category of "micro" with a population of less than 250,000 inhabitants.

[20] For additional details: http://www.pwc.be/en_BE/be/publications/2012/tax-freedom-day-2012.pdf

Luxembourg City is considered as having the highest economic potential among the cities of this category, and also ranks well in terms of quality of life (2nd) and business environment (2nd).

Table 7
Top 10 micro cities with economic potential Ranking

Rank	City	Country
1	**Luxembourg**	**Luxembourg**
2	Stavanger	Norway
3	Cambridge	UK
4	Geneva	Switzerland
5	Bergen	Norway
6	Linz	Austria
7	Slough	UK
8	Monaco	France
9	Shannon	Ireland
10	Basel	Switzerland

Source: fDi Magazine (February-March 2012)

b. Attractiveness and tax competitiveness indicators

b.1 Tax freedom day 2012

PwC (Belgium) has published its 2012 report on the national tax burden called "tax freedom day"[21]. In this study PwC estimates the total tax burden of a country, especially the burden for the average citizen. PwC extrapolates this tax burden estimated by a date, called "tax freedom day", i.e. the day of the year from which taxpayers begin to work to cover personal expenses and where they no longer fund the state. This symbolic day is established on the basis of the total tax burden as a percentage of total income, and it is estimated by dividing the total tax revenue of the government by the country's GDP. All taxes collected by the government are taken into account (central and local government), as well as social welfare contributions. Direct taxes consist of taxes on personal income, tax on corporate income and taxes related to property. VAT and excise duties are indirect taxes.

During the current financial and economic crisis, many governments have taken fiscal decisions to balance their budgets, which generally resulted in an increase of the national tax burden. Therefore, the date has tended to appear later in 2012 compared to previous years. For Luxembourg, PwC calculations show a rate of 38.11% for 2012, which is equivalent to the date of May 20 for the year 2012. The tax freedom day estimated is thus slightly later from 2009 (14 May 2009). In 2012 Luxembourg is in 5th position among the countries surveyed by PwC, ahead of the Netherlands (May 23), Germany (June 3), France (June 12) and Belgium (14 June).

[21] For additional details: http://www.pwc.be/en_BE/be/publications/2012/tax-freedom-day-2012.pdf

Table 8
Ranking of countries according to maturity "Tax Freedom Day"

Country	2009	2010	2011	2012
Slovakia	27 April	20 April	20 April	10 April
USA	13 April	9 April	12 April	17 April
Cyprus		30 April	28 April	1 May
Hungary	2 June	18 May	9 May	17 May
Luxembourg	**14 May**	**16 May**	**10 May**	**20 May**
The Netherlands	24 May	19 May	23 May	23 May
United Kingdom	14 May	30 May	30 May	30 May
Austria	1 June	2 June	2 June	2 June
Germany	8 June	27 May	28 May	3 June
Greece	20 May	25 May	30 May	7 June
Italy	10 June	6 June	5 June	8 June
France	11 June	31 May	6 June	12 June
Belgium	8 June	8 June	10 June	14 June
Norway	16 June	17 June	16 June	17 June
Denmark	25 June	25 June	20 June	20 June
Sweden	5 July	12 July	2 July	30 June

Source: PwC (2012)
Calculated by dividing the total tax revenue of general government by a nation's gross domestic product. Figures are based on estimate data.

Taxes levied by the government in an organized civil society are used to pay for public services (education, health, infrastructure). Countries must therefore find the right balance between a reasonable total tax burden and the provision of good quality public services.

c. Financial sector attractiveness and competitiveness indicators

c.1 Global Financial Centres Index

In September 2012, the consultancy bureau Z/Yen and the Long Finance initiative published the 12th edition of the biannual competitiveness index of 77 financial centres around the world, the "Global financial centres index"[22]. In a world that is increasingly globalized and interconnected through information technology and communication, financial centres face more intense competition than other sectors. Financial services are indeed at the heart of the global economy, acting as international trade and foreign investment facilitators.

The study uses two types of sources in order to assess the competitiveness of financial centres. On the one hand, the study uses 86 quantitative determinants (e.g. the cost of office space), and on the other hand, it resorts to an appreciation barometer taken from online surveys targeting relevant professionals. According to the definition in this study, competitiveness consists of five categories of indicators: human resources (education/training, flexibility, etc.), the business environment (taxes, regulation, etc.), market access (security, clustering, etc.), infrastructure (cost and availability of offices, etc.) and the broad determinants of competitiveness (perception of cities as a pleasant place to live, etc.).

[22] For additional details: http://www.longfinance.net/fcf-gfci.html

Table 9
The Top 25 global financial centres

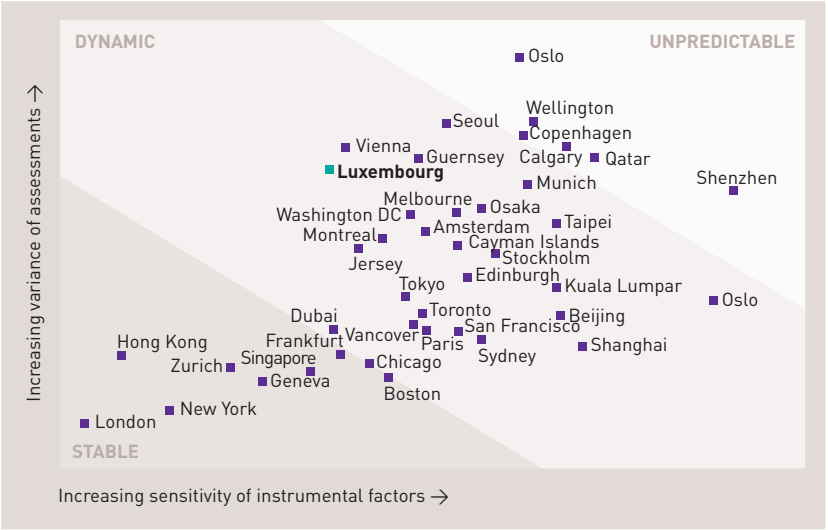
	GFCI 12		GFCI 11		Changes	
Centre	**Rank**	**Rating**	**Rank**	**Rating**	**Rank**	**Rating**
London	1	785	1	781	–	↑ 4
NewYork	2	765	2	772	–	↑ 7
Hong Kong	3	733	3	754	–	↓21
Singapore	4	725	4	729	–	↓ 4
Zurich	5	691	6	689	↑ 1	↑ 2
Seoul	6	685	9	686	↑ 3	↓ 1
Tokyo	7	684	5	693	↓ 2	↓ 9
Chicago	8	683	7	688	↓ 1	↓ 5
Geneva	9	682	14	679	↑ 5	↑ 3
Toronto	10	681	10	685	–	↓4
Boston	11	680	11	684	–	↓4
San Francisco	12	678	12	683	–	↓5
Frankfurt	13	677	13	681	–	↓4
Washington D.C.	14	672	15	677	1	↓5
Sydney	15	670	16	674	1	↓4
Vancouver	16	668	17	667	1	↑ 1
Montreal	17	667	18	658	1	↑ 9
Melbourne	18	657	20	653	↑ 2	↑ 4
Shanghai	19	656	8	687	↓ 11	↓ 31
Jersey	20	654	21	652	↑ 1	↑ 2
Osaka	21	650	24	647	↑ 3	↑ 3
Dubai	22	648	29	641	↑ 7	↑ 7
Calgary	23	647	28	642	↑ 5	↑ 5
Luxembourg	**24**	**646**	**23**	**648**	**↓ 1**	**↓ 2**
Munich	25	645	19	656	↓ 6	↓ 11

Source: Long Finance & Z/Yen (2012)

London, New York and Hong Kong are again the top three in this new edition of the study. Luxembourg is ranked 24th worldwide and loses 1 position in relation to the previous semi-annual ranking (March 2012). At the European level, Luxembourg is ranked 5th behind London (1st world ranking), Zurich (5th), Geneva (9th) and Frankfurt (13th).

One of the findings of this study is that Luxembourg is in 6th place of the financial centres that will play a more significant role in the future, according to the respondents (from an online survey). Luxembourg is also considered in this new edition, together with Moscow, as a global financial centre belonging to the category of "emerging global contender", because although its activities appear to be internationally recognized, the range of financial services is not yet considered to be broad and deep enough. Finally, we can find again in this study an analysis of the volatility of the various financial centres. In this context, Luxembourg is considered as a "dynamic" financial centre, which lies between the financial centres considered as "stable" and those considered as "uncertain", i.e. a financial centre which has the potential to evolve in either direction.

Chart 8
Variance of assessments versus sensitivity to instrumental factors



Source: Long Finance & Z/Yen (2012)

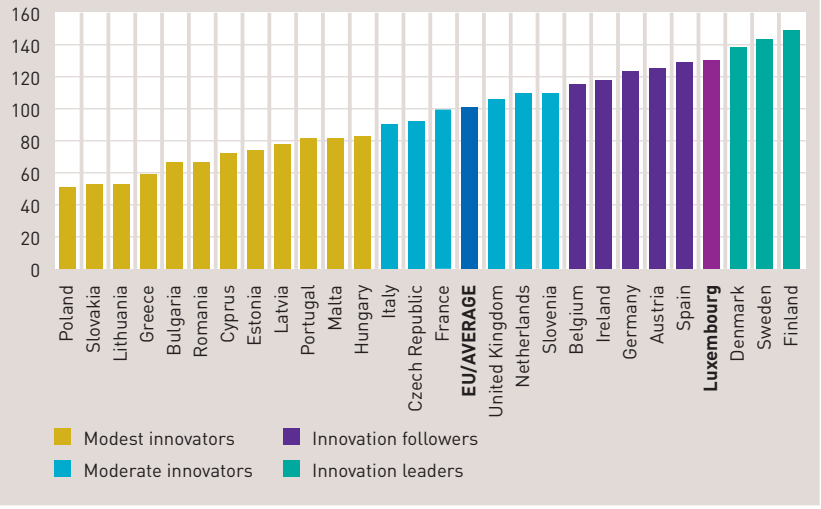
d. Innovation indicators

d.1 Eco-innovation scoreboard

The Eco-innovation observatory (EIO) has published the 2011 edition of its annual report on eco-innovation within the EU[23]. It defines eco-innovation as an innovation that reduces the use of natural resources and decreases the release of harmful substances across the whole life-cycle. In a period marked by an increasingly pronounced shortage of natural resources, eco-innovation is an opportunity to reduce the consumption of natural resources as well as to increase the productivity and hence the competitiveness of companies. In this way, eco-innovation allows to "dematerialize" the economy through increased business efficiency (cost reduction) and the development of new products and services. Measuring this eco-innovation at the level of whole economies, i.e. at the country level, allows us to identify the strengths and weaknesses and to compare the performance of the national systems in use. To this end, the EIO has developed a scoreboard called the "Eco-Innovation Scoreboard", which reflects the main outline of inputs (e.g. R&D) and outputs (e.g. patents) in eco-innovation. Based on the scoreboard indicators, the EIO also calculates a composite index to compare the overall performance of countries.

[23] For additional details: http://www.eco-innovation.eu/index.php?option=com_content&view=article&id=420&Itemid=210

Chart 9
Eco-innovation scoreboard 2011



Source: EIO

Finland, Sweden and Denmark occupy the top three spots in the 2011 edition of the EIO scoreboard. Luxembourg is ranked 4th among the 27 Member States of the EU.

d.2 Global innovation policy index

Innovation has become a key determinant of economic growth over recent years. In order to increase their competitiveness, many countries have implemented and are implementing innovation policies which are expected to increase the use of ICT, to help companies increase their productivity and to foster the creation of new businesses that create high added value.

In this context, in 2012 the Information Technology and Innovation Foundation (ITIF) released a new report on innovation policies implemented in 55 countries around the world[24]. According to the authors of the study, an effective innovation policy means more than the mere promotion of scientific research or the creation of high-tech products. Actually, such a policy must also ensure the pursuit of productivity and it must also coordinate various sectoral policies, whether it be at the levels of promoting skills, scientific research, information technology and communication, taxation, trade, intellectual property, public markets, standardization, etc. The report uses a total of 84 indicators to measure the performance of countries across seven sub-categories of policies intended to have a positive impact on innovation: trade, science and R&D, ICT, intellectual property, domestic competition, public markets, as well as high-skill immigration. Based on these indicators, countries are then classified into sub-categories according to their performance in four groups: upper tier (the best performances), upper-mid tier, lower-mid tier and lower tier (the worst performances).

[24] For additional details: http://www.itif.org/events/global-innovation-policy-index

The authors then calculate a composite index called "Global Innovation policy index", from the bulk of indicators and sub-categories, to measure the performance of national policies in order to identify the best practices. According to this overall composite index, Luxembourg is in the second group of countries (upper-mid tier), as is Belgium. Germany and France are included in the first group (upper tier).

Chart 10
Ranking of national innovation policies according to ITIF

Upper Tier	Upper-Mid Tier	Lower-Mid Tier	Lower Tier
Australia	Belgium	Brazil	Argentina
Autria	Cyprus	Bulgaria	India
Canada	Czech Republic	Chile	Indonesia
Chinese Taipei	Estonia	China	Mexico
Denmark	Hungary	Greece	Peru
Finland	Iceland	Italy	Philippines
France	Ireland	Latvia	Russia
Germany	Israel	Malaysia	Thailand
Hong Kong	Lithuania	Poland	Vietnam
Japan	**Luxembourg**	Romania	
Netherlands	Malta	Slovak Republic	
New Zealand	Portugal	South Africa	
Norway	Slovenia	Turkey	
Singapore	South Korea		
Sweden	Spain		
Switzerland			
United Kingdom			
United States			

Source: ITIF

Luxembourg's performances vary from one sub-category to another:

- Luxembourg is in the first group for trade, intellectual property and public markets;
- Luxembourg is in the second group for ICT;
- Luxembourg is in the third group for domestic market competition and high-skill immigration;
- Luxembourg is in the fourth group for science and R&D.

d.3 Global innovation index

Over recent months, the economic policy discussions were mainly focused on the austerity measures that are to be implemented in order to balance public finances. But recently, this focus has been increasingly questioned and criticized in the public debate and economic policy has shifted and focuses now more on means to implement in order to achieve sustainable growth in the long term. Innovation is a crucial determinant of sustained economic growth in the long term. Innovation is a determining factor of a long-term increased economic growth. Analysis and indicators are needed to assess the innovation ability and the implemented innovation policies.

INSEAD, in collaboration with the World Intellectual Property Organization (WIPO) has published the 2012 edition of its study "Global Innovation Index" (GII)[25]. The study focuses in particular on the interaction between the various agents of the innovation system: companies, public sector, higher education and society. The study includes a total of 141 countries around the world. The GII overall composite index is calculated considering two sub-indicators: the inputs (institutions, human resources and research, infrastructure, market sophistication and business environment sophistication) and the outputs (knowledge and technology, creativity) of the innovation system.

The world ranking of this 2012 edition is led by Switzerland, followed by Sweden and Singapore. Luxembourg is in 11th place, ahead of its neighbouring countries: Germany is ranked 15th, Belgium 20th and France 24th. The European ranking is led by Switzerland, Sweden and Finland, and Luxembourg occupies the 8th place.

Table 10
The Top 20 Global Innovation Index ranking

Country/Economy	Score (0-100)	Rank
Switzerland	68.2	1
Sweden	64.8	2
Singapore	63.5	3
Finland	61.8	4
United Kingdom	61.2	5
Netherlands	60.5	6
Denmark	59.9	7
Hong Kong (China)	58.7	8
Ireland	58.7	9
United	57.7	10
Luxembourg	**57.7**	**11**
Canada	56.9	12
New Zealand	56.6	13
Norway	56.4	14
Germany	56.2	15
Malta	56.1	16
Israel	56.0	17
Iceland	55.7	18
Estonia	55.3	19
Belgium	54.3	20

Source: INSEAD

[25] For additional details: http://www.globalinnovation-index.org/gii/

Within the two pillars on which the overall composite index is calculated:

- Luxembourg is ranked 14th in the world for inputs (19th for institutions; 12th for human resources and research; 18th for infrastructure; 23rd for market sophistication; 5th for business environment sophistication;

- Luxembourg is ranked 10th in the world for outputs (18th for knowledge and technology; 6th for creativity).

In conclusion, Luxembourg climbed 6 positions since the 2011 report, from the 17th in the world in 2011 to 11th in 2012.

e. Globalisation indicators

e.1 KOF Index of Globalization

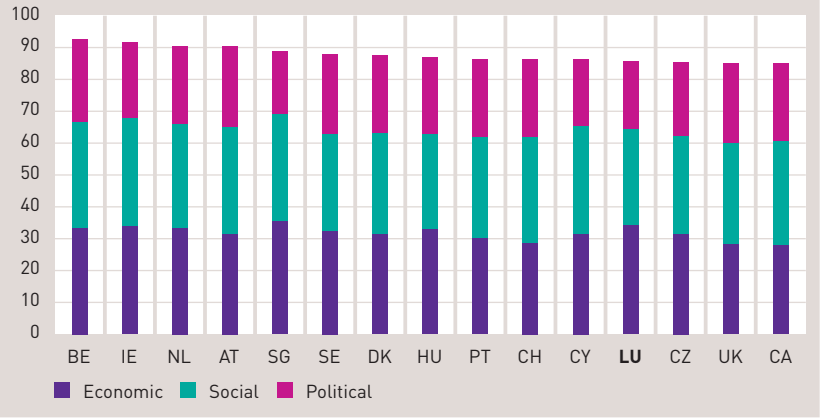
The "KOF Index of globalization" composite index from the Swiss Polytechnic ETH (Zurich)[26] measures the economic, social and political globalization and is based on a set of 24 variables. The economic sub-category measures the flow of goods, services and capital, as well as the information and perceptions related to trade exchanges. It also measures the barriers to capital flows and trade. The social sub-category measures the broadcasting of ideas and information, images, people, etc. The political sub-category reflects the dissemination of government policies, such as the number of embassies in the country, the importance of being affiliated with international organizations, etc. Based on these three sub-categories, the KOF index measures globalization on a scale of 1 (least globalized) to 100 (most globalized). The data used in this new edition dates from 2009.

The overall 2012 ranking is led by Belgium, Ireland, the Netherlands and Austria. Luxembourg ranked 12th in the 2012 edition of this study (a score of 86,02 out of 100).

Luxembourg's performance is particularly high in the economic sub-category for which the country has a score of 94.63 (2nd position). For the social sub-category, the country has a score of 81.14 (20th position) and for the political sub-category, a score of 81.00 (62nd).

[26] For additional details: http://unctad.org/en/Pages/DIAE/World%20Investment%20Report/WIR2012_WebFlyer.aspx

Chart 11
The 15 most globalized countries in the world



Source: ETH (2012)

e.2 World investment report

In 2012, the United Nations Conference on Trade and Development (UNCTAD) published a new edition of its report[27] on investment across the world, the "World investment report 2012". This report includes, among others, three indices and rankings intended to measure the performance of countries in terms of their attractiveness for foreign direct investment (FDI), their potential for attracting FDI as well as the contribution of FDI to the development of the real national economy. The purpose of these indices is to help policy-makers to assess the effectiveness of the national policies in place and to allow a comparison between countries' performances and their theoretical attraction potential, as well as to compare their performances with those of other countries.

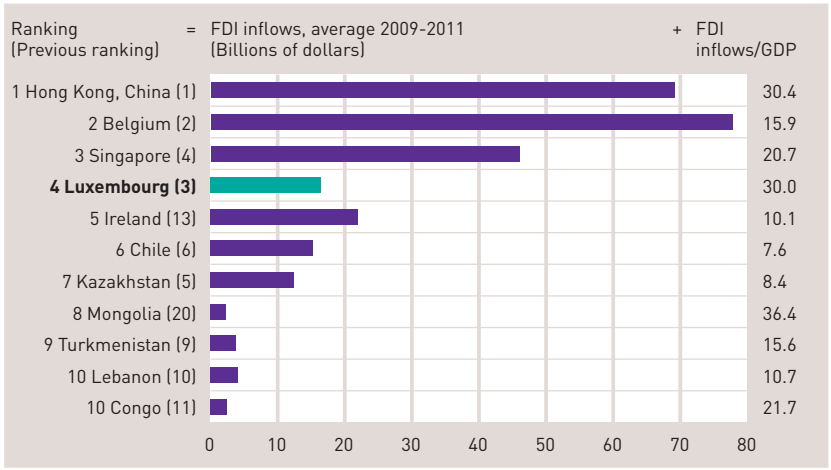
In terms of national attractiveness for FDI (attractivity index), measured in total FDI absolute flows between 2009 and 2011 compared to the size of the national economy, the ranking is led by Hong Kong, followed by Belgium and Singapore. Luxembourg is ranked 4th and loses one position since the previous edition. In general, the best performing countries in this first ranking provide a business environment conducive to investment and are often gateways to larger regional markets and enjoy very high levels of FDI compared to the size of the national economy.

[27] For additional details: http://unctad.org/en/Pages/DIAE/World%20Investment%20Report/WIR2012_WebFlyer.aspx

The second index (potential index) measures four key factors of a country's attractiveness for FDI: the market, the local availability of low cost labour and skills, natural resources and infrastructure. These four factors have the same weight in the calculation of the potential attraction index. While Luxembourg is a front-runner in terms of its attractiveness for FDI (attractiveness index, 1st quartile of countries), its potential does not reflect the same situation (3rd quartile of countries). This means that Luxembourg actually attracts more FDI than its potential should allow, and UNCTAD therefore classifies Luxembourg as being a country in the category "above expectations".

Finally, the last index (contribution index), which is new in this 2012 edition of the study, measures the contribution of FDI to the development of the national economy ("host economy"). It measures the contribution of FDI to the creation of added value (GDP), employment, wages, exports, R&D expenditures, capital formation, taxes (all as a percentage of the national economy' total). This ranking is led by Hungary, followed by Belgium and the Czech Republic. Luxembourg is ranked 63rd. Again, although Luxembourg is very attractive for FDI, according to UNCTAD this does not contribute proportionately to the development of the national economy and Luxembourg ranks only in the fourth quartile of countries ("below expectations") with a relatively small contribution of FDI to the overall development of the national economy (apart from the contribution to GDP and employment, for which Luxembourg is in the first quartile).

Chart 12
Top 10 ranking of the FDI Attractiveness Index (2011)



Source: CNUCED, World investment report 2012

Table 11
Position of Luxembourg - FDI contribution index

		FDI Contribution Index Indicators by Quartile							Memorandum Item
Rank	Region/economy	Value added	Employ-ment	Exports	Tax revenue	Wages and salaries	R&D expenditures	Capital expenditures	FDI inward stock/GDP
50	Australia	3	2	3	3	3	3	2	3
51	Jamaica	2	4	..	..	1	..	3	1
52	Ecuador	3	3	3	..	..	1	3	4
53	Chile	2	4	3	2	3	4	1	1
54	Guatemala	4	2	..	..	3	..	3	4
55	Uruguay	2	4	..	..	1	4	3	3
56	New Zealand	3	1	4	3	3	4	3	2
57	Spain	3	3	3	4	2	2	3	2
58	Sri Lanka	3	1	..	..	3	..	4	4
59	China	4	2	1	4	4	2	4	4
60	Philippines	3	4	3	2	3	..	3	4
61	India	4	3	3	3	3	2	4	4
62	Mexico	4	2	2	4	3	2	3	3
63	**Luxembourg**	**1**	**1**	**4**	**4**	**4**	**..**	**4**	**1**
64	Israel	4	3	2	4	4	1	3	3
65	Turkey	3	3	4	3	2	4	3	4
66	Russian Federation	3	4	4	4	3	3	2	3
67	Greece	4	3	3	3	3	4	4	4
68	Barbados	2	4	4	3	4	..	4	1
69	Taiwan Province of China	4	1	4	4	4	4	3	4
70	United States	4	3	2	4	4	4	3	4

Source: CNUCED, World investment report 2012

e.3 Global enabling trade report 2012

The World Economic Forum (WEF) has published the new 2012 edition of its report[28] on International Trade, the "Global Enabling Trade Report". This report analyses how countries support international trade through a system of institutions, policies and services that promote the free movement of goods and services. The purpose of the study is to provide information that enable countries to further benefit from international trade in a constantly changing environment and in a globalized world. The study is based on both quantitative and qualitative data from an annual survey (the executive opinion survey) of the World Economic Forum. The 2012 edition includes a total of 132 economies. The report includes an overall composite index called the "Enabling Trade Index" (ETI), the purpose of which is to compare the performance of countries. This overall index is made up of four sub-indices: market access, border administration, transport and communications infrastructure and business environment.

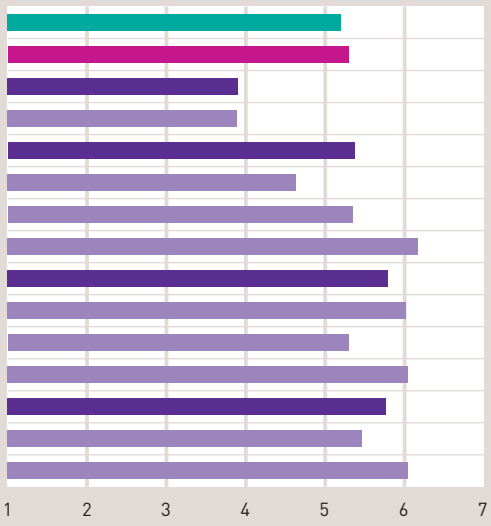
In the 2012 edition, Luxembourg is in 10th place in the overall ranking and loses one position in relation to the previous edition. Germany occupies the 13th place, France the 20th and Belgium the 21st. The overall ranking is led by Singapore, Hong Kong and Denmark.

[28] For more details: http://reports.weforum.org/global-enabling-trade-report-2012/

Table 12
Top 20 ranking and performances by sub-index

			Subindexes							
	OVERALL INDEX		**Market acess**		**Border administration**		**Transport and communications infrastructure**		**Business environment**	
Country/Economy	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**
Singapore	1	6.14	1	6.20	1	6.53	1	6.06	5	5.75
Hong Kong SAR	2	5.67	10	5.08	4	6.02	3	5.85	7	5.75
Denmark	3	5.41	67	3.90	3	6.22	8	5.75	4	5.77
Sweden	4	5.39	67	3.90	2	6.35	17	5.42	2	5.88
New Zealand	5	5.34	25	4.74	6	5.99	25	5.00	10	5.63
Finland	6	5.34	67	3.90	7	5.88	9	5.60	1	5.96
Netherlands	7	5.32	67	3.90	5	6.00	2	5.92	14	5.47
Switzerland	8	5.29	56	4.08	12	5.69	10	5.56	3	5.82
Canada	9	5.22	27	4.68	15	5.62	21	5.21	15	5.38
Luxembourg	**10**	**5.20**	**67**	**3.90**	**21**	**5.37**	**6**	**5.78**	**6**	**5.75**
United Kingdom	11	5.18	67	3.90	9	5.80	4	5.83	28	5.16
Norway	12	5.17	49	4.24	17	5.60	22	5.19	9	5.66
Germany	13	5.13	67	3.90	18	5.53	5	5.79	21	5.31
Chile	14	5.12	2	5.69	23	5.28	50	4.23	23	5.28
Austria	15	5.12	67	3.90	13	5.65	12	5.54	16	5.38
Iceland	16	5.08	24	4.76	24	5.28	27	4.94	20	5.33
Australia	17	5.08	54	4.12	14	5.63	23	5.18	18	5.38
Japan	18	5.08	98	3.79	8	5.83	14	5.51	26	5.18
United Arab Emirates	19	5.07	102	3.69	11	5.71	18	5.30	12	5.58
France	20	5.03	67	3.90	19	5.44	7	5.75	31	5.03

Enabling Trade Index	Rank (out of 132)	Score (1-7)
2012 Index	**10**	**5.2**
2010 Index	9	5.3
Subindex A: Market access	**67**	**3.9**
1st pillar: Domestic and foreign market access	67	3.9
Subindex B: Border admission	**21**	**5.4**
2nd pillar: Efficiency of customs administration	40	4.6
3rd pillar: Efficiency of import-export procedures	31	5.3
4th pillar: Transparency of border administration	8	6.2
Subindex C: Transport & communications infrastructure	**6**	**5.8**
5th pillar: Availability and quality of transport infrastructure	6	6.0
6th pillar: Availability and quality of transport services	8	5.3
7th pillar: Availability and use of ICTs	8	6.0
Subindex D: Business environment	**6**	**5.7**
8th pillar: Regulatory environment	3	5.5
9th pillar: Physical security	11	6.0



Source: WEF

With regard to the four sub-indices, Luxembourg ranks 67th on market access, 21st on border management, 6th on transport and communication infrastructure and 6th on business environment. The World Economic Forum states the following about Luxembourg: "Luxembourg rounds up the top 10. The most positive aspect of the country's overall ranking is the quality of its regulatory environment, where it's placed 3rd thanks to a strong institutional framework, highly efficient financial markets (7th), and the highest openness to foreign participation in the entire sample. The business community also recognizes the high prevalence of foreign ownership in the country's economy, the ease with which employers can hire foreign labour, and the relative ease of access to trade finance (11th). Less positive and uneven is its performance in the border administration component (21st). Although border clearance procedures are generally considered efficient by the business community, they remain expensive (US$1,420), and Luxembourg receives a rather low score on the customs services index (receiving 6 points out of 12, to rank 76th)."

f. Connectivity indicators

f.1 Global connectedness index

Domestic product, capital and labour markets are becoming more closely integrated as a result of globalization. The reduction of trade barriers, technical progress and the lowering of transport and communication costs were the main drivers of this phenomenon. Closer and lasting direct international links are being put in place.

In this context, DHL has published a report entitled "Global connectedness index 2011", a comparative study of 125 countries around the world in terms of their global connectedness, assuming that the opportunities available to countries open to globalization are important and that public policies promoting exchanges will have a major impact on future economic growth[29]. The index calculated by DHL to measure this connectedness is entirely based on quantitative data related to international flows, split into four categories (flow of goods and services, capital flows, information flows and flows of people). This analysis is done using a dual perspective: connectedness in depth and connectedness in breadth.

The world ranking is led by the Netherlands, Singapore and Ireland. Luxembourg is ranked 5th worldwide, Germany 13th, Belgium 8th and France 12th. Luxembourg has dropped two positions compared to 2005, when the country was still in 3rd position. Since 2006, the index value calculated for Luxembourg has continuously deteriorated.

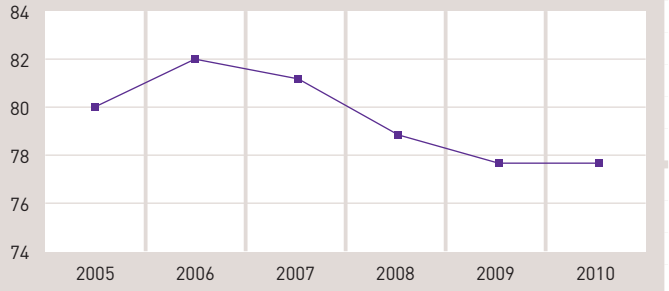
[29] For more details: http://www.dhl.com/en/about_us/logistics_insights/global_connectedness_index.html

Chart 13
Luxembourg's performances

Summary

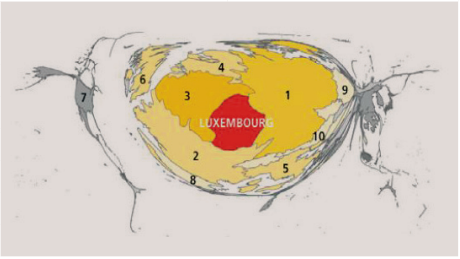
	Rank			Score		
	2010	2005	Change	2010	2005	Change
Overall	5/125	3/125	-2	78/100	80/100	-2
Depth	3/125	3/125	0	46/50	47/50	-1
Breadth	29/125	32/125	3	32/50	32/50	0
Trade Pillar	34/125	26/125	-8	60/100	67/100	-7
Capital Pillar	1/65	1/65	0	97/100	96/100	1
Information Pillar	.	.	.	.	.	.
People Pillar	13/91	13/91	0	81/100	81/100	0

Connectedness Score Trend



Rooted Map

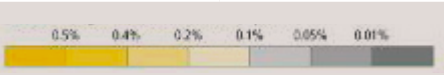
Luxembourg's Merchandise Exports, 2007-2010



Luxembourg's Top 10 Export Destinations

1. Germany (25%)	6. U.K. (4%)
2. France (15%)	7. U.S.A. (2%)
3. Belgium (12%)	8. Spain (2%)
4. Netherlands (5%)	9. Poland (2%)
5. Italy (5%)	10. Austria (1%)

Luxembourg's Share of Partner Imports



Source: DHL

Luxembourg is much better positioned in depth (3rd in the world) than in width (29th place) for global connectedness. Within the four categories and in more detail, the positions and performances of Luxembourg are the following: Luxembourg is ranked 34th in flow of goods and services, 1st in capital flows and 13th for the flow of people (no data available for the information flow category).

f.2 Global information technology report

The World Economic Forum has released the new 2012 edition of its report "Global Information Technology Report"[30]. The report's main objective is to measure the transformational impact of information and communication technology (ICT) on the economy, and on society in general, in 142 countries around the world. Indeed, in recent years, the world has become more and more "hyper-connected": Internet and related services are available almost anywhere and at any time. A better regulation of these technologies in order to enjoy a positive leverage to increase productivity and thus competitiveness and well-being has become a crucial issue for all countries. To that end, the World Economic Forum report includes a composite index called the "Networked Readiness Index" (NRI) calculated using 53 indicators divided into four pillars and 10 sub-categories (political and regulatory environment and business environment; absorption capacity through quality infrastructure, affordable prices and the necessary skills; effective usage thereof by individuals, businesses and the public administration; estimated impact on the economy and society). NRI aims to measure how a country uses ICT development. The analysis is based on both quantitative and qualitative data from the World Economic Forum's annual Executive Opinion Survey.

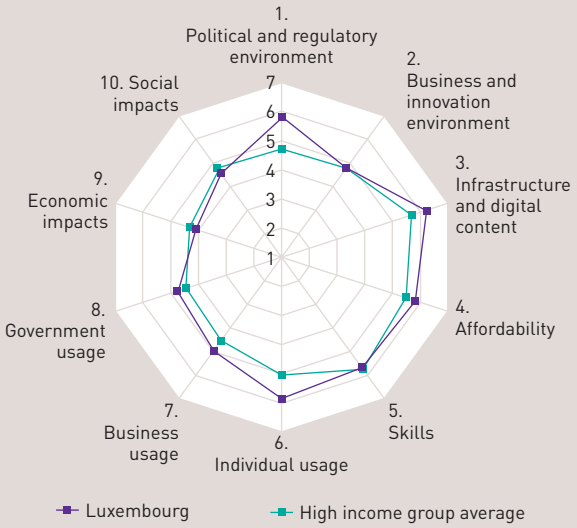
[30] For more details: http://www.weforum.org/issues/global-information-technology/index.html

The overall 2012 ranking of the NRI is led by Sweden, Singapore and Finland. Luxembourg is ranked 21st. Germany is ranked 16th, Belgium 22nd and France 23rd. Regarding the four pillars and the ten sub-categories, the classification of Luxembourg is as follows:

- Luxembourg ranks 13th in the "environment" pillar (5th in political and regulatory environment and 27th for business environment);
- Luxembourg ranks 19th in the "absorption" pillar (13th for the infrastructure component, 36th for affordability and 31st for skills);
- Luxembourg ranks 15th for "usage" pillar (7th for individual, 18th for business and 20th for public administration);
- Luxembourg ranks 28th for the "estimated impact" pillar (27th for the economic impact and 34th for the social impacts).

Chart 14
Luxembourg's performances

	Rank (out of 142)	Score (1-7)
Networked Readiness Index 2012	**21**	**5.2**
A. Environment subindex	**13**	**5.3**
1st pillar: Political and regulatory environment	5	5.8
2nd pillar: Business and innovation environment	27	4.8
B. Readiness subindex	**19**	**5.9**
3rd pillar: Infrastructure and digital content	13	6.2
4th pillar: Affordability	36	5.7
5th pillar: Skills	31	5.7
C. Usage subindex	**15**	**5.3**
6th pillar: Individual usage	7	5.9
7th pillar: Business usage	18	5.0
8th pillar: Government usage	20	4.8
D. Impact subindex	**28**	**4.5**
9th pillar: Economic impacts	27	4.3
10th pillar: Social impacts	27	4.7



Source: WEF (2012)

g. Purchasing power and cost of living indicators

Purchasing power, the cost of living or even the quality of life are important factors in the debate about territorial attractiveness and competitiveness. It is therefore not surprising that such rankings of countries or cities, that are based on composite indices are published regularly.

g.1 Index of the cost of living for expatriates

The Mercer company has released the 2012 edition of its study "Cost of Living"[31]. This study measures the cost of living for expatriates in 214 cities around the world, through 200 products and services, including housing, transport, food, clothing, etc. This study provides key elements to calculate expatriate allowances whilst they are abroad. In this edition, Tokyo (Japan), Luanda (Angola) and Osaka (Japan) are the three cities with the highest cost of living in the world. In Europe, the most expensive cities are Moscow (4th), Geneva (5th) and Zurich (6th).

Table 13
Mercer Ranking (ranks 70 to 90)

70	74	Cotonou	Benin
71	62	Brussels	Belgium
72	58	Dublin	Ireland
72	104	Tianjin	China
74	75	Santiago	Chile
74	136	Wellington	New Zealand
76	67	Abu Dhabi	United Arab Emirates
77	53	Athens	Greece
78	60	Madrid	Spain
79	57	Bratislava	Slovakia
79	70	Istanbul	Turkey
81	80	Almaty	Kazakhstan
81	88	Bangkok	Thailand
83	93	Bandar Seri Begawan	Brunei
84	**72**	**Luxembourg**	**Luxembourg**
85	66	Barcelona	Spain
85	122	Shenyang	China
87	79	Montreal	Canada
88	73	Frankfurt	Germany
89	98	Pointe-à-Pitre	Guadeloupe
90	78	Munich	Germany

Source: Mercer (2012)

In 2012 Luxembourg is in 84th place after being 72nd in 2011, and seems to have become relatively cheaper for expatriates, in a comparative perspective. In general, European cities have become cheaper in 2012 compared to 2011 due to the decline in the exchange rate of the euro. Compared to nearby cities, Luxembourg appears to be less expensive in 2012 than Paris (37th), Amsterdam (57th), or Brussels (71th), but more expensive than Frankfurt (88th).

[31] For more details: http://www.mercer.com/costofliving / http://www.citymayors.com/features/cost_survey.html

g.2 Index of the cost of living for expatriates

Solutions and information provider for international human resources professionals, ECA International has published the 2012 edition of its study on the cost of living for expatriates around the world[32]. Generated from an average basket of consumer goods and services that are commonly consumed by expatriates (food, clothing, appliances, restaurants, etc.), the study compares the price levels in more than 400 cities and parts of the world. This data is used by HR professionals to calculate the cost of living bonuses they offer to their expatriates. The cost of living for expatriates varies with inflation, product availability and exchange rate, and all these factors can have a significant impact on premium levels. Costs related to housing, transport and the education of children are not taken into account in this cost of living study, which focuses on daily expenses.

For expatriates, the most expensive cities in the world are Tokyo (Japan), Oslo (Norway) and Nagoya (Japan). In Europe, the most expensive cities' ranking is dominated by cities in Norway and Switzerland. Oslo is followed by Stavanger, Geneva, Zurich and Bern. However, most European cities have fallen within this ranking. Luxembourg occupies the 29th place in the 2012 European ranking, and loses 8 places compared to the previous 2011 edition, and it is therefore relatively less expensive compared to other European cities. Many of the nearby cities are estimated to be more expensive in 2012 than Luxembourg, including Paris (11th), Brussels (17th), Strasbourg (20th), Amsterdam (21st) and Antwerp (23rd). Luxembourg is considered, however, to be more expensive than several nearby cities such as Stuttgart (31st), Frankfurt (34th) or Düsseldorf (35th).

[32] For more details: http://www.eca-international.com/news/press_releases/7679/#.UAzxVaDYLd5

Table 14
European ranking (Top 30)

2012 European ranking	Cities	2011 European ranking
1	Oslo	1
2	Stavanger	2
3	Geneva	4
4	Zurich	3
5	Bern	5
6	Basel	6
7	Moscow	9
8	Copenhagen	7
9	Helsinki	8
10	Stockholm	10
11	Paris	11
12	Gothenburg	12
13	Baku	19
14	Berlin	14
15	St. Petersburg	15
16	Vienna	13
17	Brussels	16
18	Rome	17
19	London Centre	20
20	Strasbourg	18
21	Amsterdam	32
22	Marseille	26
23	Antwerp	23
24	Munich	29
25	The Hague	28
26	Athens	22
27	Milan	24
28	Lyons	27
29	**Luxembourg**	**21**
30	Dublin	31

Source: ECA International

g.3 Index of purchasing power

Every three years, UBS publishes a comprehensive study on prices and wages, with an update in the in-between years. Since 1970 this UBS publication offers a comparison of purchasing power between different cities around the world and reveals analysis and repercussions connected with the evolving of exchange rates and inflation. The 15th edition examines 72 cities in 58 countries around the world. The analysis compares the purchasing power using detailed surveys on the price of goods and services (122 positions split into 9 categories of products and services), salaries and working hours.

With regard to price levels, according to UBS the most expensive cities in the world are Oslo, Zurich and Tokyo. Luxembourg is ranked 7th in the world and 5th in Europe. Regarding wage levels, Zurich, Geneva and Copenhagen are placed at the top of the world ranking for gross salary.

Luxembourg is ranked 5th worldwide for gross wages and is even 3rd in the world for net salaries (after Zurich and Geneva). However, high absolute prices or low wage levels are only partially indicative of the prosperity of a city. To answer the question of how many goods and services a certain income level can buy, one must compare the two indicators of price levels and wages. The indicator of purchasing power based on net salary is the most relevant, as for a worker, it is important to know how much he can ultimately acquire with his salary. This is why the table on the purchasing power is based on net hourly wages.

Table 15
Ranking according to net hourly wage index levels (Luxembourg = 100)[33]

		Gross hourly wage	Net hourly wage	Net annual income
1	Zurich	106,6	103,5	127,2
2	Sydney	100,7	100,8	120,2
3	**Luxembourg**	**100,0**	**100,0**	**100,0**
4	Geneva	103,8	96,3	113,7
5	Nicosia	85,1	92,3	99,9
6	Los Angeles	101,9	91,9	113,2
7	Miami	95,1	89,3	112,5
8	Dublin	91,3	88,9	94,4
9	Chicago	94,3	87,8	105,3
10	New York	89,6	86,0	115,0
11	Berlin	98,1	83,5	94,4
12	Copenhagen	109,3	79,6	86,6
13	Toronto	92,5	79,5	92,5
14	Frankfurt	91,4	77,8	87,5
15	Amsterdam	90,9	77,5	87,0
16	Munich	96,8	77,3	88,7
17	Paris	83,3	75,5	74,9
18	Vienna	88,3	74,9	86,1
19	London	81,6	74,2	84,1
20	Helsinki	83,0	73,8	81,6

Source: UBS (2012)
Calculations: Observatoire de la compétitivité

The ranking based on the net salary gives a somewhat different picture from that based on the gross hourly wage. Sydney and Luxembourg are then added to the leading quartet. Zurich and Geneva remain in their position, with their comparatively lower tax burdens. The effects of compulsory levies are most felt in Copenhagen, Oslo, Munich and Brussels, which lose some of their purchasing power. For net hourly wages, Luxembourg is ranked 3rd in the world, behind Zurich (purchasing power 3.5% higher than Luxembourg) and Sydney (+0.8%).

[33] Gross or net hourly wages divided by the basket of goods and services' price, excluding rents and Net annual income, divided by the price of the basket of goods and services without rents.

h. Quality of life indicators

h.1 Survey on the quality of living for expatriates

The consulting firm Mercer has released the 2011 edition of its annual "Quality of Living survey"[34], the purpose of which is to measure the quality of living for expatriates in their host cities around the world. This survey is conducted to help multinational companies and governments determine the level of compensation for their staff abroad. The survey is based on factors that expatriates consider as having a significant impact on their quality of living abroad. In this new edition, the number of cities analysed totalled 221 and a total of 39 indicators were used to assess the level of quality of living. These indicators are grouped into ten categories: political and social environment, economic environment, sociocultural environment, health system, education system, services and public transport, leisure, consumption products, housing and, finally, the natural environment.

Table 16
The top five cities by region

Quality of living ranking			
Americas	**Asia Pacific**	**Europe**	**Middle East & Afrika**
Vancouver (5th)	Auckland (3rd)	Vienna (1st)	Dubai (74th)
Ottawa (14th)	Sydney (11th)	Zurich (2nd)	Abu Dhabi (78th)
Toronto (15th)	Wellington (13th)	Munich (4th)	Port Louis (82nd)
Montreal (22nd)	Melbourne (18th)	Dusseldorf (5th)	Cape Town (88th)
Honolulu (29th)	Perth (21st)	Frankfurt (7th)	Johannesburg (94th)
Personal safety ranking			
Americas	**Asia Pacific**	**Europe**	**Middle East & Afrika**
Calgary (tied 17th)	Auckland (tied 9th)	Luxembourg (1st)	Abu Dhabi (23rd)
Montreal (tied 17th)	Wellington (tied 9th)	Bern (tied 2nd)	Muscat (29th)
Ottawa (tied 17th)	Canberra (tied 25th)	Helsinki (tied 2nd)	Dubai (39th)
Toronto (tied 17th)	Melbourne (tied 25th)	Zurich (tied 2nd)	Port Louis (59th)
Vancouver (tied 17th)	Perth (tied 25th)	Vienna (5th)	Doha (67th)
	Sydney (tied 25th)		

Source: Mercer

In 2011, the cities of Vienna, Zurich and Auckland occupy the top positions in the world ranking. In general, European cities continue to dominate. Luxembourg is in the 19th position in the world ranking and thus occupies the same level as in the previous two editions. At European level, Luxembourg is ranked 12th.

The 2011 survey also includes a new ranking called "personal safety". This ranking is based on internal stability, crime, international relations of the country, etc. In this second ranking, Luxembourg is placed 1st worldwide, followed by Bern, Helsinki and Zurich.

[34] For more details: http://www.mercer.com/qualityofliving

h.2 Survey on cities where life is pleasant for expatriates

The company ECA International has published the 2012 edition of its report on cities in the world where life is pleasant for expatriates[35]. The rating of cities for expatriates is the result of a study made from expatriates ratings, previous rankings and independent studies. The report evaluates many factors in order to estimate the quality of living in 400 cities worldwide. The ranking takes into account both the origin and the destination of expatriates and ECA International develops various rankings according to the origin of expatriates: one rating for European expatriates, one for Asian expatriates, etc. This study is intended to help HR managers to identify the benefits that outweigh the expatriates' adaptation difficulties to their new environment.

The ranking reviewed here includes 254 cities in the world from a European perspective. It is derived from criteria such as climate, health services, housing, utilities, isolation, social life, leisure and infrastructure as well as security, political tensions and air quality. Deterioration or improvements in the criteria and the relative movements of cities in relation to each other do affect the rankings from one year to another.

In this 2012 edition of the study, Bern and Copenhagen are again the European cities that offer the best living conditions. Luxembourg City occupies the 3rd position in 2012, and climbed one position since the previous 2011 edition (4th place). For 2012, in comparison with cities that are relatively close to Luxembourg, we find that Luxembourg City is notably better than Antwerp (4th), Dusseldorf (7th), Brussels (9th), Amsterdam (10th), Frankfurt (10th), Strasbourg (17th) or Paris (23th).

Table 17
"Where life is pleasant" for Europeans Ranking (Top 20)

2012 World ranking	Cities	2011 World ranking
1	Bern	1
1	Copenhagen	1
3	**Luxembourg**	**4**
4	Stuttgart	3
4	Antwerp	4
4	Geneva	4
7	Basel	4
7	Dusseldorf	9
9	Brussels	4
10	Dublin	9
10	Amsterdam	9
10	Bonn	9
10	Frankfurt	9
10	Munich	9
15	Berlin	15
15	Hamburg	15
17	Zurich	15
17	Vienna	15
17	Strasbourg	19
17	Toulouse	19

Source: ECA International

[35] For more details: http://www.eca-international.com/news/press_releases/7652/#.UAzvm6DYLd5

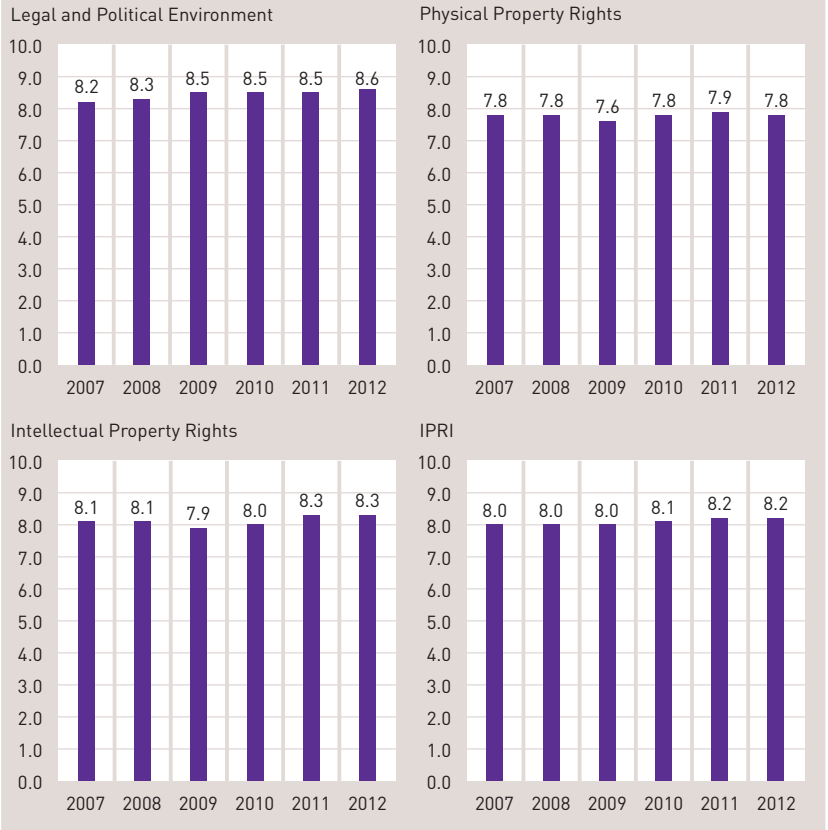
i. Miscellaneous indicators

i.1 International property rights index

In 2012 the Property Rights Alliance published the 6th edition of its composite indicator "International property rights index" (IPRI)[36]. The purpose of this study is to measure property security levels around the world (physical and intellectual property). The report includes an analysis of the legal and political environment (LP), the protection of physical property (PPR), and of intellectual property (IPR) in 130 countries around the world. The purpose of this study is to develop a barometer capable of measuring the degree of property rights security, which is a key factor of competitiveness in a market economy. Ten indicators are used in total, grouped into three sub-categories in order to calculate the overall IPRI composite index, which is supposed to measure the degree of property security in the different countries that were analysed. Amongst these indicators we find for instance the independence of the judiciary, political stability, corruption level, patent protection, etc. The indicators are both qualitative and quantitative. The scale used to measure the degree of property protection varies from 0 (no protection) to 10 (the highest protection).

In this 2012 edition, Luxembourg is in 6th place overall (score of 8.2), together with Denmark and New Zealand. Germany is ranked 15th, Belgium 18th and France 20th.

Chart 15
Luxembourg's performances by sub-category



Source: IPRI (2012)

[36] For more details: http://www.international-propertyrightsindex.org/

With regards to the three sub-categories, Luxembourg is in the top 10 best performing countries for each of them:

- 6th place with a score of 8.6 for legal and political environment (LP);
- 9th place with a score of 7.8 for physical property rights (PPR);
- 4th place with a score of 8.3 for intellectual property rights (IPR).

i.2 Corruption perceptions index

In December 2011, Transparency International, a nongovernmental organization which is at the forefront of the fight against corruption, published the annual edition of its composite index for perception of corruption, called the "Corruption Perceptions Index" (CPI)[37]. The institutional and regulatory framework within which economic activity takes place affects the way resources are allocated, investment decisions are guided and creativity and innovation are stimulated. Corruption weakens a country and thus undermines stability and security for economic agents' decisions.

The CPI composite index measures the perception of corruption in the public sector per country. It is calculated using information from 17 surveys of experts and business decision-makers, conducted by 13 international institutions. The CPI ranges between 10 (high level of integrity) and 0 (highly corrupt) for the 183 countries analysed. The sources used to calculate the CPI include questions about the abuse of power and focus on the payment of bribes to public officials and within the framework of public procurement contracts, the embezzlement of public funds as well as issues related to the strength and effectiveness of the fight against corruption in the public sector. Thus, they include the administrative and political aspects of corruption. The results are then used to rank the countries/territories according to the degree of perceived corruption.

In the 2011 edition, New Zealand, Denmark and Finland are in the top of the table. Together with Ireland, Luxembourg is in the 11th world position (with a score of 8.5). Germany is ranked 14th, Belgium 19th and France 25th. Within Europe, Luxembourg is in the 7th position. Luxembourg is therefore amongst the analysed countries where corruption in the public sector is perceived to be less important.

[37] For more details: http://cpi.transparency.org/cpi2011/

Table 18
Ranking per country

Rank	Country/Territory	Score
1	New Zealand	9.5
2	Denmark	9.4
2	Finland	**9.4**
4	Sweden	9.3
5	Singapore	9.2
6	Norway	9.0
7	Netherlands	8.9
8	Australia	8.8
8	Switzerland	8.8
10	Canada	8.7
11	**Luxembourg**	**8.5**
12	Hong Kong	8.4
13	Iceland	8.3
14	Germany	8.0
14	Japan	8.0
16	Austria	7.8
16	Barbados	7.8
16	United Kingdom	7.8
19	Belgium	7.5
19	Ireland	7.5
21	Bahamas	7.3
22	Chile	7.2
22	Qatar	7.2
24	United States	7.1

Source: Transparency International (2011)

i.3 Consumer conditions index

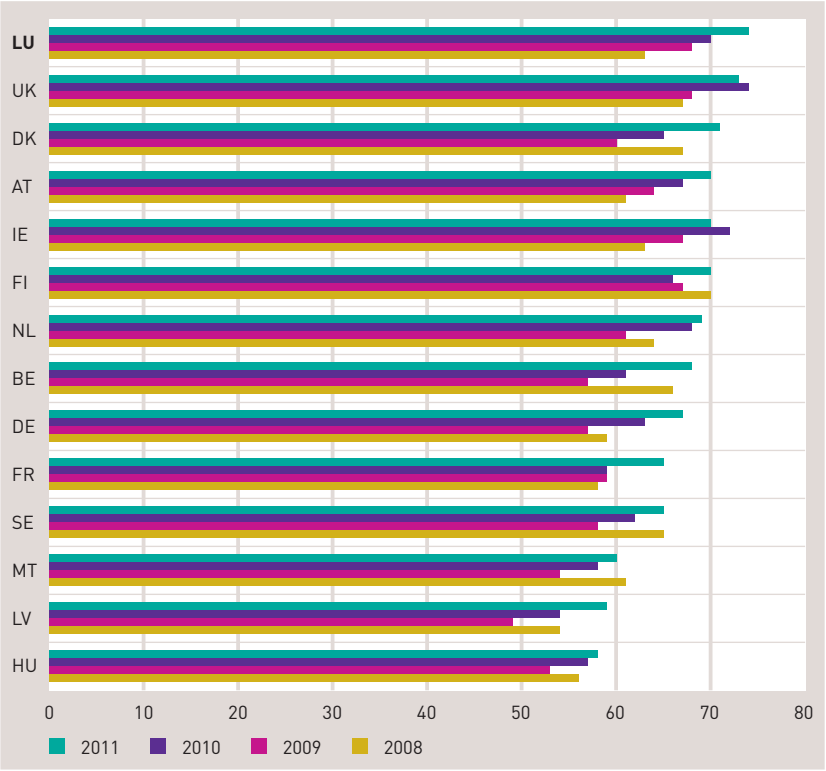
In May 2012, the European Commission released the new 2011 edition of its consumption scoreboard[38]. An attractive and favourable environment for consumers allows the EU as a whole to benefit from the full potential of the internal market, which is a major prerequisite for economic growth and job creation.

This consumption scoreboard contains a composite index called "Consumer Conditions Index" that is intended to provide a horizontal view of the national economic environment for consumers from the several EU Member States. The quality of the economic environment for consumers is measured through qualitative surveys of perception and practical experiences, that are conducted with consumers and distributors in the following areas: quality of regulation affecting consumers and businesses, effectiveness of complaint handling and dispute resolution, consumer confidence in the authorities, retailers, advertisers and consumer organizations, consumer confidence in the safety of the products placed on the market. Each underlying indicator has the same weight in the composite index.

In 2011, the European Commission placed Luxembourg in 1st position (index of 74 out of 100), followed by the United Kingdom (73) and Denmark (71). The EU-27 average is an index of 62 in 2011. Since 2008, Luxembourg has continuously increased its score, from an index of 63 in 2008 to 68 in 2009 and 70 in 2010.

[38] For more details: http://europa.eu/rapid/pressReleasesAction.do?reference=IP/12/510&format=HTML&aged=0&language=FR&guiLanguage=en

Chart 16
Excerpts from the "Consumer innovation index" countries ranking



Source: European Commission

2.3 Conclusions

As we have shown throughout this chapter, as well as in the Competitiveness Reports from previous years, many studies are published each year on the "relative competitiveness", also called comparative competitiveness, of territories, whether at country, regional or even cities level. Even if the world financial crisis has caused, since Autumn 2008, the economic policy debate to focus primarily on short-term counter-cyclical measures implemented to support the economy, on prescribed measures to exit the crisis (public balance and public debt) or on countries with financing difficulties on the financial markets, rather than on structural issues, still, in a general way, the interest in such studies tends to increase with the increased phenomenon of globalization. In fact, the hope that these composite competitiveness and sustainable growth indicators might help to explain and predict the future economic development of a country largely explains the special attention that is devoted to them.

Regarding the evolution of Luxembourg's competitive position in the four major international rankings that are updated annually, we can see that since the previous edition of Autumn 2011, Luxembourg remained constant within the EU in two of the four rankings (WEF and Heritage foundation), it has lost one position in one ranking (IMD) and lost three positions in the last ranking (European Commission). In the world rankings (i.e. including non-EU countries), Luxembourg climbed one position (WEF), lost one (IMD), remained constant (Heritage Foundation) and, finally, lost four positions (European Commission). The trend of these four major benchmarks seems to be on average on a declining path since the last edition of the Report (2011).

There is no doubt that the ranking of countries is the most highly publicized feature of each report. But the interpretation of these reports and benchmarks' results goes much further. When using these types of composite indices, one cannot lose sight of their inherent limitations: the relativity of the rankings, the underlying data that was used, the methodological differences between the various benchmarks and the methodological weaknesses related to such a relative comparative exercise. Actually these indices tell a far more complex story than their apparent simplicity would suggest at a glance.

First, a ranking change in one direction or in the other does not necessarily mean that Luxembourg's performance has truly improved or worsened over the past year! Indeed, "ranking evolution" can also be caused by the fact that other countries might have experienced the economic and financial crisis[39] and the current turbulence in the financial markets more or less severely than Luxembourg. It is important to take this relativity into account in competitiveness comparison.

Secondly, concerning the underlying data, it is worth noting that there is a time gap between many underlying statistics which are used and the period of publication of the composite indices. The composite indicators mentioned and analysed in this 2012 Competitiveness Report often use underlying indicators from 2009, 2010 or 2011. This implies that the benchmarks and rankings included in these reports should not be considered as short-term predictive tools, or as a short-term measurement of (relative) resistance to a crisis.

[39] However, the data that is made available to the public for the several benchmarks often does not allow a more detailed analysis of this issue.

Thirdly, despite the attractiveness of their visible simplicity, there are considerable methodological differences between many of the indices. Even if they attempt to measure the same phenomenon, meaning competitiveness, differences appear in the definition of what is being measured itself: whilst the World Economic Forum attempts to measure the countries' capacity to achieve sustainable economic growth, the IMD analyses the countries' capacity in creating and maintaining a supportive environment for company competitiveness, as wealth creation is supposed to happen at the entrepreneurial level, within a national environment that either facilitates or hampers their competitiveness. As we have seen, Luxembourg's rankings strongly vary between one index and another one, according to the method that was used. In fact, whilst Luxembourg is ranked by the IMD's most recent report in 12th place amongst the 59 countries included, the country is only 22nd amongst the 144 countries that were analysed by the World Economic Forum in the latest edition of its report.

Fourth, we often criticize the different research works over methodology weaknesses. These appear in three main areas, i.e. the quality of the used sources, the choice of underlying data and the calculation method of the composite indicator. For analysing and interpreting the results of different composite indices as well as countries' rankings, we should first make a critical evaluation of the methods that where used: the quality of primary and secondary data sources, the potential "ideological assumption", the calculation method of the composite index and the weighting of the different basic indicators. For example, the basic indicators used in these benchmarks often reveal themselves to be inadequate to the specificity of the Luxembourgish economy. The best-known example is the famous "GDP per capita" indicator which, among other things, does not take into account the important flow of cross-border workers in Luxembourg, and consequently strongly overestimates Luxembourg's performance in comparison with other countries. Another example relates to the number of students in the higher education cycle, for which the calculations often only take into account the students in the national system without considering the fact that the majority of Luxembourg's students are studying abroad and are therefore not included in these results, which considerably underestimate Luxembourg's national performance in this area. Additionally, we can note that the different international organizations change their methods on a periodic basis, which can also have a significant effect on countries' rankings.

Fifth, the selection of countries analysed in each report has a impact on the ability to make direct comparisons between them. For example, in their most recent editions, the WEF compares 144 countries, the IMD compares only 59 countries and the Heritage Foundation compares 184 countries, which obviously has an influence on the countries' relative position in the various rankings. For instance, we could include only the EU Member States in each of the indices, in order to get a better comparison between their rankings. The Luxembourg's relative position would be as follows: Luxembourg would climb from 22nd position to 10th position in the WEF, from 12th to 4th place in the IMD ranking and from the 13th to 3rd place in the Heritage Foundation's ranking.

Sixth, there are groups of countries in many rankings within which countries' performances are relatively similar (almost identical index levels). All things being equal, a marginal rise (or fall) in the value of the composite index could therefore cause a significant rise (or drop) in the ranking. The country's ranking should therefore not be consulted in separately from the numerical value of the composite index because significant ranking differences could actually be concealing marginal differences in the index values.

In view of the different weaknesses outlined above, what should one make of these rankings and aggregate indices, and especially how should one interpret them?

Even if the methodology of composite indicators and rankings arouses some reserve, they provide nevertheless a useful calibration and deserve to be closely monitored. On the one hand, their echo in the media gives them a not insignificant impact on a country's brand image and can influence the investors' perception of the country, especially foreign investors who generally have limited information. On the other hand, composite indicators which summarize complexities down to a figure are useful communication tools and promote the political debate. One must nevertheless avoid caving into the syndrome of ranking for ranking's sake. These different rankings, and other composite indicators, certainly provide helpful information about a country's competitiveness, but they are not an end in themselves. One should not lose sight of the fact that the global information that is supplied in this type of report is also often too general to be usable for very specific type of activity and project. These composite indicators should be aimed at focusing one's attention and to prompt a more rigorous and critical analysis. There is in fact no single recipe for increasing competitiveness. Different policies can be compared and monitored, but each country must adapt them to its own socioeconomic environment and its own national specificities. Competitiveness strategies succeed when they strike the right balance between the economic imperatives imposed by global markets and a country social cohesion born out of its history, its value systems and traditions.

For that purpose, in 2003 the Tripartite Coordination Committee identified the need for an enlarged indicator board, in order to better understand the competitiveness of Luxembourg through indicators that better reflect the national specificities of the country. This Committee entrusted Professor Lionel Fontagné from the University of Paris I (Sorbonne) the task of elaborating proposals on this topic. The "Fontagné Report[40] proposed a scoreboard (November 2004) and the *Observatoire de la compétitivité* periodically updates the data and comments upon the evolution of the competitive situation.

[40] 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
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3 The Competitiveness Scoreboard

3.1 Introduction

The Competitiveness Scoreboard was launched in the 2004 Fontagné report. Since then several of the 88 indicators are no longer updated. The scoreboard currently includes 78 indicators. However, it still includes indicators that are no longer justifiable, such as Internet penetration in households, that is around 100% in all Member States, or indicators from the Lisbon strategy that have been replaced by indicators from the EU 2020 strategy, and the European scoreboard indicators for the macroeconomic imbalance procedure are completely absent. A revision is therefore necessary.

But a revision of the scoreboard indicators does not amount to a revision of the definition of competitiveness. The *Observatoire de la compétitivité* recalls the broad definition of the concept of competitiveness, adopted by the tripartite, and which is that from the Economic and Social Council (ESC). In fact, it attributes the following objectives to the government: "... the role of the State is to contribute to achieving and maintaining a sustainable and high quality of life for 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 rate similar to or higher than the one of its major trading partners that have 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 development of scoreboards is very fashionable. Every project has its own set of indicators. In 2004, scoreboards such as the European innovation scoreboard and the Lisbon strategy's list of indicators were the best known. More recent scoreboards from the *PIBien-être*, sustainable development or even the EU2020 strategy projects were developed. It is reasonable to analyse and compare the different sets of indicators with the Competitiveness Scoreboard indicators.

Each project has its own reason for being and deserves to be analysed and discussed annually. Indicators overlap partially, but without losing purpose.

Table 1
Competitiveness Scoreboard Indicators

Category 1: Macroeconomic Performance (12 indicators)

- A1: Gross National Income per capita PPS (2011)
- A2: Real growth rate of GDP (2011)
- A3: Growth in domestic employment (2011)
- A4: Unemployment rate as a percentage (2011)
- A5: Inflation rate as a percentage (2011)
- A6: Public balance as a % of GDP (2011)
- A7: Public debt as a % of GDP (2011)
- A8: Gross fixed capital formation of the public administration (2011)
- A9: Terms of trade (2011)
- A10: Real effective exchange rate (index 1995 =100) (2011)
- A11: Diversification – Entropy coefficient (2010)
- A12: Foreign Direct Investment inflows and outflows (2011)

Category 2: Employment (9 indicators)

- B1: Employment rate as a % (Total) (2011)
- B2: Employment rate as a % (Men) (2011)
- B3: Employment rate as a % (Women) (2011)
- B4: Employment rate of persons aged 55-64 (Total) (2011)
- B5: Employment rate of persons aged 55-64 (Men) (2011)
- B6: Employment rate of persons aged 55-64 (Women) (2011)
- B7: Unemployment rate of persons under 25 (2011)
- B8: Long-term unemployment rate as a % (2011)
- B9: Persons holding a part-time job (2011)

Category 3: Productivity and Labour Costs (5 indicators)

- C1: Trends in total factor productivity (2011)
- C2: Trends in apparent work productivity (2011)
- C3: Productivity per hour worked as a percentage of U.S. figures (2011)
- C4: Changes in unit labour costs (2011)
- Costs / Revenue ratio in the banking sector (2011)

Category 4: Market Operations (11 indicators)

- Percentage of full-time employees on minimum wage [1*2]
- D2: Price of electricity (ex-VAT) – industrial users (2011)
- D3: Price of gas (ex-VAT) – industrial users (2011)
- D4: Market share of the primary operator in cellular telephones (2010)
- Composite basket of fixed and cellular telecommunications (ex-VAT) (2004)
- D6: Composite basket of cellular telephone rates (ex-VAT) (2008)
- D7: Broadband Internet access rates (2009)
- D8: Basket of domestic royalties for 2 Mbits leased lines (ex-VAT) (2010)
- D9: Value of public tenders using open procedure procurement (2010)
- D10: Total State aid as a % of GDP (except horizontal objectives) (2010)
- Market share of the primary operator in fixed telecommunications [3*]

Category 5: Institutional and Regulatory Framework (10 indicators)

- E1: Corporate tax rate (2011)
- E2: Income tax rate (2011)
- E3: Standard VAT rate (2012)
- E4: Tax wedge – Single, without children (2010)
- E5: Tax wedge – Married, with 2 children, one-wage-earner (2010)
- E6: Administration efficiency index (2010)
- E7: Law compliance index (2010)
- E8: Regulation quality index (2010)
- E9: Degree of sophistication of online public services (2010)
- E10: Full online availability of public services (2010)
- 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 signaled in light gray 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 (2009)
F2: Self-employed jobs as a percentage of total employment (2011)
F3: Net change in number of companies – start-up rate minus wind-up rate of (2009)
F4: Volatility amongst companies – start-up rate plus wind-up rate of disappearance (2009)
Category 7: Education and Training (5 indicators)
G1: Annual cost per student in public educational facilities (2009)
G2: Part of the population aged 25 to 64 with at least a secondary education (2011)
Share of population aged 25 to 34 with a university education*[4]
G4: Share of human resources in scientific and technological fields as a % of total employment (2011)
G5: Lifelong learning (participation of adults in training and teaching programmes) (2011)
G6: Secondary school drop-outs (2011)
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 (15 indicators)
H1: Internal R&D expenditure (2010)
H2: Public R&D budget credits (2009)
H3: Portion of public research financed by the private sector (2010)
Percentage of sales allocated to the introduction of new products on the market (new or significantly improved products) (2003)
H5: Number of researchers per 1,000 employed persons (2010)
Scientific publications per million inhabitants (2005)
H7: Number of USPTO patents per million inhabitants (2011)
H8: Number of OEB patents per million inhabitants (2009)
H9: Use of broadband connections by companies (2009)
H10: Investment in public telecommunications as a percentage of gross fixed capital formation (2009)
H11: Percentage of households that have Internet access at home (2011)
H12: Number of cell and fixed phones per 100 inhabitants (2009)
H13: Percentage of households that have broadband Internet access (2013)
H14: Number of secure web servers per 100,000 inhabitants (2010)
H15: Percentage of total employment in medium or high technology sectors (2011)
Category 9: Social Cohesion (6 indicators)
I1: Gini coefficient (2010)
I2: At-risk of poverty rate after social transfers (2010)
I3: At persistent risk of poverty rate (2010)
I4: Life expectancy at birth (2011)
I5: Gender wage gap (2010)
I6: Serious work related accidents (2006)
Category 10: Environment (7 indicators)
J1: Number of ISO 14001 certifications (2010)
J2: Number of ISO 9001 certifications (2010)
J3: Total greenhouse gas emissions (2010)
J4: Share of renewable energy (2010)
J5: Volume of municipal waste generated (2010)
J6: Energy intensity of the economy (2010)
J7: Modal breakdown in transportation choice for passenger – Percentage of car users (2010)

Source: Fontagné (2004)

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

Competitiveness is a multidimensional concept that does not exclude overlapping or counteracting dimensions. Improving competitiveness amounts to finding the right balance between policies in different fields. Nature protection policy is certainly very important, but it may impede an economic development policy. The Scoreboard is used to pinpoint the different facets of competitiveness. Afterwards it is up to policy makers, to employees and employers to find a balance in the formulation of future policies.

Since the Fontagné report (2004), the Scoreboard's Competitiveness indicators for Luxembourg are analysed in detail according to two points of view. First, Luxembourg's position in relation 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 performance is analysed over time, that is to say by comparing the most recent data values with those from previous years. The arrows will indicate in which direction each indicator has changed recently (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.

Third, indicators are synthesized by calculating a composite indicator with all the advantages and disadvantages that this implies.

Scoreboard data is updated annually. Obviously, Eurostat, OECD or the World Bank, to mention only the main sources of data, not only add the last year's data but also update the data from previous years following the updating of the national accounts, which also has a relatively important effect on the other indicators. Therefore the results from the Scoreboard, i.e. the composite indicator ranking, are not stable over time and differences may arise from one edition of the Report to the next.

The Scoreboard does not come up with "pseudo-scientific" truths as claimed by its critics: it merely measures a set of agreed criteria based on data supplied by the public statistics in a common conceptual framework. A serious and thorough analysis can only be done by studying each indicator separately by area and industry. The composite index, which aggregates all the information to give a synoptic view, is valuable to the media, fans of compact and instant information.

Data missing in the Scoreboard have a significant effect on its outcome, including on the composite indicator. Indeed, for Member States such as Romania, Lithuania, Latvia, Bulgaria, Cyprus and Malta, the ranking provided by the composite indicator is to be interpreted with caution. The table below provides information on the percentage of missing data in the Scoreboard.

Table 2
Non-availability of data over time

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Macroeconomic Performance	4,94	4,01	3,70	4,01	3,70	3,09	3,09	2,78	2,47	2,16	2,16	3,40	100
Employment	0	0	0	0	0	0	0	0	0	0	0	0	100
Productivity and Labour Costs	1,85	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100
Market Operations	49,07	57,41	31,48	54,63	16,67	18,06	16,20	31,02	15,28	31,48	32,87	76,85	100
Institutional and Regulatory Framework	25,9	49,6	19,6	19,6	9,3	25,9	10,4	8,9	28,9	8,5	4,4	70,0	90,0
Entrepreneurship	19,4	19,4	19,4	19,4	18,5	31,5	31,5	8,3	30,6	6,5	77,8	80,6	100
Education and Training	14,1	8,9	3 %	3,7	3	0,7	2,2	1,5	3	2,2	20	20	100
Knowledge Economy	36,2	33,6	31,6	20,2	14,8	9,1	9,1	7,1	9,7	7,7	41,3	69,2	100
Social Cohesion	17,3	15,4	35,8	27,8	29,0	17,3	19,8	25,3	20,4	21	22,8	93,8	100
Environment	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	1,06	100	100

Source: Observatoire de la compétitivité

Macroeconomic Performance, Employment, Productivity and Labour Costs and Environment categories show the least missing data. Missing data is influenced by the source on which it is based. Indeed, when it comes to OECD data, data concerning EU Member States which are not yet members of the OECD is automatically missing. For the Environment category, Market Operations, Institutional and Regulatory Framework, Education and Training and Social Cohesion data is only available until 2010. For the Entrepreneurship category data is missing from 2009. This missing data, from the moment it becomes available, has a significant impact on the ranking outcome, of course.

As a reminder, the following acronyms are used:

Table 3
Acronyms

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

Source: Eurostat

3.2 The Competitiveness Scoreboard

In general, the indicators have not changed significantly in 2012 compared to 2011. However, there is an improvement since 2009, with six more indicators in green. At the category level, this stability seems to be confirmed from one year to the next when comparing Luxembourg to the EU average.

Table 4
Colour evolution since 2000

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Macroeconomic Performance		8	7	8	7	8	8	8	8	6	8	8	7
		1	2	2	3	2	2	1	2	3	2	2	3
		1	1	0	0	0	0	1	0	1	0	0	0
Employment		2	2	2	2	2	3	2	2	2	2	2	2
		4	4	4	5	5	4	5	5	5	7	7	7
		3	3	3	2	2	2	2	2	2	0	0	0
Productivity and Labour Costs		3	1	1	1	1	3	1	2	1	1	1	1
		1	0	2	0	2	0	0	2	0	0	0	0
		0	3	1	3	1	1	3	0	3	3	3	3
Market Operations		2	2	2	3	4	3	3	3	3	4	4	4
		4	4	4	3	4	4	3	3	3	2	1	1
		2	2	2	2	0	1	2	2	2	2	3	3
Institutional and Regulatory Framework		5	5	6	6	6	5	5	5	5	5	5	5
		3	3	2	2	3	3	3	3	4	4	4	4
		2	2	2	2	1	2	2	2	1	1	1	1
Entrepreneurship		1	1	0	0	0	0	0	0	1	1	1	1
		2	2	3	3	2	2	3	2	2	2	2	2
		1	1	1	1	2	2	1	2	1	1	1	1
Education and Training		0	0	0	1	1	0	0	0	0	3	3	3
		3	3	4	2	3	4	4	3	4	1	1	1
		2	2	1	2	1	1	1	2	1	1	1	1
Knowledge Economy		4	4	4	4	5	5	5	5	5	5	5	5
		5	4	4	4	5	5	4	4	5	5	6	6
		4	5	5	5	3	3	4	4	3	3	2	2
Social Cohesion		0	0	1	1	1	0	1	1	1	1	2	2
		5	5	4	4	4	5	4	4	4	4	3	3
		0	0	0	0	0	0	0	0	0	0	0	0
Environment		0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	2	2	1	1	1	1	1	1	1
		4	4	4	3	3	4	4	4	4	4	4	4
Total		25	22	24	25	28	27	25	26	24	30	31	30
		29	28	30	28	32	30	28	29	31	28	27	28
		19	23	19	20	13	16	20	18	18	15	15	15
Total indicators		73	73	73	73	73	73	73	73	73	73	73	73

Source: Observatoire de la Compétitivité

The Competitiveness Scoreboard

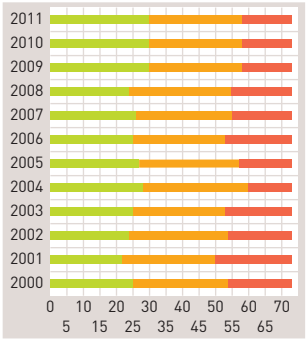


Table 5
LU indicator development compared to the previous year

		2004	2005	2006	2007	2008	2009	2010	2011
A Macroeconomic Performance (12)	↑	3	7	2	8	3	3	7	6
	=	0	0	2	1	0	0	0	1
	↓	9	5	8	3	9	9	5	5
B Employment (9)	↑	5	7	4	5	3	9	4	3
	=	1	1	1	0	0	0	1	0
	↓	3	1	4	4	6	0	4	6
C Productivity and Labour Costs (5)	↑	3	3	2	2	0	2	3	0
	=	1	0	0	1	0	0	0	0
	↓	0	1	2	1	4	2	1	4
D Market Operations (9)	↑	6	4	5	2	6	4	4	3
	=	0	0	0	0	0	0	1	1
	↓	2	4	3	6	2	4	3	4
E Institutional and Regulatory Framework (10)	↑	3	2	4	5	5	7	4	4
	=	3	3	2	2	3	2	3	1
	↓	4	5	4	3	2	1	3	5
F Entrepreneurship (4)	↑	1	1	2	1	1	1	2	2
	=	0	0	1	0	0	0	0	0
	↓	3	3	1	3	3	3	2	2
G Education and Training (5)	↑	3	2	1	3	3	4	3	3
	=	0	1	0	0	0	0	1	0
	↓	2	2	4	2	2	1	1	2
H Knowledge Economy (14)	↑	9	8	9	8	7	9	5	7
	=	1	0	1	0	1	1	1	0
	↓	3	5	3	5	5	3	7	6
I Social Cohesion (6)	↑	4	2	0	4	4	1	4	4
	=	1	3	2	0	0	1	1	1
	↓	1	1	4	2	2	4	1	1
J Environment (7)	↑	2	5	4	6	6	5	1	1
	=	0	0	0	0	0	0	0	0
	↓	5	2	3	1	1	2	6	6
Total (78)	↑	39	41	33	44	38	45	37	33
	=	7	8	9	4	4	4	8	4
	↓	32	29	36	30	36	29	33	41

Source: Observatoire de la compétitivité

Comparing Luxembourg's own performance from one year to the next, a different picture emerges. Out of the 78 indicators, Luxembourg's performance has deteriorated for 8 indicators. At category level, we observe a performance improvement for Luxembourg on Social Cohesion in 2010 compared to 2009 while the worsening is more obvious for the categories Environment, Knowledge Economy, Institutional and Regulatory Framework and Employment.

3.2.1 Macroeconomic Performance

Table 6
Category A Macroeconomic Performance

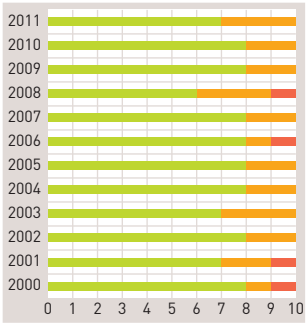
Code	Indicator		LU	EU-27	DE	FR	BE	MIN	MAX
A1	Gross national income at market prices per capita in PPS (2011)	↑	192	100	123	109	120	BU 43	LU
A2	Growth rate of real GDP, as a % (2011)	↓	1.7	1.5	3	1.7	1.8	GR -7.1	EE 8.3
A3	Growth rate of domestic employment, as a % (2011)	↑	2.8	0.3	1.3	0.6	1.3	GR -6.7	EE 7
A4	Unemployment rate, as a % (2011)	↓	4.8	9.7	5.9	9.6	7.2	AT 4.2	ES 21.7
A5	Inflation rate, as a % (2011)	↓	3.4	3.10	2.5	2.3	3.5	IR 1.2	RO 5.8
A6	Public balance, as a % of GDP (2011)	↑	-0.6	-4.5	-1	-5.2	-3.9	IR -12.8	HO 4.2
A7	Public debt, as a % of GDP (2011)	↑	18.2	82.5	81.2	85.8	98	EE 6	GR 165.3
A8	Gross fixed capital formation, as a % of GDP (2011)	→	4.0	2.5	1.6	3.1	1.7	AT 1	PO 5.8
A9	Terms of trade (2011)	↓	108.14	-	98.22	96.46	97.65	FIN 88.77	RO 139.82
A10	Real effective exchange rate (index 2000 =100) (2008)	↓	104.9	96.7	98.42	101.1	103.8	UK 83.2	SK 131.4
A11	Diversification – Entropy coefficient (2011)[5]	↑	0.89	0.90	0.88	0.9	0.88	LT 0.82	MT 0.92
A12	Market integration (2011)	↑	530	2.4	1.3	2.6	15.9	CY -3.1	LU

*LU inflation rate: IPCN, other IPCH; harmonized unemployment rate EUROSTAT/BIT LU: Adem; **EU-15

In the Macroeconomic Performance category, Luxembourg is still a model example among the 27 Member States. However, it is noteworthy that 5 indicators for Luxembourg's performance deteriorated, and 2 indicators remained unchanged.

In 2011, Luxembourg had a public debt amounting to 18.2% of GDP, three times more than Estonia. Real GDP in Luxembourg grew in 2011 by 1.7%, which places Luxembourg within the EU average. France and Belgium show a similar growth rate. Germany achieved a growth rate of 3% in 2011. However, to properly assess the situation of public finances, it is necessary to neutralize the impact of the situation on GDP and public finances, which amounts to calculating potential growth and the structural public deficit.

Macroeconomic Performance



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

The real effective exchange rate (REER), an indicator measuring the cost-competitiveness of a country relative to its trading partners and which is included in the scoreboard of the excessive imbalances procedure, deteriorated in Luxembourg in 2011 compared to 2010. It should be noted that the REER as used in the context of the excessive imbalances strategy is an average over 3 years. This average is a smoothing, so that the indicator shows a slight improvement in 2011 compared to 2010 in the macroeconomic imbalances scoreboard.

Regarding the unemployment rate, Luxembourg is still in green, but it must be noted that under the effect of the crisis this indicator has steadily increased. In 2001, Luxembourg still showed an unemployment rate of 1.9%.

Luxembourg's economy is driven by exports. Three factors come into play, namely cost, situation and quality. For the moment, the last two factors easily outweigh the cost factor. However, denying the cost factor is dangerous as the situation deteriorates and other advantages may disappear. The nominal ULC, which has deteriorated in Luxembourg in 2011 compared to 2010, is the best indicator of competitiveness as the Luxembourg economy is governed by intense competition and companies are therefore "price takers" A sectoral analysis must identify the intensity of competition and the degree of pricing power.

In general, we can say that the inflation rate is higher in Luxembourg than in neighbouring countries. It is a generally accepted fact, now it is a question of explaining the differential. The effects of a wage shock (an indexation) measured through a macroeconometric simulation are reduced exports, activity, employment, public deficit and an increase in inflation, labour costs, unemployment, disposable income and private consumption.

3.2.2 Employment

Table 7
Category B Employment

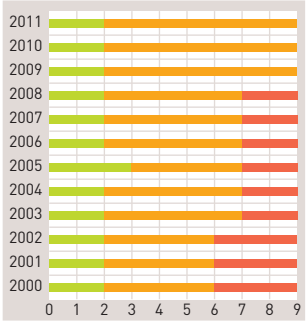
Code	Indicator		LU	EU-27	DE	FR	BE	MIN	MAX
B1	Employment rate, as a % (aged 15-64) (2011)	↓	64.6	64.3	72.5	63.8	61.9	GR 55.6	NL 74.9
B2	Employment rate – Men (aged 15-64) (2011)	↓	72.1	70.1	77.3	68.1	67.1	BU 60.9	NL 79.8
B3	Employment rate – Women (aged 15-64) (2011)	↓	56.9	58.5	67.7	59.7	56.7	MT 41	SE 71.8
B4	Employment rate of persons aged 55-64, as a % (2011)	↓	39.3	47.4	59.9	41.4	38.7	SL 31.2	SE 72.3
B5	Employment rate of persons aged 55-64 – Men (2011)	↓	47	55.2	67	44	46	SL 39.5	SE 75.7
B6	Employment rate of persons aged 55-64 – Women (2011)	↑	47.4	40.2	55.3	35.6	40	NL 13.8	UK 68.9
B7	Unemployment rate of persons under 25, as a % (2011)	↑	15.6	21.4	8.6	22.9	18.7	NL 7.6	ES 46.4
B8	Long-term unemployment rate as a % (2011)	↓	1.4	4.1	2.8	4	3.5	AT 1.1	SK 9.2
B9	Persons holding a part-time job as a % (2011)	↑	18.4	19.5	26.6	17.9	25.1	BU 2.4	NL 49.1

In the Employment category, 7 indicators out of 9 are in orange for Luxembourg and only 2 indicators are green. The red disappeared since 2009, for this category. However, it is noteworthy that Luxembourg's performance has deteriorated for 7 indicators.

The employment rate goes up to 64.6% in 2011 for Luxembourg. Best student among EU Member States, the Netherlands displays a rate of 74.9% in 2011, followed by Sweden, Denmark and Germany, displaying respectively a rate of 74.1%, 73.1% and 72.5% in 2011. Note that the employment rate as specified in the scoreboard refers to the age group 15-64 years, while the employment rate of the EU 2020 strategy refers to the portion of age 20-64.

The unemployment rate of young people (under 25 years), which is a concern for the majority of EU Member States, reached the level of 15.6% in Luxembourg in 2011. The EU average is 21.4% in 2011. Note also that the youth unemployment rate in Spain reached 46.4% in 2011. These alarming unemployment rates in Spain, Portugal, Lithuania, Slovak Republic and Greece are likely to have effects on migration flows in Europe.

Employment



3.2.3 Productivity and Labour Costs

Table 8
Category C Productivity and Labour Costs

Code	Indicator		LU	EU-27	DE	FR	BE	MIN	MAX
C1	Trends in total factor productivity (2011)	↓	-1.54	0.76	1.59	0.58	0.86	GR -1.9	EE 3.62
C2	Trends in apparent work productivity (2011)	↓	-1.2	1.2	1.6	1.2	0.4	GR -1.6	LT 14.8
C3	Productivity per hour worked, as a % of US figures (2011)	↓	86	58	77	92	89	RO 15	FR
C4	Changes in unit labour costs (2011)	↓	2.2	0.9	1.4	1.6	2.7	IR -3.2	LT 3

*EU-15; **EU-25

In terms of Productivity and Labour Costs, in 2011 Luxembourg shows poor results. Out of 4 indicators, 3 are displayed in red for Luxembourg. It should be noted that an indicator Cost/Income Ratio for the banking sector has been removed from the scoreboard, due to lack of available data.

Nominal unit labour cost has deteriorated in Luxembourg in 2011 compared to 2010. An apparently trivial debate divides the social partners on whether to keep the real or the nominal unit labour cost. While both seemed to evolve at the same pace, this choice did not seem to be a problem. When both indicators began to diverge, it was necessary to think of it more thoroughly. The real effective exchange rate is the best indicator because it compares the costs and prices of producing branches in Luxembourg with those of our trading partners. Nominal unit labour cost and real effective exchange rate are among the indicators used by the European Union in the new procedure for surveillance of macroeconomic imbalances used from 2012 within the framework of the European Semester.

Productivity and Labour Costs

3.2.4 Market Operations

Table 9
Category D Market Operations

Code	Indicator		LU	EU-27	DE	FR	BE	MIN	MAX
D2	Price of electricity (ex-VAT) – industrial users, in € per 100 kWh (2011)	↓	0.0960	0.0934	0.09	0.0722	0.0977	EE 0.0616	MT 0.18
D3	Price of gas (ex-VAT) – industrial users, in € per GJ (2011)	↓	11.58	8.98	11.58	89.86	8.72	RO 4.23	SE 11.71
D4	Market share of the primary operator in cellular telephones, as a % (2010)	↑	51	38	33	41	43	PO 31	CY 76
D6	OECD basket of mobile telephone rates for large consumers, VAT included – Total in USD (2008)	↓	448.69	652.27**	941.31	829.57	886.98	FI 327.09	ES 1191.5
D7	Broadband Internet access rates in USD PPP/MB (VAT included) (2009)	↑	16.51	36.74**	19.17	27.91	22.07	UK 13.16	SE 98.80
D8	OECD Basket of domestic royalties for 2 Mbits leased lines (ex-VAT) in USD (2010)	↓	11844	210763**	15697	24767	18163	DK 4515	HO 3067549
D9	Value of public tenders using open procedure procurement, as % of GDP (2010)	→	1.50	3.7	1.3	7.4	3.1	DE	SK 11.6
D10	Total State aid as a % of GDP (except horizontal objectives) (2010)	↑	0.23	0.60	0.64	0.8	0.61	BU 0.15	HU 2.28

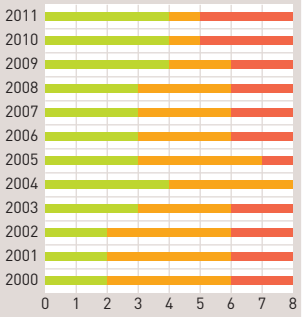
*UE-15 ; **OECD

In the Market Operations category 3 indicators are red and 4 indicators are green.

Luxembourg has average to bad results on the price of electricity and gas for industrial users. In other Member States, the price of electricity and gas are lower than in Luxembourg.

In terms of public procurement, the value of public procurement awarded in accordance with the open procedure stagnated in 2010 at 1.5% of GDP. The total number of State aid has decreased in 2010 to 0.23% of GDP.

Market Operations



3.2.5 Institutional and Regulatory Framework

Table 10
Category E Institutional and Regulatory Framework

Code	Indicator		LU	EU-27	DE	FR	BE	MIN	MAX
E1	Corporate tax rate, as a % (2011)	↓	28.80	23.03	29.37	33.33	33.99	BU 10	MT 35
E2	Income tax rate, as a % (2011)	↓	41.3	37.51	47.5	46.7	53.7	BU 10	SE 56.6
E3	Standard VAT rate, as a % (2012)	→	15	21.02	19	19.6	21	LU	HU 27
E4	Tax wedge – Single, without children, as a % (2010)	↓	34.30	35**	49.20	49.3	55.4	IR 25.8	BE
E5	Tax wedge – Married, with 2 children, one wage-earner (2010)	↓	11.6	25**	33	42.2	39.8	IR 4.7	FR
E6	Administration efficiency index (2010)	↓	1.71	1.18	1.55	1.44	1.59	RO -0.14	DK 2.17
E7	Law compliance index (2010)	↑	1.82	1.18	1.63	1.52	1.4	BU -0.08	FI 1.97
E8	Regulation quality index (2010)	↑	1.69	1.26	1.58	1.34	1.30	BU 0.61	DK 1.90
E9	Degree of sophistication of online public services, as a % (2010)	↑	87	90	99	94	92	GR 70	PT 100
E10	Full online availability of public services, as a % (2010)	↑	72	82	95	85	79	GR 48	SE 100

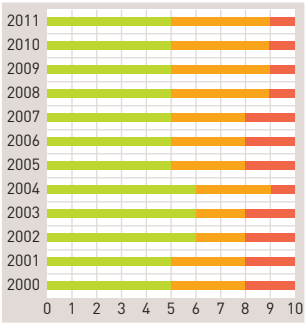
**OECD

The Institutional and Regulatory Framework describes on one hand the tax environment for companies and households and, on the other, the functioning of the public administration. In Luxembourg, this environment is favourable for both companies and households. 5 indicators are green, 4 indicators are orange and only 1 indicator is red.

Regarding corporate taxes and individual revenue tax, these rates increased in 2011 compared to 2010. In Bulgaria, the corporate tax rate is the lowest among the Member States with a rate of 10%. In Malta, this rate is 35%, the highest in the European Union.

Concerning the degree of sophistication of the basic public services available online and the share of public services fully available online, Luxembourg continues its efforts, but it ranks with 87% and 72% respectively on EU average in 2010. Sweden leads the ranking with 100% of public services fully available online in 2010.

Institutional and Regulatory Framework



3.2.6 Entrepreneurship

Table 11
Category F Entrepreneurship

Code	Indicator		LU	EU-27	DE	FR	BE	MIN	MAX
F1	Propensity for entrepreneurship, as a % (2009)	↑	44	45.1	40.8	50.8	30	SK 25.6	CY 66.3
F2	Self-employed as a percentage of total employment (2011)	↑	5.65	16.07	11.06	9.18	16.16	SE 5.34	RO 35.26
F3	Net change in number of companies, as a % (2009)	↓	1.52	0.01	-0.82	8.03	-6.32	LT –17.36	FR 8.03
F4	Volatility among companies, as a % (2009)	↓	17.02	20.83	17.44	22.67	15.48	CY 5.42	LT 46.8

* EU-15

In terms of Entrepreneurship, the performances of Luxembourg are within the EU average. Two indicators are orange, one indicator is green, and one indicator is red. The number of self-employment as a percentage of total employment has increased slightly. This is attributable to the fact that total employment increases faster than the number of self-employed workers. 44% of Luxembourg's population wish to be self-employed, but only few of them fulfil this ambition.

Entrepreneurship

Frame 1
DG Enterprise and Industry: 2010/2011 SBA Technical sheet

The European Commission publishes an annual technical sheet[6] under the Small Business Act (SBA), whose objective is to gain insight into recent trends and policies adopted in respect of SMEs. The analysis focuses on 10 areas related to small and medium enterprises, namely entrepreneurship, second chance, Think Small first, responsive administration, State aid and public procurement, access to finance, single market, skills within companies and innovation, environment, internationalization.

The analysis of the European Commission can be summarized by the following points:

- "The SME sector is expanding rapidly, with a 23% net increase in the number of SMEs (between 2003 and 2010) and 25,000 new jobs.
- Having been spared from damaging effects of the crisis, growth is set to increase well into the future (even beyond 2012).
- Luxembourg's SBA profile in almost all areas is equivalent to the EU average.
- Major steps have been taken in all SBA areas, except for 'Second chance', 'Access to Finance' and 'Skills and Innovation'."

Luxembourg already offers many initiatives to encourage entrepreneurship and to support entrepreneurs. Besides the general form of entrepreneurship, the government is promoting an alternative form of entrepreneurship, namely solidarity entrepreneurship.

[6] http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/performance-review/files/countries-sheets/2010-2011/luxembourg_fr.pdf

Frame 2

"Alternative entrepreneurship" - The Department of solidarity economy promotes solidarity entrepreneurship

In 2009, the government decided to promote in a more active and targeted way the solidarity economy in order to give this sector a better visibility as an alternative form of economic activity. The government statement in 2009 is illustrative: "The solidarity economy offers the public goods and services with socio-economic value. Most of these products and services are not on offer in the real economy. However, they are needed. That is why we will do more on this important part of our overall economic offer."

Beyond this statement of principles, the government is committed more particularly to carrying on with the work undertaken by the Ministry of Labour and Employment in order to introduce a new company status in Luxembourg law, in the service of solidarity economy. This task was entrusted to the Minister in charge of Solidarity Economy.

Other international institutions are also dedicated to the analysis and development of this sector, such as the OECD[7] and the European Commission[8], given its importance for the GDP of various countries and as an alternative approach to the market's economic activities.

The department of solidarity economy, which became fully operational in March 2010, reports to the Ministry of Economy and Foreign Trade, reflecting the recognition by the government of a new economic reality.

To the Minister in charge of Solidarity Economy, Romain Schneider, solidarity economy in Luxembourg is above all "An economy that combines economic activities and social purposes. An economy that is part of a sustainable development approach."

There is a lot of various solidarity enterprises' status and activities. They primarily gather round common values of solidarity and practices that reflect a desire to build an economy on a human scale and that has the ambition to meet all the needs of society: employment, health, education, independence, housing, food, and many others.

The strategic objective of the action plan is to include the solidarity economy in our economic, social and environmental development policies. This ambition to spread solidarity practices requires bridging a gap between worlds that are unfamiliar to each other.

In this perspective a first strategic objective is to make the social gains generated by the solidarity economy more visible, by shedding a new light on the business practices that are applied to social change.

Then it will be a matter of providing solidity to the economic models developed and of identifying the best practices to be placed permanently at the heart of our development policies, as well as arousing the desire for entrepreneurship in collective interest.

The action plan is constructed around 4 main themes, each of which refers to the various successive actions to implement.

First, the objective of this plan is primarily to raise awareness not just among the general public, but also among public authorities and the standard private sector of the solidarity economy concept through information that should be better targeted at its features and at sector news. Awareness campaigns will be carried out through conferences, publications and other events.

Knowledge about the sector will be improved further by a pilot research project led by Statec which aims at the development and implementation of a method that could help to establish available statistical data to document the importance of the solidarity economy in Luxembourg economy.

In the same perspective, Luxembourg will also participate in an OECD survey within the framework of the LEED program (Local Employment and Economic Development), which aims to provide national and local policies with an assessment of factors that contribute to job creation by the organizations of the social and solidarity economy in the relevant countries and/or regions. Practically, this project will analyse how these organizations can create and maintain quality jobs for people who have difficulty entering the labour market, including young people, older people, women and the so-called "vulnerable" people.

Secondly, the Constitutive Committee of a representative platform of solidarity economy in Luxembourg aims to bring together as many stakeholders from the sector as possible.

[7] For more than a decade the OECD has devoted a significant portion of its resources to the study and observation of this sector which it addresses under the notion of social enterprise.

[8] In its Report on the Social Economy from 26.01.2009, the European Parliament identifies the ESS as one of the 12 levers to modernize the Single Market. For more details: http://ec.europa.eu/internal_market/social_business/index_en.htm

Frame 2
Continued

The mission of the Constitutive Committee is to develop a working model for the future platform that is intended to be a forum for exchange and dialogue between the players in the social and solidarity economy so as to open a space for dialogue with other parties.

The objectives are to facilitate synergies between players in the social and solidarity economy and to create or even strengthen links between the players through the implementation of working groups of common interest and to become an interlocutor with the capacity to impact the political decisions that affect the interests of stakeholders.

Thirdly, to make social or solidarity entrepreneurship more attractive and to build confidence in it, its social impact must become visible. As part of a pilot project, it is suggested to extend Business Initiative a.s.b.l.'s competence and its traditional business plan competition 1,2,3 GO[9] to the launch of a pilot competition entitled 1,2,3 GO SOCIAL.

The objective of this initiative is to generate, strengthen or develop innovative projects that fall within the scope of the solidarity economy, as promoted by the government.

Practically, project leaders are supported in developing their social business plan. They will participate in a business plan contest with prizes and will benefit from media visibility.

Fourthly, the issue of complaints for "unfair competition" made against the players in the solidarity economy was very powerful during 2011.

Having realized the negative effect on the development and promotion of the solidarity economy within the Luxembourg economic and social fabric, it is suggested to concretely deal with these issues, for a clean and constructive debate.

In collaboration with the Luxembourg Company Union (UEL - *Union des Entreprises Luxembourgeoises*), the implementation of a pilot mediation mechanism will allow to assess the scope and validity of the allegations that were made.

The department of solidarity economy, with the support of an expert in competition law, will lead this mediation space during a test phase.

[9] Business Initiative a.s.b.l. is a non-profit association founded in 2000 by the Chamber of Commerce of Luxembourg, Fedil - Business Federation Luxembourg and Luxinnovation (National Agency for the Promotion of Innovation and Research in the Grand Duchy of Luxembourg).

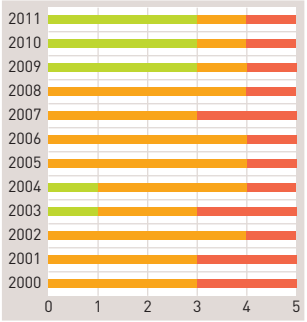
3.2.7 Education and Training

Table 12
Category G Education and Training

Code	Indicator		LU	EU-27	DE	FR	BE	MIN	MAX
G1	Annual cost per student in public educational facilities, in PPS (2009)	↓	13054	6339	6732	7317	8459	RO 2538	LU
G2	Part of the population having achieved at least the second cycle of secondary education, as a % (2011)	↓	77.3	73.4	86.3	71.6	71.3	MT 31.5	LT 92.9
G4	Share of human resources in scientific and technological fields, as a % of total employment (2011)	↑	57.1	42.3	44.9	48.1	49.6	RO 25.8	LU
G5	Lifelong learning, as a % of the population aged between 25-64 (2010)	↑	13.6	8.9	7.8	5.5	7.1	BU 1.2	DK 32.3
G6	Secondary school drop-outs, as a % (2011)	↑	6.2	13.5	11.5	12	12.3	SL 4.2	MT 33.5

In the Education and Training category, we observe a performance improvement for Luxembourg in comparison with the previous year. The three indicators, namely the share of human resources in scientific and technological fields in total employment, lifelong learning and school drop-outs, are green and have improved in 2011 compared to 2010. Employees benefit greatly from training in Luxembourg. Companies seem to invest in training in order to increase their productivity by adapting qualifications of their employees. Lifelong learning can also be seen as a kind of reward that companies offer to their employees.

Education and Training



According to an OECD study, "the comparison between spending on education and educational attainment reveals a significant lack of efficiency." The inefficiency stems from the fact that the resources (money, people) involved in the education system produce poor results, as measured through Pisa tests.

In absolute terms, expenditure per student in Luxembourg is the highest among the European Union countries. Due to the lack of a suitable recurring indicator reflecting the efficiency of education, it has been decided that increased spending is a sign of degradation at the moment. Not taking the results of education into account would place Luxembourg at the same level as Finland, the world champion in Pisa tests! This problem however, did not arise concerning spending on R&D, as several studies published in the Report showed the positive effect of R&D on innovation and productivity in the company.

3.2.8 Knowledge Economy

Table 13
Category H Knowledge Economy

Code	Indicator		LU	EU-27	DE	FR	BE	MIN	MAX
H1	Internal R&D Lisbon expenditure, as a % of GDP (2010)	↓	1.63	2	2.82	2.26	1.99	RO 0.47	FI 3.87
H2	Public R&D budget credits, as a % of GDP (2010)	↑	29.7	34.9	29.7	39.7	25.3	BE 25.3	CY 69
H3	Portion of public research financed by the private sector, as a % of GDP (2010)	↓	65.9	54.1	66.1	51	58.6	CY 15.7	FI 66.1
H5	Number of researchers per 1,000 employed persons (public and private sectors taken together) (2010)	↑	7.1	7	8.1	9.1	8.5	RO 2.1	FI 17
H7	Number of USPTO patents per million inhabitants (2011)	↑	77.75	118.4	145.87	69.48	73.1	LV 1.35	SE 181
H8	Number of OEB patents per million inhabitants (2009)	↓	154.79	115.8	294.53	134.3	143.61	BU 1.22	SE 332.03
H9	Use of broadband connections by companies, as a % (2009)	↑	92	88	91	96	95	RO 56	MT 99
H10	Investment in public telecommunications, as a % (2009)	↓	1.54	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 % (2011)	↑	91	73	83	76	77	BU 45	NL 94
H12	Number of cell and fixed phones per 100 inhabitants (2009)	↑	240.52	167.10*	200.4	164.2	184.08	SK 132.27	EE 253.25
H13	Percentage of households that have broadband Internet access (2011)	↓	75	92	93	92	97	RO 65	MT 100
H14	Number of secure web servers per 100,000 inhabitants (2011)	↑	149.48	25.05*	86.09	30.86	50.44	GR 12.46	NL 229.99
H15	Percentage of total employment in medium or high technology sectors (2011)	↓	0.7	5.6	9.7	4.8	5.2	CY 0.7	CZ 10.2

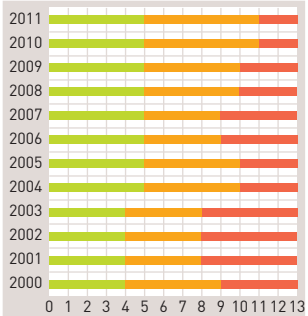
*OECD

In general, we can say that the performance of Luxembourg is more or less within the EU average. For indicators relating to research financed by the private sector or the use of the Internet by households or still the number of mobile cellular accesses and the number of secure web servers, the performances of Luxembourg are much higher than the EU average. However, for the indicator on the number of patents (USPTO) or the percentage of total employment in medium-high and high technology, Luxembourg is less effective.

Investments in telecommunications remain a priority as evidenced by the national strategy[10] for "ultra-high" speed network - The "ultra-high" speed for all - launched in 2010 by the Luxembourg government. Technological change is so fast and Luxembourg must adapt to novelty in order to deliver the best infrastructure to companies and households. In 2004, during the development of the scoreboard, it was important to develop high-speed or broadband access. Seven years later, it is about developing ultra-high speed, which will reach speeds of up to 1 Gigabit per second (Gbit/s) for landline networks and up to 150 Megabits per second (Mbit/s) for mobile networks.

In terms of the Knowledge Economy, Luxembourg should still make efforts in domestic expenditure on R&D. The strategy aim of achieving a rate between 2.3% and 2.6% remain very ambitious.

Knowledge Economy



[10] http://www.mediacom.public.lu/institutions/Institutions_nationales/smc/20100309_ngn/Strategie_nationale_pour_les_reseaux_a_ultra-haut_debit.pdf

3.2.9 Social Cohesion

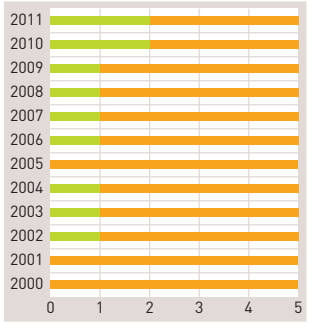
Table 14
Category I Social Cohesion

Code	Indicator		LU	EU-27	DE	FR	BE	MIN	MAX
I1	Gini coefficient (2010)	↑	27.9	30.5	29.3	29.9	26.6	SL 23.8	LT 36.9
I2	At-risk of poverty rate after social transfers, as a % (2010)	↑	13.7	16.4	15.6	13.5	14.6	CZ 9	LV 21.3
I3	At persistent risk of poverty rate, as a % (2010)	↑	6	9.7	9.1	6.4	9.3	SE 4.9	RO 18.2
I4	Life expectancy at birth in numbers of years (2011)	→	80.7	79.7	80.5	81.8	80.3	LT 73.5	ES 82.2
I5	Gender wage gap, as a % of gross hourly wages of male employees (2010)	↑	14.5	21.7	26.1	15.8	13.3	SL 10.1	EE 28.3
I6	Serious work related accidents (index 1998=100) (2006)	↓	78	76	66	82	60	GR 55	EE 120

Indicators in the Social Cohesion category have improved compared to the previous year. Three indicators, including the Gini coefficient, life expectancy at birth and the at-risk of poverty rate are still orange, and the indicator measuring the gender wage gap as a % of gross earnings of male employees remains green. The green indicator category also includes the at persistent risk of poverty rate. Generally, Luxembourg is better off than its neighbours.

These indicators provide a first view of social cohesion in Luxembourg, however the project *PIBien-être* will surely enrich and complete the set of indicators in order to analyse social cohesion in Luxembourg in more detail.

Social Cohesion



Frame 3
2012 Eurobarometer social climate survey[11]

Eurobarometer "special" surveys on the social climate cover fifteen areas and ask respondents to assess the current situation, the developments over the past five years and the changes they expect in the coming year for each of these areas. This is the fourth edition after the first one, conducted in 2009 (EB Special 315), the second in 2010 (Special EB 349) and the third in 2011 (EB Special 370).

The social climate EU index, which takes into account the personal situation, the national situation and social protection, is -0.8 in 2012, slightly lower than the 2011 index (-0.6) and those recorded in 2009 and 2010 (both -0.7).

Luxembourg (2.7) is among the Member States with a positive index, namely Denmark and the Netherlands (both 2.8), Sweden (2.6), Austria (2.5), Germany (2.0) Finland and Belgium (both 1.5), Malta and the United Kingdom (both 0.1). These ten Member States have formed the top 10 of the general social climate index in each of the four years of the survey. Eight of the ten Member States show an improvement in their social climate index since 2011, leading this list Denmark (+ 0.7 points) and Germany (+ 0.6). In Luxembourg, there is a slight deterioration in 2012 compared to 2011 (-0.1) in the general index.

At category level, it is important to highlight that in Luxembourg, citizens have a pretty good perception about their lives, their environment and the country's economic situation. Perception is poorer in the domains of cost of living, energy prices and housing prices. Citizens perceive social protection and inclusion as being rather good in Luxembourg.

Luxembourg	**2012**	**Position in the ranking**
General index	2.7	3
Personal situation		
General assessment of your life	5.8	4
Assessment of the environment in which you live	6.9	2
Assessment of your employment status	4.6	3
Evaluation of the household's financial situation	4.1	4
Situation of the country		
The cost of living	-0.5	6
How affordable is energy in your country	0.6	6
How affordable is housing in your country	-5	18
How well does government function in your country	2.4	1
The economic situation in your country	2.8	3
The employment situation in your country	0.8	3
Social protection and inclusion		
Health care provision	5.9	3
Provision of pensions	4.9	1
Unemployment benefits	4.5	1
Relations between people from different cultural and religious situations	2.3	1
They way inequalities and poverty are addressed	0.9	1

How to read the table: The index is an average based on judgments to which a value is assigned. The index varies within a range of -10 to +10. The higher the index is, the more satisfied the citizens are. Using the calculated indices, we can rank the countries, and this ranking puts into perspective the perception of citizens in relation to the perception of citizens of other Member States. For example: in Luxembourg citizens perceive the situation as being worse, with a score of -0.5. However, in other countries, this perception is even worse, Luxembourg is in the 6th position.
Source: Eurobarometer Social Climate 2012

[11] http://ec.europa.eu/public_opinion/archives/eb_special_399_380_fr.htm#391/

3.2.10 Environment

Table 15
Category J Environment

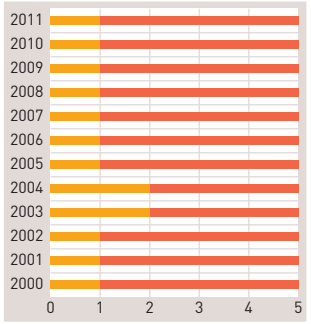
Code	Indicator		LU	EU-27	DE	FR	BE	MIN	MAX
J1	Number of ISO 9001 certifications per million inhabitants (2010)	↓	211	706	619	458	341	LU	IT 2296
J2	Number of ISO 14001 certifications per million inhabitants (2010)	↓	38	187	73	81	75	LU	CZ 630
J3	Total greenhouse gas emissions (index 1990=100) (2010)	↓	92	89	76	93	91	LT 42	ES 123
J4	Share of renewable energy (2010)	↓	3.09	19.94	16.9	14.45	6.79	MT 0.0	AT 61.41
J5	Volume of municipal waste generated in kg per person, per year (2010)	↑	678	524	583	532	466	LV 304	CY 760
J6	Energy intensity in kg of oil equivalent per thousand of euros (2010)[12]	↓	140	152	142	152	191	IR 93	BU 671
J7	Modal breakdown in transportation choice for passenger method – Percentage of car users in passenger kilometres (pkm) (2010)	↓	101.5	94.6	96.8	95	96.2	SK 58.4	LT 113.8

In the Environment category, Luxembourg's performance deteriorated in 6 out of 7 indicators and red and orange prevail in this category. The indicator for "municipal waste generated in kg per person" is the only indicator that has improved compared to the previous year, even if it remains red.

For renewable energy, Austria is the champion among EU countries with a 61.41% share of renewables. Luxembourg has a rather poor performance with a rate of 3.09%. The Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources provides for Luxembourg an objective of 11% of renewable energy in its final energy consumption in 2020[13]. In order to achieve this ambitious goal, the government has set an indicative evolution path. It is thus expected to achieve a rate of 2.92% in 2011/2012, a rate of 3.93% in 2013/2014, a rate of 5.45% in 2015/2016 and a rate of 7.47% in 2017/2018.

The indicator relating to the total greenhouse gas emissions has deteriorated compared to the previous year. In the EU 2020 strategy, Luxembourg has set the objective to reduce greenhouse gas emissions by 20% in relation to 2005 levels by 2020. This ambitious goal requires huge efforts in the coming years. Technological change has helped these objectives from 1994 to 1998 with the transition in the steel industry from traditional blast furnaces to electric steel plants. With the opening of a cogeneration gas-steam plant in 2002 greenhouse gas emissions increased. Additionally, fuel tourism, which has a positive impact on the State budget, has a negative effect on the Kyoto balance.

Environment



[12] This indicator differs from the indicator that is used for the EU 2020 strategy.

[13] National Reform Programme of the Grand Duchy of Luxembourg in the framework of the European Semester, April 2012, p. 32-34.

3.3 Competitiveness composite indicator

3.3.1 General Result

In 2011, Luxembourg is ranked 11th and therefore loses three positions compared to last year. Germany lost two positions and Belgium climbed one. France was able to keep its rank compared to 2010, the 12th position. Estonia has improved its competitiveness whilst also climbing in the general composite indicator ranking. Estonia climbed five positions and is thus among the top 10 ranking. Austria was able to gain two positions from ninth to seventh place.

Luxembourg is not among the worst off countries, quite the opposite, but efforts are essential in order to maintain its competitive position in the long run. The best position that Luxembourg was able to reach over the period 2006-2011 is the 6th place in 2000 and 2009 and the worst is the 11th position in 2006 and 2011.

For Latvia, Lithuania, Bulgaria, Cyprus and Malta, results must be placed in perspective, as there are a number of scoreboard indicators that do not exist for these countries.

Frame 4
Methodology

Concerning the applied methodology for calculating the composite indicator, we take the recommendations made in the audit into account (2010 competitiveness Report, Economic Outlook No. 15).

For some indicators, there are outliers. For example, for Luxembourg there are two indicators in the Scoreboard in which the performance is well above that of other countries. These are well known indicators, namely direct foreign investment (A12) and expenditure on education (G1). Given that these indicators threaten to influence the results too much, extreme values are dealt with by replacing them with the same value as the closest scoring country.

In order to fix 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 the country that shows similar performance for the other indicators.

For the composite indicator calculation, basic indicators are standardized first.

Each indicator i 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 each category k (k = 1, ..., 10) at the time t is calculated by an average of the sub-indicators of this category in the following 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 on 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 using a simple arithmetic mean of its composite indicators, which means that the 10 categories are equally weighted.

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

The *Observatoire de la compétitivité* wishes to recall again that from a methodological point of view, this ranking is constructed relatively, which means that Luxembourg's ranking also depends on the other countries' performances. Even if Luxembourg's performance is bad, it may be that other countries' performances have deteriorated much more, so that the relative position of Luxembourg is better at the end. The ranking says nothing about the absolute performances of Luxembourg.

In other words, an improvement in a country's ranking may be caused by a deterioration of the performance of other countries. That is why the *Observatoire de la compétitivité* always recommends that one's interpretation of the ranking be supplemented by information provided by the Scoreboard, i.e. the basic indicators.

Table 16
Composite indicator results from 2000 to 2011

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Germany	9	9	13	12	13	14	9	11	8	10	7	9
Austria	7	7	9	7	7	9	8	7	7	7	9	7
Belgium	17	18	16	18	11	17	17	16	14	16	18	17
Bulgaria	25	25	23	21	19	18	25	23	15	20	17	16
Cyprus	22	17	24	26	22	22	22	18	16	15	20	24
Denmark	2	2	2	3	2	2	2	2	3	2	2	2
Spain	18	16	17	17	17	19	18	17	17	18	25	25
Estonia	10	11	7	6	10	8	6	8	10	13	11	6
Finland	3	4	3	4	3	3	5	5	4	8	4	4
France	14	13	15	15	14	15	14	14	12	12	12	12
Greece	24	21	26	19	25	26	21	24	23	23	27	27
Hungary	20	20	19	22	26	23	23	27	24	25	26	23
Ireland	8	8	5	8	15	13	12	10	13	9	14	14
Italy	21	22	20	20	20	21	20	20	19	17	15	18
Latvia	11	19	11	13	18	12	15	15	26	24	16	13
Lithuania	12	6	14	11	12	11	13	12	20	26	22	20
Luxembourg	**6**	**10**	**10**	**9**	**6**	**6**	**11**	**9**	**9**	**6**	**8**	**11**
Malta	16	27	22	25	27	24	26	26	27	27	24	26
Netherlands	5	3	6	5	5	5	3	3	2	3	3	3
Poland	26	26	27	27	24	25	24	22	21	14	19	19
Portugal	23	24	25	24	23	27	27	25	25	22	23	22
Romania	19	14	8	14	8	20	16	21	22	19	21	21
United Kingdom	4	5	4	2	4	4	4	4	5	4	5	5
Slovak Republic	27	23	21	23	21	16	19	19	18	21	13	15
Czech Republic	15	15	18	16	16	10	10	13	11	5	10	10
Slovenia	13	12	12	10	9	7	7	6	6	11	6	8
Sweden	1	1	1	1	1	1	1	1	1	1	1	1

Source: Observatoire de la compétitivité

3.3.2 Results per category

By analysing the rankings by category, we observe that for the Productivity and Labour Costs category, Luxembourg occupies the 23rd position in the ranking. The classification in this category is very volatile indeed as indicators depend strongly on the situation. In terms of Entrepreneurship, Luxembourg is also in 23rd position. However, this category should be improved by adding other indicators. In the Macroeconomic Performance, Employment, Institutional and Regulatory Framework, Knowledge Economy and Social Cohesion categories, Luxembourg is among the top 10 countries of the European Union.

Table 17
Ranking by category in 2011

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

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
Source: Observatoire de la compétitivité

3.3.3 The composite indicator stress test

Following the criticisms, the Observatoire de la compétitivité conducted a stress test for its composite indicator. The test consists in excluding one by one the 78 indicators and recalculating the ranking. Other scenarios include not imputing missing values or not treating outliers. The table below shows that Luxembourg is ranked 9th in 1% of cases, 10th in 32% of cases, 11th in 66% of cases and 12th in 1% of cases (see table). Luxembourg varies thus essentially in a range [10, 11]. For 2010, the same test shows that Luxembourg varies in between the 8th and 9th position. This loss of three positions in 2011 compared to 2010 should be put in perspective, as it is a loss of maximum 3 positions and minimum of 1 position.

Table 18
The stress test, %

Country	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
Sweden	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Denmark	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Finland	0	0	0	72	24	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
United Kingdom	0	0	0	25	58	11	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Estonia	0	0	0	4	7	44	19	21	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Austria	0	0	0	0	6	24	39	31	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slovenia	0	0	0	0	5	15	32	40	4	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	0	0	0	0	1	2	6	6	84	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Czech Republic	0	0	0	0	0	0	0	0	5	66	27	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Luxembourg	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**32**	**66**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
France	0	0	0	0	0	0	0	0	0	0	4	95	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Latvia	0	0	0	0	0	0	0	0	0	0	0	1	80	15	4	0	0	0	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0	0	0	0	18	73	6	4	0	0	0	0	0	0	0	0	0	0	0
Slovak Republic	0	0	0	0	0	0	0	0	0	0	0	0	1	8	82	6	1	1	0	0	0	0	0	0	0	0	0
Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	4	6	72	8	5	6	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	14	49	25	7	2	1	0	0	0	0	0	0
Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	32	49	8	6	0	0	0	0	0	0	0
Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	15	53	25	0	0	0	0	0	0	0
Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	5	26	65	1	0	0	0	0	0	0
Romania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	95	2	0	0	0	0	0
Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	28	22	5	1	0
Hungary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	41	18	20	0	0
Cyprus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	29	12	42	13	1	0
Spain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	18	16	56	6	0
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	6	92	0
Greece	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100

Source: Observatoire de la compétitivité

4 The European Semester and the Europe 2020 strategy

4.1 The "European Semester"

Since the ten-year strategy for Growth and Employment (called "Lisbon strategy") expired in 2010, the European Council had set up in 2010 the foundations for a new European economic governance. Since 2011 it takes place in an integrated and parallel way at two levels within the "European semester". This new governance structure is based on the following pillars: macroeconomic surveillance and thematic coordination under the aegis of the Europe 2020 strategy, which replaces the Lisbon strategy; fiscal policy coordination under the Stability and Growth Pact (SGP). EU Member States must agree each year on a series of concrete actions to be implemented within a period of twelve months. These commitments are also reflected in the National Reform Programmes (NRPs) developed as part of the Europe 2020 strategy and in the stability programmes developed under the SGP, which the Member States are required to submit each year during the European Semester.

This chapter[1] is limited to a descriptive analysis of quantitative targets and monitoring indicators used in the context of thematic coordination (coordination of structural policies) in the Europe 2020 strategy.

[1] The system of indicators provided in the context of macroeconomic surveillance, which is intended to better detect potential internal and external macroeconomic imbalances and which is also a part of the Europe 2020 strategy, is reviewed in another chapter of this Report.

4.2 From the Lisbon strategy to the Europe 2020 strategy

4.2.1 Implementation of the Europe 2020 strategy

The Europe 2020 strategy[2], which is a central element of the response of the European Union (EU) to the global economic crisis, was designed to update and replace the Lisbon strategy[3] launched in March 2000 and renewed in 2005 as a European strategy for growth and employment. The new strategy involves greater coordination of economic policies and focuses on key areas where action must be taken to boost the potential of a sustainable and inclusive growth and competitiveness in Europe. The way out of the crisis was considered to be the point of entry into a social market economy, a greener and smarter economy, in which prosperity is the result of the capacity to innovate, of the better usage of resources, and where knowledge will be key. In early 2010, the Commission made proposals to implement this new Europe 2020 strategy[4]. In March 2010, the European Council, on the basis of a communication from the Commission, discussed and approved the main elements[5], including key objectives that will guide its implementation as well as provisions to improve its monitoring. The European Council[6] agreed on a series of elements . The June European Council finally completed the development of the new Europe 2020 strategy. The European Council confirmed five major EU objectives in particular, 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, and improving the levels of education and social inclusion, particularly by reducing poverty[7]:

"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 bringing 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;

2 For additional information: http://ec.europa.eu/eu2020/index_en.htm

3 For additional information: http://ec.europa.eu/archives/growthandjobs_2009/

4 European Commission, EUROPE 2020 A strategy for smart, sustainable and inclusive growth, COM(2010) 2020 final, Brussels, 3.3.2010.

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

6 European Council, Conclusions, Brussels, June 2010 For additional information: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/115348.pdf

7 In Luxembourg, a policy debate on the Europe 2020 strategy took place in early June 2010 at the Chamber of Deputies before its final adoption by the European Council. For additional information: http://www.odc.public.lu/actualites/2010/06/europe_2020/index.html

Improving education levels, in particular by aiming to reduce early school leaving 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 objectives on the basis of what they judge as the most appropriate indicators among these."

4.2.2 The first European Semester (January-June 2011)

In January 2011, the first European Semester was launched within the framework of the new economic governance following the publication by the Commission of the annual report on growth[8], the priorities of which have been validated by the European Council in March 2011. In 2011, many discussions were held about the strategy in the coming years in order to cope with the present challenges[9]. In Luxembourg, a second policy debate was held in the Chamber of Deputies[10] and the social partners and civil society[11] were consulted and submitted their own comments to the government on the NRP draft. In April 2011 Luxembourg sent its finalized NRP to the Commission[12]. Alongside a macroeconomic scenario and a section dedicated to macroeconomic surveillance, the NRP also approved the national targets for 2020, by indicating as well the methodological limitations of some indicators and targets for Luxembourg, and by proposing measures that would allow these national objectives to be achieved. The European Commission subsequently analysed the NRPs and SGPs provided by the Member States. On 7 June 2011 the publication of Commission recommendations by country[13], including those for Luxembourg, was a new stage in European economic governance. These recommendations rest on a deeper assessment of fiscal consolidation (SGP) plans of each Member State and the measures adopted to stimulate growth and create jobs (NRP). In early July 2011 the Council adopted the finalized recommendations by country[14], which also closed the first European Semester.

At the end of this first round of the "European semester" in 2011, a debate took place on July 14th at the Luxembourg Chamber of Deputies to launch the first "national semester", as the government wished to hear the opinions of members of Parliament about the conclusions of the EU Council and in particular on the four recommendations that were addressed to Luxembourg[15].

8 European Commission, Annual growth Survey: advancing the EU's comprehensive response to the crisis COM (2011) 11 final, Brussels, 12 January 2011.

9 For example, the Europe 2020 summit organized by the think tank "The Lisbon council." For more information: http://www.lisboncouncil.net/news-a-events/254-president-barroso-keynotes-the-europe-2020-summit.html

10 For additional details: http://www.odc.public.lu/actualites/2011/03/debat_europe_2020/index.html The various parliamentary committees that are involved in the Europe 2020 strategy and the European Semester as a whole have also expressed their views to government.

11 During 2011 consultations were held with social partners and civil society about the different national goals that were set by Luxembourg.

12 NPR Luxembourg 2020, Luxembourg, April 2011 For more details: http://www.odc.public.lu/actualites/2011/03/debat_europe_2020/index.html

13 For more details: http://ec.europa.eu/europe2020/tools/monitoring/recommendations_2011/index_fr.htm

14 For more details: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/fr/ecofin/123613.pdf

15 For a summary of the debates: http://www.europaforum.public.lu/fr/actualites/2011/07/chd-semestre-europeen/index.html

4.2.3 The second European Semester (January-June 2012)

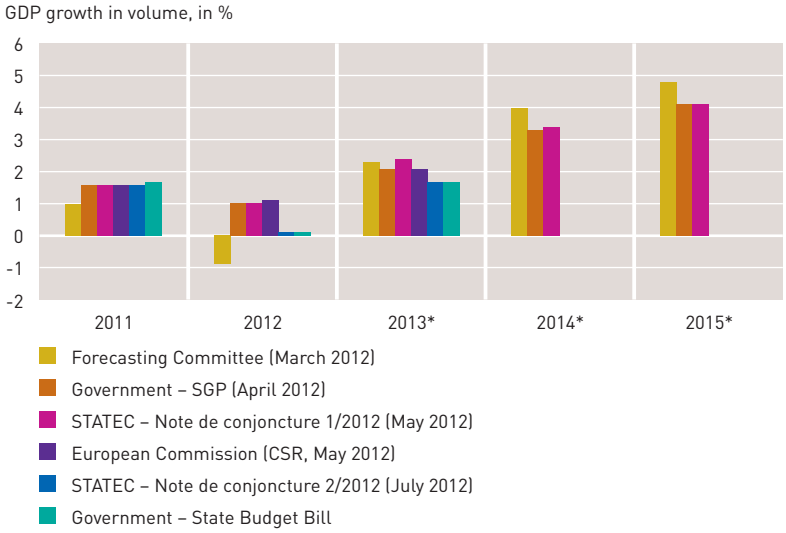
In January 2012, the second European Semester was launched following the publication by the Commission of the 2012 annual growth report[16], whose priorities have been validated by the European Council in March 2012. A consultation discussion took place in the Chamber of Deputies[17, 18]. In April 2012 Luxembourg sent its NRP and the SGP to the Commission[19].

Frame 1

Successive versions of economic forecasts developed in Luxembourg within the "European Semester" and "national semester" 2012[20]

Several sets of economic forecasts have been made in Luxembourg in the European semester 2012, three of which were made public: a note from the Forecasting Committee to the Governing Council (March 2012), the Government Stability and Convergence Programme (April 2012) and the report on the economy (*Note de conjoncture*) by Statec (May 2012).

The most problematic factors for doing business



Source: IMD

In July 2012, shortly after the adoption of the country recommendations in Luxembourg by the Council and therefore at the end of the European Semester and the beginning of the "national semester" in relation to the budget discussions for 2013, Statec published its new macroeconomic forecasts for the years 2012 and 2013. Ultimately, these updates have resulted in a downward revision of economic growth forecasts for 2012 and 2013. GDP growth would amount to only 0.1% in 2012 (as compared to 1.0% in the previous forecast) and 1.7% in 2013 (as compared to 2.4%). The 2013 State Budget Bill, which was submitted in early October 2012, maintained these forecasts[21].

16 European Commission, Annual Growth Survey 2012, Brussels, 23.11.2011

17 For more details: http://www.odc.public.lu/actualites/2012/03/debat_PNR_2012/index.html

18 According to an analysis by the European Parliament, carried out in the 27 EU Member States for the year 2012, a plenary debate in the national parliament about the NRP has only occurred in Luxembourg and Italy. European Parliament, An assessment of the European semester, September 2012, p. 71.

19 2020 Luxembourg NRP, Luxembourg, April 2012. For more information: http://www.odc.public.lu/actualites/2012/04/PNR_Luxembourg_2020/index.html

20 For a more detailed overview, Statec, Conjoncture No. 1-12, Luxembourg, 2012

21 Bill No. 6500 (02.10.2012). For more details: http://www.chd.lu

The Commission services have subsequently performed a complete analysis of Luxembourg's economic policy[22] and evaluated the SGP and the NRP. It took into account not only their relevance in the perspective of a viable socio-economic and fiscal policy in Luxembourg, but also their compliance with EU rules and policies.

- Based on the SGP evaluation, the Commission considers that the macroeconomic scenario underpinning the budgetary projections is plausible. According to the Commission, the programme scenario for 2012 and 2013 is very close to the Commission's 2012 spring forecast. Projections for the medium-term deficit are made under a slightly optimistic growth scenario, higher than the potential growth rate but well below historical average rates. The objective of the budgetary strategy outlined in the programme is to reduce the deficit from 1.5% in 2012 to 0.9% in 2014 through a series of restructuring measures amounting to 1.2% of GDP and to provide greater flexibility in case of negative shocks. The programme confirms the previous medium-term objective (MTO) of a structural surplus of 0.5%. However, this MTO cannot be regarded as satisfactory under the provisions of the Stability and Growth Pact since, on the basis of current policies and projections, it does not appear to take sufficiently into account the implicit liabilities related to ageing, although debt is below the reference value of the Treaty. In addition, according to forecasts by the Commission in the Spring 2012 and on the basis of the structural budget balance (recalculated) in the programme, Luxembourg should deviate significantly from its own MTO in 2012. The growth rate of public spending, net of discretionary measures on the revenue is expected to significantly exceed the expenditure criteria as defined in the Stability and Growth Pact. Gross public debt, which amounts to 20% of GDP, is below the reference value of the Treaty.

- The Commission considers that the reform of the pension scheme (bill) should introduce some specific corrective measures in case of adverse change in the scheme financial situation and modifies the very generous calculation method of benefits. However, the implementation of the new calculation method will be spread over a very long period (40 years). In addition, early retirement opportunities remain mostly unchanged and no action has been proposed to establish a link between the legal age of retirement and life expectancy. In general, although the measures taken by Luxembourg go in the right direction, the proposed reform does not seem to provide a sufficient guarantee for the long-term sustainability of public finances.

[22] European Commission, Staff Working Document (Services Committee) - Evaluation of national reform programme for 2012 and the stability programme of Luxembourg, Brussels, 30 May 2012.

- Concerning the implementation of automatic wage indexation, the Commission considers that, apart from the temporary modulation determined for the period 2012-2014, and a possible change in the benchmark, the government has not announced any other project to permanently reform the wage setting system. The Commission believes that if the productivity of Luxembourg is currently very high, the potential for further growth is getting more limited. An ongoing review of the wage setting system, made in consultation with the social partners and in accordance with national practice, is therefore necessary, according to the Commission, to preserve the competitiveness of the economy in the long term.

- The Commission considers that Luxembourg has taken a number of relevant and credible measures to address the relatively high unemployment rate among young people. However, in order to facilitate the integration of young people into the labour market, it is necessary, according to the Commission, to develop a coherent strategy to strengthen cooperation between municipalities and to improve the efficiency of employment services. Young job seekers, especially those with a low educational level, should also benefit from additional investments in education and training.

- Finally, according to the Commission, Luxembourg should experience difficulties in achieving its target of reducing greenhouse gas emissions by 2020. According to the latest projections for 2020, based on existing measures, the country should even increase its emissions in the sectors that are not covered by the emissions trading scheme, whereas its goal was a 20% reduction. The road transport sector is the main emission source and offers thus a significant reduction potential. The price of transport fuels, which remains one of the lowest in the EU, stimulates "fuel tourism" and induces negative externalities through pollution and congestion. According to the Commission, it is necessary to take additional measures to reduce greenhouse gas emissions, or costly flexibility mechanisms will need to be used.

Based on this detailed analysis, the Commission published on 30 May its recommendation proposals (2012-2013)[23]. On the basis of these proposals and the discussions that followed, on 10 July 2012 the Council finally adopted the 2012-2013 recommendations, which ended the second European Semester.

[23] European Commission Recommendation for a COUNCIL RECOMMENDATION on the NRP of Luxembourg for 2012 and a Council opinion on the stability programme of Luxembourg 2012-2015, Brussels, 30 May 2012.

Table 1
Country-specific recommendations made for Luxembourg by the Council during the 2011 and 2012 European Semesters

	2011 European Semester for 2011-2012[24]	**2012 European Semester for 2012-2013**[25]
Recommendation 1	*To take advantage of improved market conditions, to strengthen the fiscal effort and to use the unexpected additional revenue in order to further reduce its nominal deficit and achieve its medium-term objective in 2012;*	*To maintain a sound fiscal position by correcting any deviation from the MTO that ensures the long-term sustainability of public finances, taking into account, in particular, implicit liabilities related to ageing; to this end, to strengthen and rigorously implement the budgetary strategy, supported by sufficiently well defined measures for the year 2013 and beyond, notably by complying with the expenditures criteria;*
Recommendation 2	*To propose and implement a broad pension reform in order to ensure its long-term sustainability, starting with measures that will increase the participation rate of older workers, and in particular by discouraging early retirement. With a view to raising the effective retirement age, measures such as binding legal age of retirement to life expectancy could be considered;*	*To strengthen the proposed pension reform by taking additional measures to increase the participation rate of older workers, in particular by avoiding early retirement, and by taking additional measures to raise the effective retirement age, including measures such as binding legal age of retirement to life expectancy in order to ensure the long-term sustainability of the pension plan;*
Recommendation 3	*To take steps to reform, in consultation with the social partners and in accordance with national practice, the system wage bargaining and indexation, to ensure that wage growth better reflects the developments in labour productivity and competitiveness;*	*To take steps to reform, in consultation with the social partners and in accordance with national practice, the system wage bargaining and indexation, in order to maintain the competitiveness of Luxembourg economy in the long term, firstly by maintaining the current period of one year between each indexation beyond 2014 and by reducing the impact of energy and other volatile elements upon the benchmark;*
Recommendation 4	*To take measures to reduce youth unemployment and, in particular, to strengthen education and training measures aimed at better matching young people's qualifications to the labour market demand.*	*To continue its efforts to reduce youth unemployment by strengthening the participation of stakeholders and by adopting additional measures in education and training, particularly with respect to those with a low level of education in order to better bring young people's skills and qualifications into line with the needs of the labour market;*
Recommendation 5	/	*To ensure that the objectives of reducing greenhouse gas emissions from activities not covered by the emissions trading scheme will be respected, in particular by increasing taxation on energy products.*

Source: EU Council

Compared to the recommendations of the previous year (2011), and to the reforms implemented since then by Luxembourg within the framework of its NRP we can note in particular the Council request that in 2012 Luxembourg further strengthens the reform proposed by the government in relation to the pension system and to work towards a structural reform of the automatic wage indexation, in addition to the temporary solution currently found for 2012-2014. Compared to 2011, Luxembourg has also received an additional 5th recommendation with respect to greenhouse gas emissions. After the publication of the recommendations, the government has taken a position[26] :

[24] For more information: http://register.consilium.europa.eu/pdf/fr/11/st11/st11321-re02.fr11.pdf

[25] For more details: http://register.consilium.europa.eu/pdf/fr/12/st11/st11263.fr12.pdf

[26] See in particular, the Prime minister's press conference on some national and international current political themes (31 May 2012): http://www.gouvernement.lu/salle_presse/actualite/2012/05-mai/31-juncker/index.html and the Foreign Minister's position statement in the Council General Affairs (26 June 2012): http://www.europaforum.public.lu/fr/actualites/2012/06/conseil-cag/index.html?print

- It has accepted the recommendation to maintain a sound budgetary position;

- It does not plan additional changes in the adjustment of pensions and annuities, being the revision for 2013 already considerable;

- It does not plan additional changes that go beyond the modulation of the automatic wage indexation decided for 2012, 2013 and 2014. In particular, government does not follow the Commission's proposal to sustain this solution beyond 2015;

- It accepted the recommendation on the efforts to reduce youth unemployment;

- It accepts the recommendation on targets for reducing greenhouse gas emission from sources not covered by the emissions trading scheme, even if the country will face significant challenges, especially because Luxembourg is behind in the field of renewable energies and due to the problem of fuel taxation related to "fuel tourism", but it does not intend to substantially increase the price of gasoline and diesel in Luxembourg although in long run, the price level will tend to go up.

Throughout next European Semester (2013) the Commission will assess how Luxembourg has implemented the recommendations 2012-2013 which were issued in July 2012.

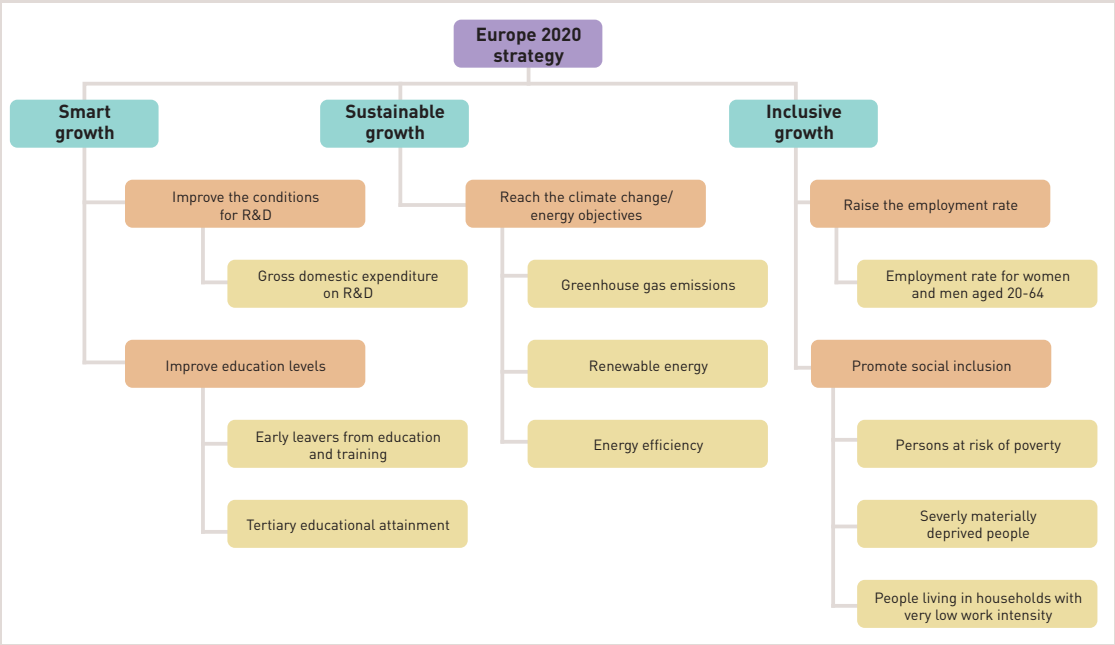
4.3 Thematic Coordination: priorities, objectives and indicators

Obviously, the new governance of the Europe 2020 strategy, whose main objectives and monitoring indicators are included, will not alone create growth, jobs and prosperity. It should nevertheless ensure more emphasis on quantitative targets and indicators. Implementing policies without measurable goals and without monitoring indicators is not the way forward because the assessment will then be totally subjective. Despite the many limitations of 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 us 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 derived from a list of indicators that was selected during painstaking negotiations and based on a compromise (and which is therefore likely to be accommodating to everyone); to discuss objectives and indicators only between experts, without providing sufficient involvement from the general public; to be limited to ex-ante indicators (input) measuring the resources invested, without resorting to indicators measuring ex-post performance and the efficiency of resources involved (output).

The thematic coordination of structural policies component of the Europe 2020 strategy lies on three priorities, five goals and ten indicators[27]:

- Three mutually reinforcing priorities - a smart, sustainable and inclusive growth;
- Five major European objectives to accomplish for 2020 - to improve the conditions of the R&D, to improve educational levels, to reach the goals for climate change and energy, 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 those having an equivalent level of education, greenhouse gas emissions, renewable energy sources in final energy consumption, energy efficiency, employment rates for women and men aged 20 to 64, risk of poverty, material deprivation and living in a jobless household.

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



Observation: Outline 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)

[27] This chapter is limited to a descriptive analysis of quantitative targets and monitoring indicators used in the context of thematic coordination (coordination of structural policies) in the Europe 2020 strategy. The system of indicators provided in the context of macroeconomic surveillance, also part of Europe 2020, is reviewed in another chapter of this Competitiveness Report.

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

Given the diversity of Member States within the EU, and their varying levels of economic development, applying the same objectives and criteria to all Member States, as had originally been made in the context of the Lisbon Agenda, has not proven to be the right approach. As part of the Europe 2020 strategy, the major European objectives no longer apply uniformly to all Member States. This is because European objectives have to be broken down into national objectives by Member States, according to the starting points and national specificities of each Member State in dialogue with the European Commission. Each country will have to ultimately meet its own national commitments in 2020. European objectives can only be achieved if, on one hand the amount of national objectives will lead to the fulfilment of European objectives and on the other hand, the first condition being satisfied, if each Member State honours 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 because they may cause the failure of major European objectives, and therefore also the efforts of those countries that have fulfilled their commitments.

Eurostat periodically publishes these indicators for each Member State[28]. In the following pages, the indicators for Luxembourg[29] will be analysed in more detail. A descriptive overview[30] of its performances will be presented as well as a comparison with its neighbouring countries and the best and worst performers in the EU[31]. It is referred to Luxembourg's 2012 NRP for more details on the measures implemented to explain the evolution of indicators[32].

[28] For additional details: http://epp.eurostat.ec.europa.eu/portal/page/portal/europe_2020_indicators/headline_indicators

These new 2020 Europe indicators will replace in the future the Lisbon structural indicators used in the *Observatoire de la compétitivité* scoreboard.

[29] According to the statistics available on the Eurostat website when finishing this manuscript, i.e. 12 October 2012.

[30] 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.

[31] For more details about the other EU Member States: Eurostat, Europe 2020 strategy - towards a smarter, greener and more inclusive EU economy?, Statistics in focus 39/2012, 09/21/2012.

For more details: http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-12-039/EN/KS-SF-12-039-EN.PDF

[32] Government of the Grand Duchy of Luxembourg, the National Reform Programme 2020 Luxembourg, Luxembourg, April 2012. http://www.odc.public.lu/publications/pnr/index.html

Table 2
National objectives set by Luxembourg (NRP 2012)

		European objective for 2020	Luxembourg objective for 2020	Luxembourg's situation (Eurostat)[33]
Priority 1 *"smart growth"*	Objective 1	*"(...) raising combined public and private investment levels in this sector to 3% of GDP"*	**2.3 to 2.6% interval** (2.0% for 2015)	**1,63%** (p, 2010)
	Objective 2	*"(...) reduce the early school leaving rate to **less than 10%**"*	**sustainably less than 10%**[a]	**6,2%** (u, 2011) [According to national survey (2009/2010): early school leaving rate 9%][34]
		*"(...) increasing the share of people aged 30 to 34 who graduated from higher education or achieved an equivalent educational level to **at least 40%**"*	**66%**[b]	**48,2%** (2011) [This rate is higher for foreign residents than for Luxembourg nationals, who have a rate slightly above 40% (2010)][35]
Priority 2 *"sustainable growth"*	Objective 3	*"(...) **reducing** greenhouse gas emissions by **20%** (...)"*	**- 20%**[c]	Index **94** (2010) 1990 = base 100
		*"(...) increasing the share of renewable energy sources in final energy consumption to **20%**"*	**11%**[c] (average 2015/2016 5,45%)	**2,8%** (2010)
		*"(...) moving towards a **20%** increase in energy efficiency"*	**14,06%** (objective for 2016)[d]	Index **96,9** (2010) 2005 = base 100
Priority 3 *"inclusive growth"*	Objective 4	*"(...) raise to **75%** the employment rate for women and men aged 20 to 64"*	**73%** (71,5% for 2015)	**70,1%** (2011)
	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 ***6000 people*** by 2020	**16,8%** which is equivalent to 83,500 people (2011)

Sources: European Council, Eurostat
Observations: p=provisional, u=unreliable

[a] National data will also be used as measuring instruments for these two objectives, as the indicator calculated by Eurostat, from the survey "Workforce", 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 educate 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 skill needs within higher education and the labour market. In Luxembourg, 30% of people aged 25 to 64 are graduates. In Luxembourg, there is a strong disparity by country of birth. Among those born in Luxembourg, only 22% are graduates of higher education, while this proportion is 40% among those born abroad. In neighbouring countries, the differences between these two populations are much less pronounced. Moreover, in these countries the proportion of graduates 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.

[d] Luxembourg has set, in its first EEAP under Directive 2006/32/EC, a 10.38% national indicative target for energy efficiency out of final energy usage by 2016. After a thorough analysis and evaluation in 2011 in the context of the second EEAP preparation, the national indicative target for 2016 was revised upwards to 14.06%. Regarding objectives for 2020, the outcome of negotiations on the new energy efficiency directive at European level are awaited. If negotiations fail, the plan is to implement an energy efficiency target of 1.5% per annum at the national level.

[33] Eurostat Data, except where mentioned. For more details: http://epp.eurostat.ec.europa.eu/portal/page/portal/europe_2020_indicators/headline_indicators

[34] For more details: http://www.men.public.lu/actualites/2012/01/120106_chiffres_clefs_10_11/index.html

[35] Source: STATEC. For more details: Ministry of Economy and Foreign Trade, The European semester and Europe 2020, in Competitiveness Report 2011, Luxembourg, October 2011.

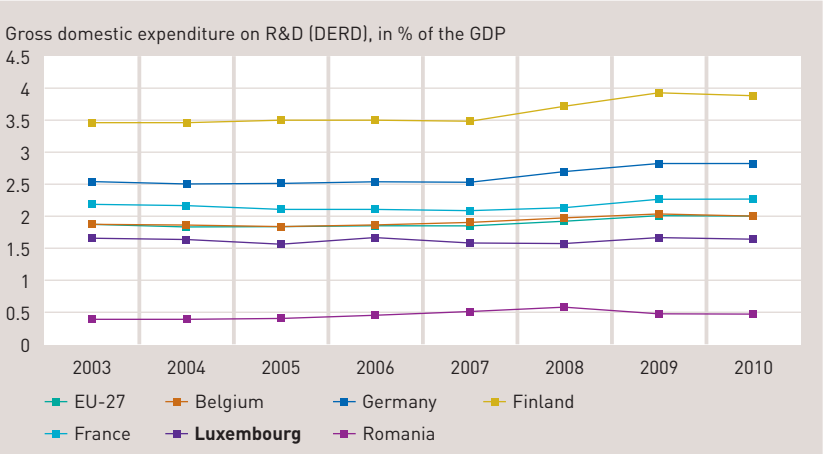
A. Smart growth

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 target of spending 3% of GDP on R&D was set by the European Council in Barcelona in March 2002. This was one of two key objectives in the old Lisbon strategy. The logic underlying the setting of this goal 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 U.S. and 3% in Japan). For the Europe 2020 strategy, it was proposed that this target of 3% be kept has 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 policy in favour of R&D.

For this indicator, the EU-27 as a whole achieved a rate of 2% in 2009. At Member State level Finland, with 3.87% (2010), has the highest R&D to GDP ratio. Romania shows the lowest rate in 2010, with 0.47% of GDP. Germany is at 2.82%, Belgium at 1.99% and France at 2.26%. In Luxembourg, the rate is at 1.63% and remained almost constant since 2000 (1.65%)[36]. Finally, we have to note that in Luxembourg, spending on R&D is mainly from the private sector. Indeed, in 2010 R&D performed by the private sector is estimated at €466 million (1.16% of GDP) and R&D performed by the public sector at 191.6 million euros (0.48% of GDP). An analysis by Statec (2011) shows that investment in R&D tends to decrease in the private sector in both volume and intensity. Most of the R&D efforts are made by a very small number of large companies, and only one company in five is engaged in the R&D in Luxembourg[37].

Chart 2
Gross domestic expenditure on R&D (DERD)[38]



Source: Eurostat

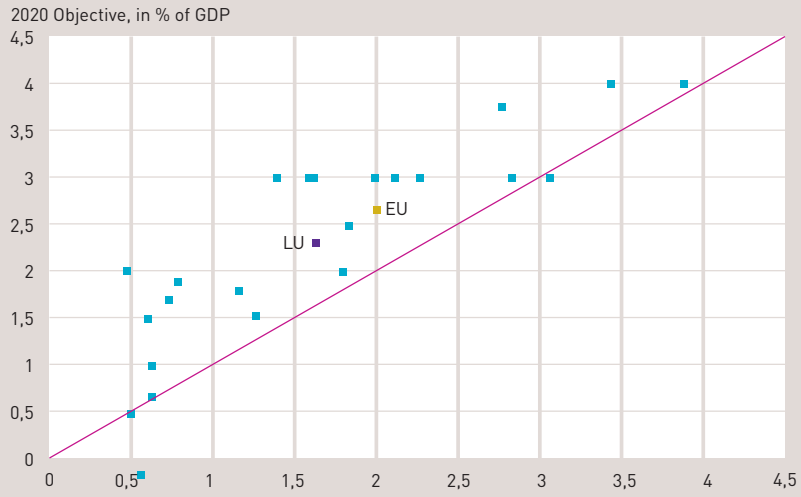
The EU objective is to achieve a rate of 3% of GDP in 2020. A target of spending on R&D in the range of 2.3 to 2.6% of GDP by 2020, with a share of 1.5% to 1.9% for the private sector and 0.7 to 0.8% of GDP for the public sector was set in Luxembourg's 2011 NRP and confirmed in its 2012 NRP. Luxembourg still needs to make great additional efforts in R&D in the coming years in order to achieve its overall goal.

[36] The first data available for Luxembourg is for the year 2000.

[37] STATEC, Regards sur les dépenses privées de R&D au Luxembourg, n°14/2011, Luxembourg, 5 May 2011. For additional details: http://www.statistiques.public.lu/catalogue-publications/regards/2011/PDF-14-2011.pdf

[38] Definition: "R&D comprises 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.

Chart 3
R&D - Situation in 2010 and objective for 2020 (in % of GDP)



Source: Eurostat, European Commission
Observations: Excluding Greece, Czech Republic, United Kingdom.
In cases where a Member State has set a goal range, the lower bound was used for graphical representation.
The value for the EU is an estimate of the 2020 target on the basis of Member States' national objectives (it is not the Europe 2020 target agreed by the European Council).

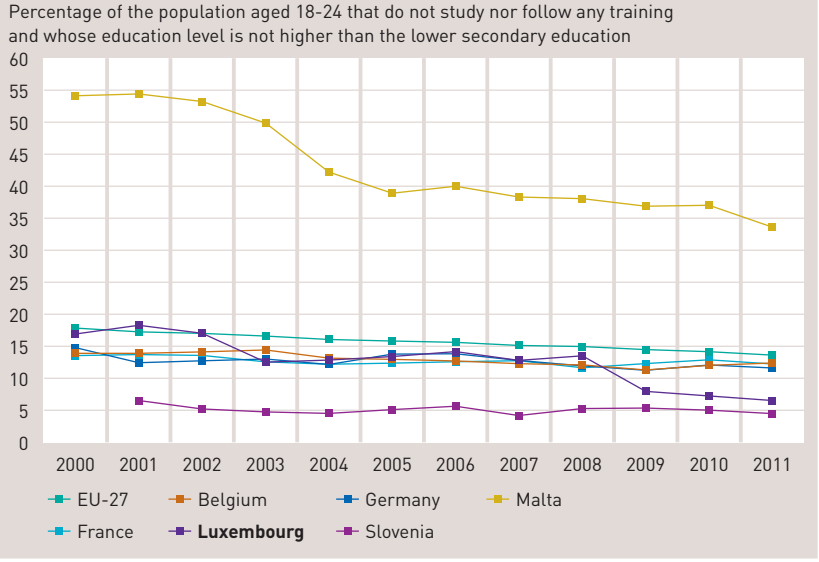
A.2 Improving education levels

Investment in human resources, along with that in R&D, is essential for the development of knowledge and new technologies. As the aim of the Europe 2020 strategy is a smart and inclusive growth, two objectives are set for education and training. In general, the evolution of these two indicators is determined by the demographic and social changes, as well as by policy and institutional reforms, and should thus not be influenced by cyclical fluctuations.

A.2.1 Early school leavers

Within the EU-27, Slovenia has the lowest early school-leaving rate in 2011 with 4.2%. Malta has the highest rate with 33.5%. Germany has a rate of 11.5%, Belgium 12.3% and France 12%. In Luxembourg, the overall early school-leaving rate is at 6.2% in 2011 within a downward trend since 2000.

Chart 4
Persons who left education and training prematurely[39]



Source: Eurostat

The statistics resulting from the survey on the labour force used by Eurostat to calculate this indicator for early school leavers in Luxembourg are subject to annual variations that are due to the limited size of the sample. The Ministry of Education and Vocational Training (MENFP) has set up since 2005 a national survey on early school leaving[40].

[39] Definition: From 20 November 2009, this indicator is based on annual averages of quarterly data instead of one unique reference quarter in spring. See footnotes for further details. 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.

[40] Ministry of National Education and Vocational Training, Le décrochage scolaire au Luxembourg : Parcours et caractéristiques des jeunes en rupture scolaire - Causes du décrochage année scolaire 2009/2010, Luxembourg, 2012.

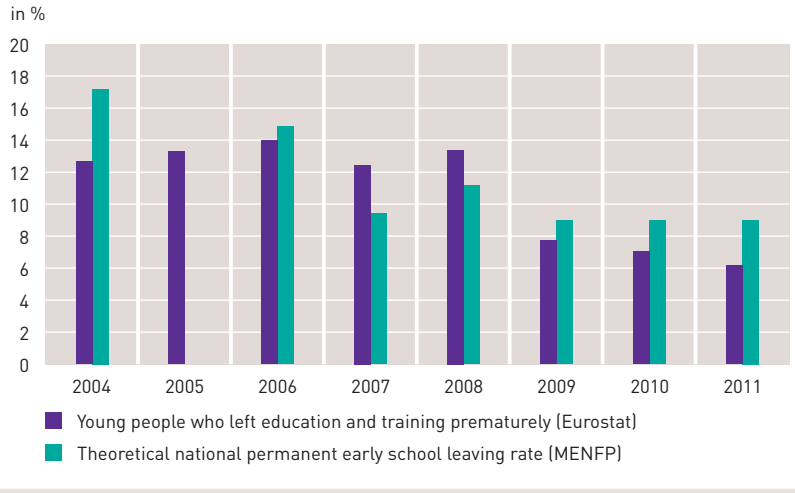
For more details: http://www.men.public.lu/actualites/2012/03/120313_taux_decrochage_stabilise_09_10/index.html

Frame 2
Comparing statistics from Eurostat and from MENFP

Table 3
Statistics on the early school leaving rate according to a national study on early school leaving (national figures)

Study (n°)	School year	Leaving rate
1	2003/2004	17,2%
2	2005/2006	14,9%
3	2006/2007	9,4%
4	2007/2008	11,2%
5	2008/2009	9,0%
6	2009/2010	9,0%

Source: MENFP
Definitions: The notion of 'early school leaver' applies to young people who left school permanently without qualifications and who joined the job market, benefiting by a professional integration measure or not having a specific occupation. It also includes young people who, after an initial leaving, have re-enrolled in a school, then left again during the same period of observation, and for whose current situation there is no additional information.



Observations: National early school leaving rate (MENFP) not available for 2004/2005; national early school leaving rate (MENFP) for 2010/2011 mentioned at a press conference on 13.09.2012

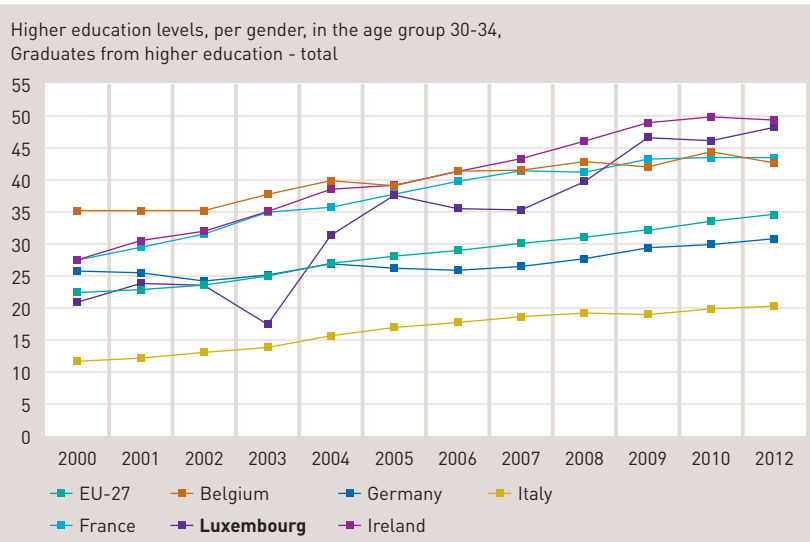
The objective of the EU is an early school-leaving rate of less than 10% in 2020. Luxembourg adhered to this objective and has set a national goal to maintain a sustainable early school-leaving rate below 10%, and decided that the national target would be adjusted if the leaving rate were stabilized below 10% until 2015[41]. At present, Luxembourg has already achieved its target, according to both the Eurostat indicator and the MENFP indicator.

[41] Measurement tool: national survey on school dropping-out by MENFP.

A.2.2 Share of higher education graduates

In 2011 Ireland has the highest rate of higher education graduation in the EU with 49.4%. Italy has the lowest rate with 20.3%. Germany is at 30.7%, Belgium 42.6%, and France at 43.4%. In Luxembourg, the rate is at 48.2% and the proportion of male graduates from higher education is slightly higher (49.1%) than that of women (47.4%).

Chart 5
Higher education levels in the age group 30-34[42]



Source: Eurostat

This indicator, derived from the labour force survey, is not fully representative for Luxembourg since it includes foreign graduates who are working in Luxembourg and are residents, and it can neither capture people from Luxembourg that were graduated abroad and that are working abroad nor the cross-border workers. The actual rate among nationals residing in Luxembourg is at a lower level than that of foreigners. For this objective, it is necessary to follow statistics that distinguish people who attended schools in Luxembourg in order to measure the quality of the national education system. Luxembourg wishes in fact this indicator provide information on the ability of the national education system to educate young people to make them able to successfully complete tertiary education, rather than reflecting the skills needs within higher education and the labour market. In Luxembourg, 30% of people aged 25 to 64 are graduates of higher education. This proportion is 31% in Belgium and 26% in France. In Luxembourg, however, there is a strong disparity by country of birth. Among those born in Luxembourg, only 22% are graduates of higher education, while this proportion is 40% among those born abroad. In neighbouring countries, the differences between these two populations are much less pronounced. Moreover, in these countries the proportion of graduates is higher among indigenous people than among non-indigenous people.

The overall objective of the EU is 40% by 2020. Luxembourg has set in the 2012 NRP a rate of 66% for higher education graduates.

[42] 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 that were set at the European Council in March 2007 were kept as part of the Europe 2020 strategy. The objectives of reducing greenhouse gas emissions and increasing the share of renewable energy in the total energy consumption are legally binding[43].

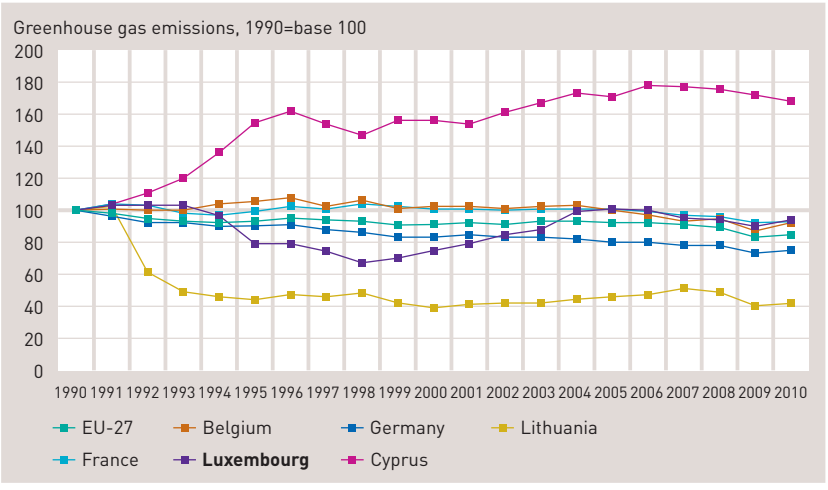
B.1.1 Greenhouse gas emissions

Within the EU-27, Cyprus currently has the highest level of CO_2 emissions in relation to its starting position, with a level of 168 in 2010 compared to its starting position 100 in 1990. Lithuania has the lowest level of emissions with a level of 42 in 2010 compared to its starting position. Germany is at a level of 75, Belgium 92 and France 93.

Luxembourg displays an index of 94; emissions in Luxembourg experienced various changes since the base year:

- Relatively stable from 1990 to 1993;
- A sharp decline from 1994 to 1998, reaching the lowest level (-33% compared to 1990) in 1998;
- A steady increase from 1999 to 2005;
- Stabilization from 2005 to 2006;
- Reduction in 2007 and a stabilization between 2008-2010, except in 2009.

Chart 6
Total greenhouse gas emissions, base 100 = 1990[44]



Source: Eurostat

[43] See the European Directive 2006/32/EC. The reduction in energy consumption is a policy objective endorsed by the Member States in their Energy efficiency action plan.

[44] Definition: This indicator shows trends in total man-made emissions of the 'Kyoto basket' of greenhouse gases. It presents annual total emissions in relation to 1990 emissions The 'Kyoto basket' of greenhouse gases includes: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and the so-called F-gases (hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride (SF_6)). These gases are aggregated into a single unit using gas-specific global warming potential (GWP) factors. The aggregated greenhouse gas emissions are expressed in units of CO_2 equivalents. The indicator does not include emissions and removals related to land use, land-use change and forestry (LULUCF); nor does it include emissions from international aviation and international maritime transport. CO_2 emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and not included in national greenhouse gas totals. The EU as a whole is committed to achieving at least a 20% reduction of its greenhouse gas emissions by 2020 compared to 1990. This objective implies: - a 21% reduction in emissions from sectors covered by the EU ETS (emission trading scheme) compared to 2005 by 2020; - a reduction of 10% in emissions for sectors outside the EU ETS. To achieve this 10% overall target each Member State has agreed country-specific greenhouse gas emission limits for 2020 compared to 2005 (Council Decision 2009/406/EC). Data Source: European Environment Agency.

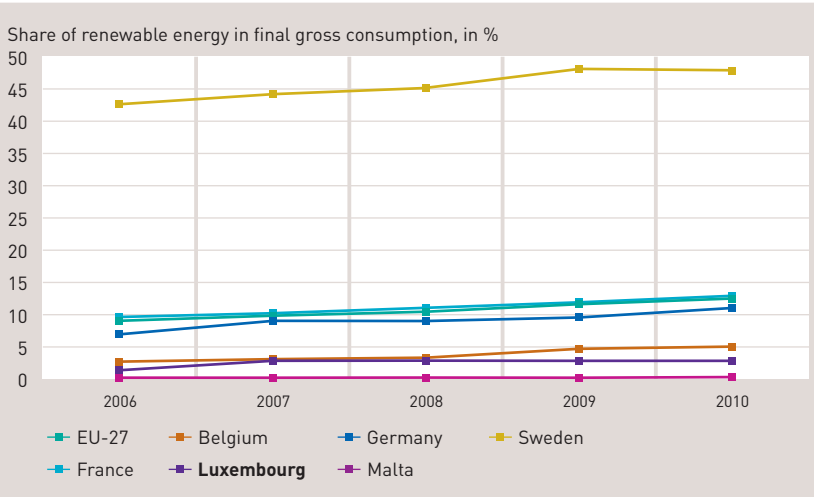
These phases are explained by the effect of some technological changes, which are exacerbated in a small country. This is in particularly the case in the steel industry with the transition from traditional blast furnaces to electric steel plants, which explains the sharp drop in emissions recorded from 1994 to 1998. The activation of a cogeneration gas-type steam plant in 2002 resulted in an increase in annual emissions from 0.8 to 1 million tonnes of CO_2e per year. However, the steady increase in emissions since 1998 - as well as the stabilisation in emission levels followed by a reduction in recent years - is the result of a steady increase in fuels sale, nearly three-quarters of which is sold to non-residents: the number of cross-border workers has risen more than 8% on yearly average since 1990 and currently represent almost 30% of the resident population of the country; road transit traffic, since Luxembourg is located on one of the main transport axes for freight and tourism in Europe; the "fuel tourism". All of this is also bolstered by lower road fuel prices in Luxembourg than in neighbouring countries[45].

The EU has set a target level of 80 to be achieved by 2020 (therefore 20% less compared to the reference year). Luxembourg shares this objective and has therefore also set such a goal of 20% less by 2020 compared to 2005, and consequently faces a huge challenge in the coming years.

B.1.2 Share of renewable energy in energy consumption

Within the EU-27, Sweden has the highest proportion of renewable energy, with a rate of 47.9% in 2010. Malta has the lowest rate (0.4%). Germany is at 11%, France 12.9% and Belgium 5.1%. In Luxembourg, the rate rose from 1.4% in 2006 to 2.8% in 2010 but tends to stagnate since 2007.

Chart 7
Share of renewable energy in final gross consumption[46]



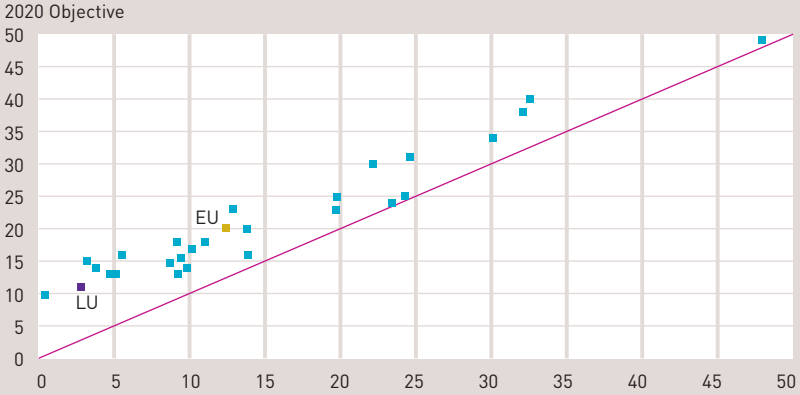
Source: Eurostat

[45] Grand-Duchy of Luxembourg Government, National Reform Programme, Luxembourg 2020, Luxembourg, April 2011.

[46] 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 http://ec.europa.eu/energy/renewables/index_en.htm

The EU has set a target share of renewable energy of 20% by 2020. Within this context, Luxembourg has set an overall target of 11% renewable energy in final consumption of energy by 2020, with an interim target of 5.45% on average in 2015/2016. Luxembourg will therefore face a major challenge in the coming years in order to achieve its 2015 intermediate goal and its 2020 target of 11%.

Chart 8
Renewable energy - Situation in 2010 and objective for 2020



Source: Eurostat, European Commission
Observations: The score for the EU is an estimate of the 2020 objective based on the objectives of national Member States.

B.1.3 Energy Efficiency

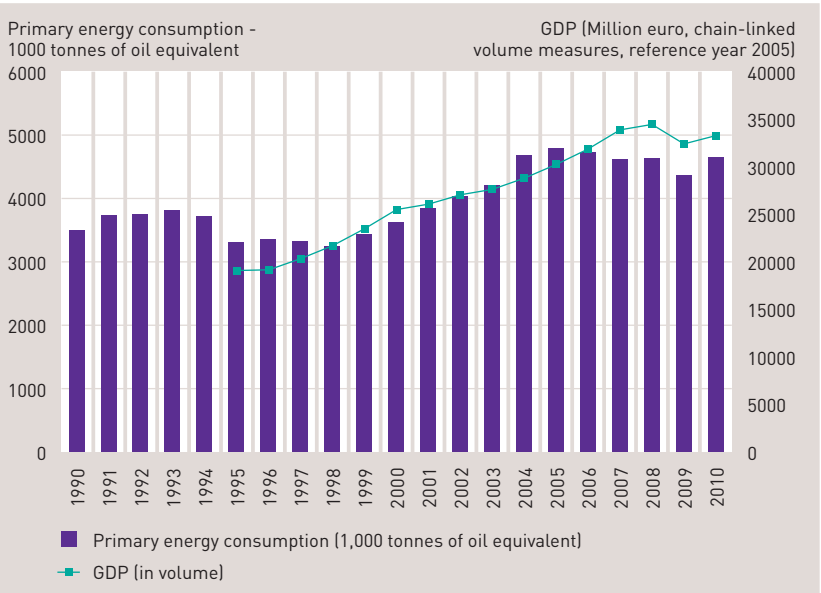
During the first European semester 2011, in order to make comparisons between Member States with regard to energy efficiency, Eurostat still had to use a proxy indicator, since the monitoring mechanism was still under construction by statisticians. So at the time it was still a measure of the energy intensity of the economy, that is to say, the amount of energy needed to create €1,000 worth of wealth[47]. During the European Semester 2012, Eurostat finalized the statistical monitoring indicator of energy efficiency itself: it is from now on the "primary energy consumption in thousand tonnes of oil equivalent (Mtoe)"[48].

Between 1990 and 2005, Luxembourg increased its consumption of primary energy from 3,497.8 Mtoe (1990) to a peak of 4,788.9 Mtoe (2005), then decreased it to 4,640.6 Mtoe (2010).

[47] Definition: This indicator is the ratio between the gross inland consumption of energy and the gross domestic product (GDP) for a given calendar year. It measures the energy consumption of an economy and its overall energy efficiency. The gross inland consumption of energy is calculated as the sum of the gross inland consumption of five energy types: coal, electricity, oil, natural gas and renewable energy sources. The GDP figures are taken at chain-linked volumes with reference year 2000. The energy intensity ratio is determined by dividing the gross inland consumption by the GDP. Since gross inland consumption is measured in kgoe (kilogram of oil equivalent) and GDP in 1.000 EUR, this ratio is measured in kgoe per 1.000 EUR.

[48] Definition: The term "primary energy consumption" means the domestic gross consumption excluding all "non-energy use" of energy (e.g. natural gas used not for combustion but for the production of chemicals). It is relevant to measure this quantity, the actual energy consumption and to compare it with Europe 2020 objectives. The "Percentage of savings" is calculated using 2005 values and forecasts for 2020. The Europe 2020 target will be achieved when this value will reach the level of 20%.

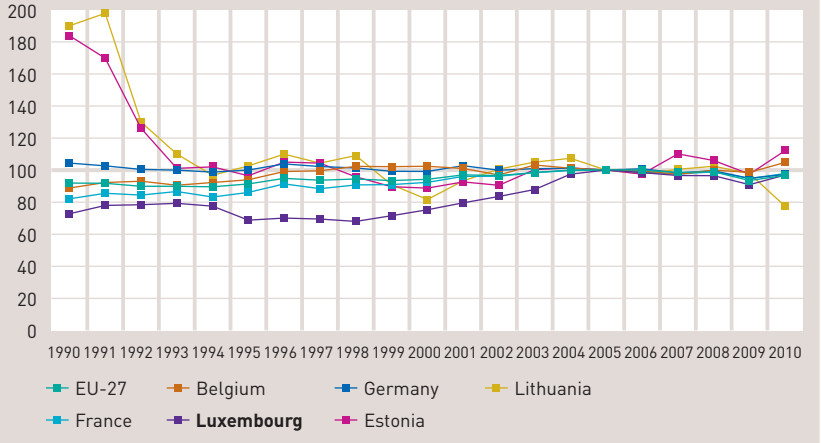
Chart 9
Primary energy consumption and GDP growth in Luxembourg



Source: Eurostat
Observation: 1990-1994 data not available for Luxembourg's GDP

In 2010, Luxembourg is at an index of 96.9 compared to 2005 (base 100), that is to say that Luxembourg has reduced its primary energy consumption by 3.1% in 2010 compared to 2005. In 2010 Belgium shows an index of 104.8, Germany and France 97.4 and 97.9 respectively. The EU-27 as a whole has an index of 96.6 compared to 2005. Lithuania is the country with the largest decrease (index 77) and Estonia has the highest growth (index 112.7).

Chart 10
Primary energy consumption between 1990 and 2010 (2005 = 100)



Source: Eurostat

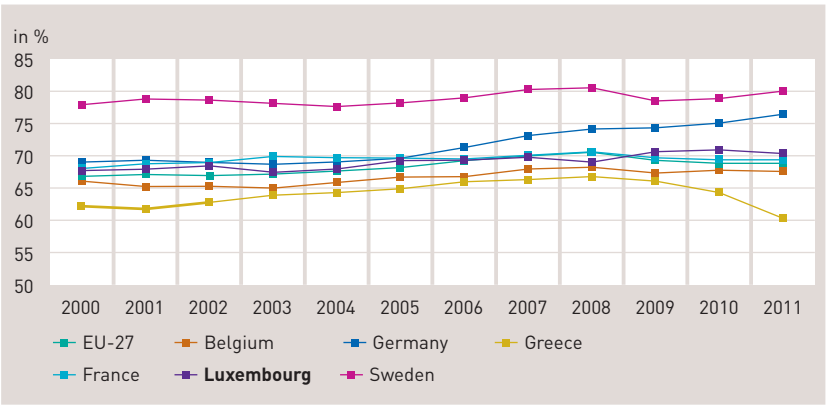
The EU has set a target of increasing energy efficiency by 20% by 2020. After a thorough evaluation in the context of the preparation of the second Energy Efficiency Action Plan, Luxembourg has set its own national target for energy efficiency in final energy usage of 14,06% by 2016[49]. Regarding 2020 objectives, the 2012 NRP states that one must wait for the outcome of the negotiations on the new energy efficiency directive at European level and, in case of failure of negotiations, it is expected to implement an energy efficiency target of 1.5% per annum at the national level.

C. Inclusive Growth

C.1 Promoting employment

In the Lisbon strategy (2000-2010) there was a target related to employment policies: the employment rate. The new Europe 2020 strategy objective shows two major changes in relation to the previous Lisbon strategy objectives. Firstly the age range considered (20-64 years for 2020 instead of 15-64 years for 2010) so as to reduce potential conflicts between employment and education policies, and secondly, the target reference value (75% for 2020 instead of 70% for 2010).

Chart 11
Employment rate for people aged 20-64, 2011[50]



Source: Eurostat

Changes in the employment rate depend on many uncertainties, which we must be taken into account in setting objectives for the Europe 2020 strategy. Indeed, the employment rate indicator is a very cyclical indicator. The actual exit date of the crisis will play a key role in the evolution of this indicator.

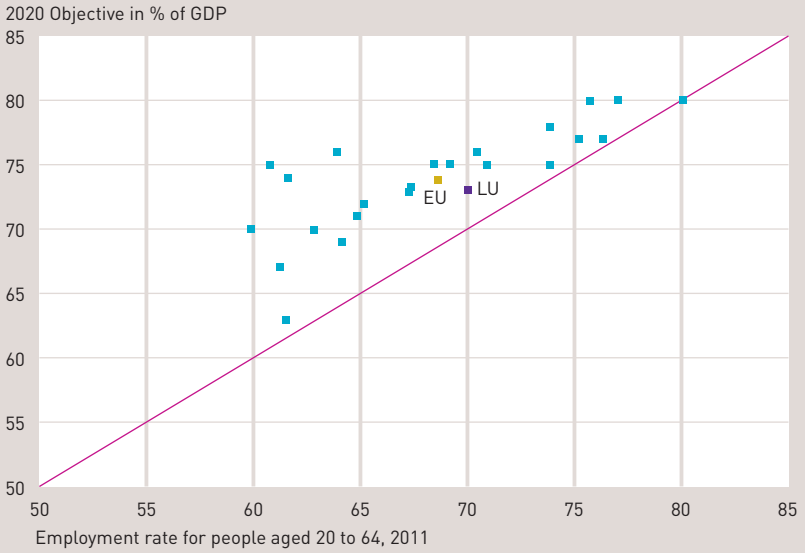
In 2011 Sweden has the highest overall employment rate with 80%. Greece has the lowest employment rate with 59.9%. Germany is at 76.3%, Belgium 67.3% and France 69.1%. In Luxembourg, the overall employment rate is 70.1%.

[49] 2011: thorough analysis and evaluation in the context of the establishment of the second EEAP.

[50] 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.

This overall employment rate, an average of the resident labour force, "hides" somewhat significant differences in rates depending on the category of workers observed. If we proceed to a more detailed segmentation of the employment rate, for example according to gender or age of the worker, we can see that the employment rate fluctuates significantly. Indeed, while the overall employment rate is 70.1% in 2011, the male is close to 78.1% while the female is only 61.9%. A review of the employment rate of workers per age also reveals major differences, especially for young people and older workers: the employment rate of young people is low (for young people between 20 and 29 years, it is close to 59% in 2011); the employment rate of older workers is also relatively low (for seniors between 55 to 59 years it is about 54.6% and for those aged 60 to 64 years it is 20.9% in 2011)[51].

Chart 12
Employment - Situation in 2010 and objective for 2020 (in %)



Source: Eurostat, European Commission
Observations: Except the United Kingdom
When a Member State has set a target range, the lower bound was used for graphical representation.
The value for the EU is an estimate of the 2020 target on the basis of Member States' national objectives (it is not the Europe 2020 target agreed by the European Council).

The EU objective is to achieve an overall employment rate of 75% by 2020. Luxembourg has set as national target the overall employment rate of 73% in 2020, with a rate of 71.5% as an interim target in 2015.

[51] Increasing senior worker participation is one of the four recommendations to Luxembourg during the European semester (2011).

Even if a higher employment rate generally allows increasing the supply of domestic labour, boosting growth and alleviating social spending and public spending, these statements must be put into perspective, in the case of Luxembourg. In Luxembourg, labour supply consists of three components: the native offer, the cross-border offer and the immigrant offer. But cross-border workers are not taken into account by the concept of employment rate. This is a purely national concept, based on residence. Domestic employment includes more than 40% of cross-border workers, and about half of the new jobs created in the recent past have been occupied by cross-border commuters. As noted by the Economic and Social Council, this indicator is "not representative of the macroeconomic reality in Luxembourg and shows itself to be even less adequate as a macroeconomic employment target, on which the employment policy should be defined"[52]. However, the employment rate of young people, women and the elderly is useful for understanding the use of human resources in the economy.

C.2 Reducing poverty

The European objective that was initially proposed by the European Commission for social inclusion was reducing poverty by twenty million people who were finding themselves at-risk-of-poverty. In order to meet the objective of the Europe 2020 strategy to promote inclusive growth, the European Council of March 2010, however, 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 twenty million people at least no longer be faced with the risk of poverty and exclusion, and defined this population as the number of people threatened by poverty and exclusion according to three indicators, Member States being free to set their national targets on the basis of indicators that 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 income distribution, taking 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, experiencing at least four of the nine defined situations of deprivation[53]. The material deprivation rate is a measure of non-monetary 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.

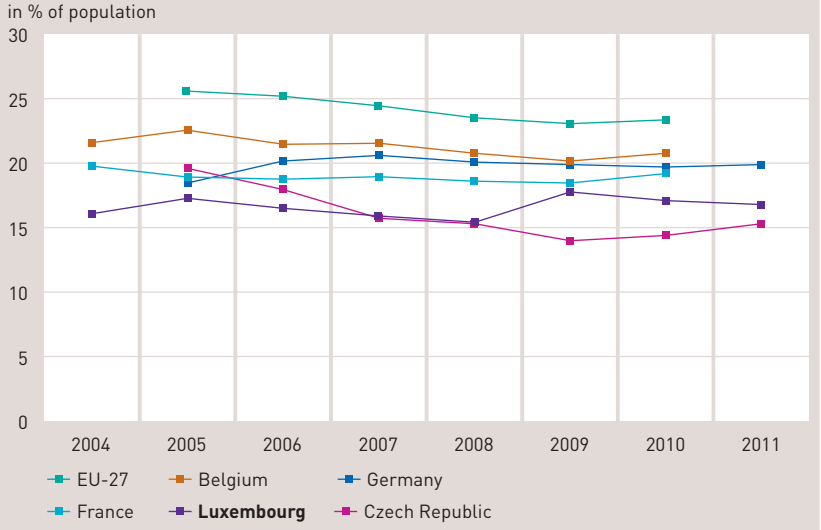
[52] WSCX, Deuxième avis sur les Grandes Orientations des Politiques Économiques des États membres et de la Communauté (GOPE), Luxembourg, 2003. For further information: http://www.ces.public.lu/fr/avis/index.html

[53] 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.

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 or the rate of material deprivation, have 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 also mention in this context the service vouchers that are not taken into account.

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. By analysing this indicator, we find that in 2011[54], the Czech Republic has the least at-risk-of-poverty or exclusion population in the EU, with a rate of 15.3%. Bulgaria has the highest proportion, with a rate of 49.1%. Germany is at 19.9%, Belgium at 20.8% (2010) and France at 19.2% (2010). In Luxembourg, the rate is 16.8% in 2011 amounting to 83,500 people[55].

Chart 13
People at-risk-of-poverty or exclusion, in % of population

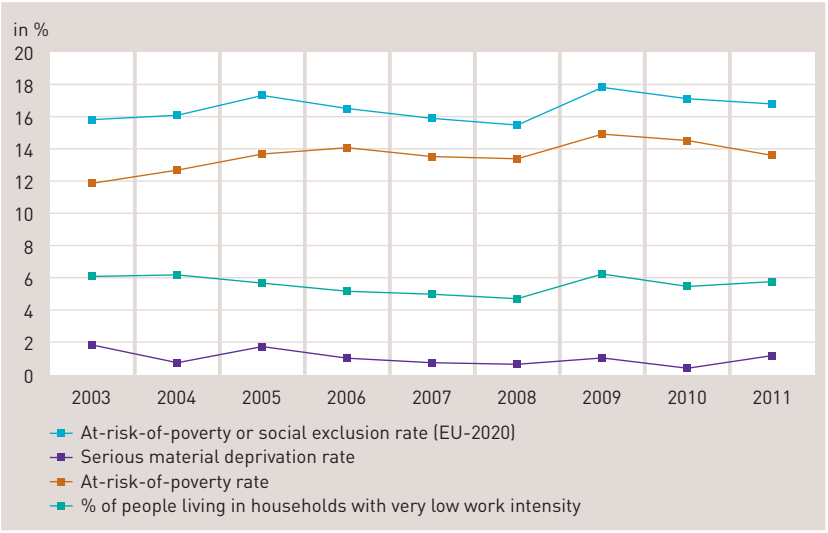


Source: Eurostat
Observations: 2011 STATEC Data

[54] According to data available on the Eurostat website on 12 October 2012.

[55] STATEC, Rapport travail et cohésion sociale 2012, cahier économique n°114, Luxembourg, 2012.

Chart 14
Serious material deprivation and people living in households with very low work intensity (2003-2011)



Source: STATEC

Through an analysis of the three underlying indicators for the year 2011, we observe that 13.6% (or 67,500 people) in Luxembourg faced the risk of poverty after social transfers, 1.2% (or 6,000 people) were facing serious material deprivation and 5.8% (or 23,700 people) lived in households with very low work intensity).

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5 European Semester - Surveillance of macroeconomic imbalances

In the 2011 edition of the Competitiveness Report[1], the *Observatoire* provided information about the procedural organization and indicators for monitoring macroeconomic imbalances, also called "macroeconomic governance".

5.1 The European Semester

The recent economic crisis has highlighted the interdependence of the Member States' economies and the vulnerability of economies within the eurozone. Coordination mechanisms for economic policy proved to be inadequate after the economic and financial crisis. Budgetary discipline, the competitiveness gaps and imbalances in the private sector are issues that affect the European economy. From now on, it is important to further strengthen and coordinate economic policy within the EU and the eurozone. This observation had already been made in 2008 by the European Commission in its report "EMU @ 10: successes and challenges after 10 years of Economic and Monetary Union"[2].

Although the instruments and methods of existing coordination have enabled the EU to assemble its recovery efforts and to weather a storm that no Member State could have done by itself, the European Commission still proposed to further strengthen the coordination of economic policy. In its communication of the 12 May 2010 "Reinforcing Economic Policy Coordination", the European Commission highlights a persistent accumulation of macroeconomic imbalances, which can destabilize the eurozone and the operation of the European monetary union. It proposes to extend economic surveillance beyond the budgetary dimension in order to meet the challenge of other macroeconomic imbalances, according to Article 136 of the EC Treaty[3]. It is planned to use the instruments provided by the Treaty and to supplement these instruments as needed.

1 2010 Competitiveness Report, chapter 6 "Toward a Short-Term Scoreboard"

2 Commission Communication on "EMU@10: successes and challenges after 10 years of Economic and Monetary Union"- 7 May 2008 – IP /08/716

3 EC Treaty of 25/03/57 as consolidated after the Lisbon Treaty 25 March 1997. Treaty on the Functioning of the European Union: Article 136 1. In order to ensure the proper functioning of economic and monetary union, and in accordance with the relevant provisions of the Treaties, the Council shall, in accordance with the relevant procedure from among those referred to in Articles 121 and 126, with the exception of the procedure set out in Article 126(14), adopt measures specific to those Member States whose currency is the euro: a) to strengthen the coordination and surveillance of their budgetary discipline; b) to set out economic policy guidelines for them, while ensuring that they are compatible with those adopted for the whole of the Union and are kept under surveillance. 2. For those measures set out in paragraph 1, only members of the Council representing Member States whose currency is the euro shall take part in the vote. A qualified majority of the said members shall be defined in accordance with Article 238, paragraph 3, point a).

Chart 1
European Semester: Integrated Economic Surveillance/Governance

Source: European Commission, DG ECFIN

The European Semester was born. And it proposes a three-pillar approach (Chart 1) to strengthen coordination of economic policies using preventive and corrective sets of measures:

1) Structural reforms within the framework of the EU 2020 strategy;

2) Budgetary policies under the Stability and Growth Pact;

3) Macroeconomic surveillance.

The advantage of the European Semester is that it allows an ex-ante coordination of fiscal policy by aligning the submission and discussion of the Stability and Growth Pact and the National Reform Programme in order to assess the general economic situation and synchronization with national budget cycles. Thus, the Council and European Council recommendations based on evaluations of the European Commission support Member States more effectively and at the appropriate time, and thus allow a better implementation of reforms at the national level.

The present chapter analyses the third pillar of the European Semester, namely macroeconomic surveillance. Note that the first pillar of the European Semester has been discussed in Chapter 4 "The European Semester and the Europe 2020 strategy".

5.2 The third pillar: "Macroeconomic monitoring" - a new instrument

Based on the Communication from the European Commission, the European Council of 17 June 2010 decided to establish a European stabilization mechanism and invited the European Commission and the Van Rompuy Taskforce to quickly develop these guidelines whilst also making them operational.

On 30 June 2010, the European Commission in its communication "Enhancing economic policy coordination for stability, growth and jobs - Tools for stronger EU economic governance" developed in greater detail its ideas about the governance of economic policy. The Commission proposes to develop a new structured mechanism for the detection and correction of macroeconomic imbalances, including for the differences in competitiveness. To better detect imbalances, along with the Member States, the Commission will establish a scoreboard composed by economic and financial indicators.

On 29 September 2010, the European Commission finally proposed a legislative package of six texts called "six-pack". The legislative package has four objectives:

First, the rules of the Stability and Growth Pact (SGP), which aims to limit budget deficits and government debt, through a much stronger early stage monitoring, will be strengthened. Greater emphasis will be given to debt reduction (and not just the deficit) and to sustainable growth.

Second, new macroeconomic imbalance controls will be established across the EU, such as housing and increasing differences in competitiveness between Member States.

Thirdly, standards will be established to ensure the proper and independent compilation of statistics, since these data are critical to developing sound budgetary policies and monitoring budgets.

Finally, the transparency in decision-making and the accountability of decision-makers will be strengthened.

The European Commission addresses the surveillance of macroeconomic imbalances and the building of an EIP scoreboard in the proposal:

- Proposal for a regulation of the European Parliament and the Council on the prevention and correction of macroeconomic imbalances (Com(2010) 525final);

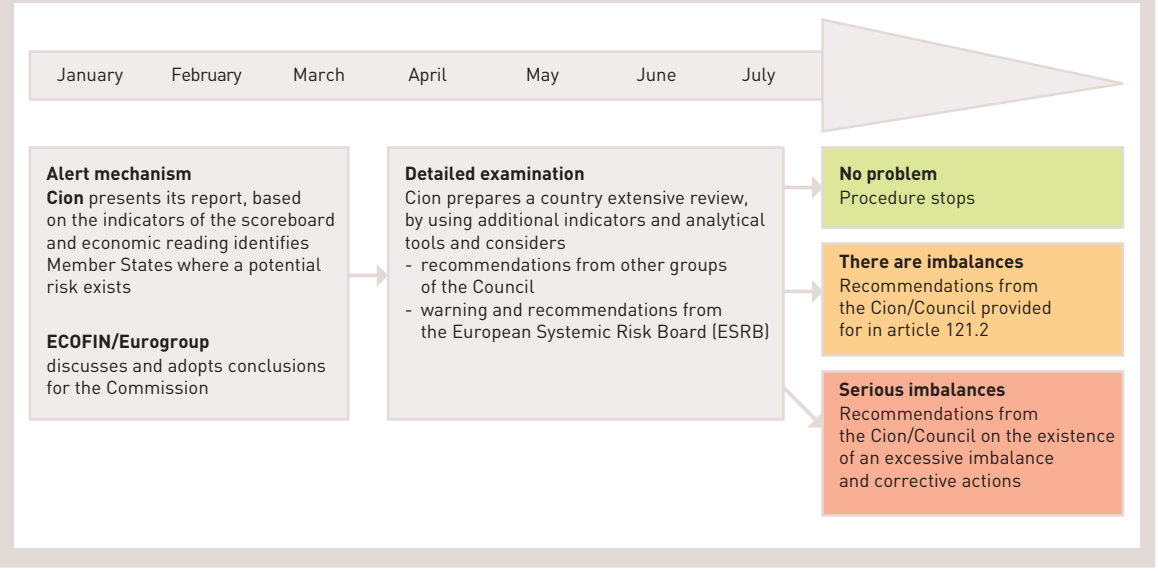
- Proposal for a regulation of the European parliament and the council on enforcement measures to correct excessive macroeconomic imbalances in the eurozone (Com(2010)527final).

Thus, the fundamental objective of the "excessive imbalance procedure" at European level is to provide a solid platform for a better monitoring, prevention and correction of imbalances[4].

The ECOFIN Council of 15 March 2010 has reached an agreement on a general approach to a regulation to monitor and correct macroeconomic imbalances.

The "six-pack" economic governance package was approved[5] on 28 September 2011 at the European Parliament plenary session. This package includes the proposed regulations to establish a surveillance procedure to monitor and correct macroeconomic imbalances, the excessive imbalances procedure (EIP). This European regulation came into force in late 2011, that is to say, in time for the 2012 European Semester.

Chart 2
Preventive arm of the macroeconomic imbalance procedures



Source: European Commission, DG ECFIN

The excessive imbalances procedure includes a preventive and a corrective arm.

In the preventive arm (Chart 2), the scoreboard, which includes ten economic indicators, is published annually by the European Commission.

The first "alert mechanism" report[6] was published on 14 February 2012 by the Commission. A mechanism of alert thresholds, along with an economic reading of indicators based on other complementary indicators, identifies a potential risk. In its February report, the Commission requested further analysis for the following countries: Belgium, Bulgaria, Denmark, Spain, France, Italy, Cyprus, Hungary, Slovenia, Finland, Sweden and the United Kingdom.

4 European Commission, Surveillance on macroeconomic imbalances under the excessive imbalances procedure (EIP): Possible work streams for the EPC in the first half of 2011, Note for the attention of the Economic Policy Committee, ECFIN/B1/ARES SN (2011)69586

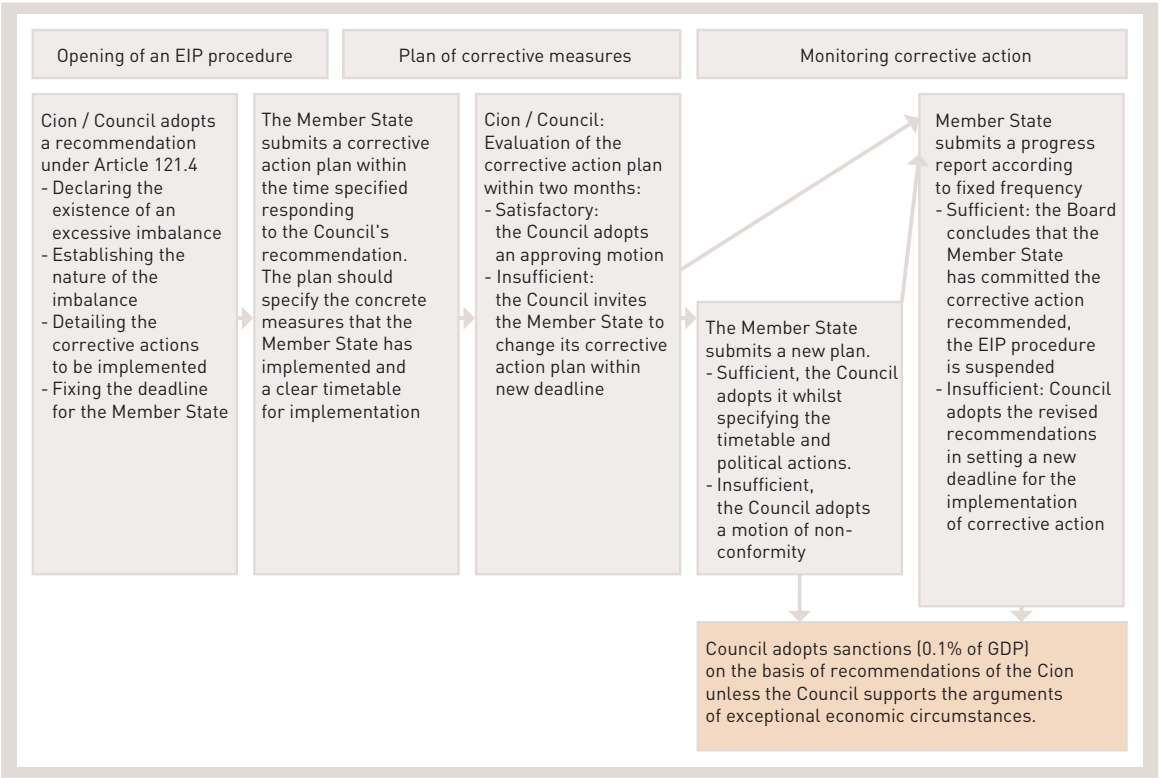
5 http://www.europarl.europa.eu/news/en/headlines/content/20110916FCS26869/11/html/Parliament-gives-green-light-to-future-economic-governance-plans

6 European Commission, Report from the 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

Each of the 12 in-depth analysis examined the origin, nature and severity of an eventual macroeconomic imbalance while analysing whether the country is affected by an excessive imbalance or not, and if appropriate, the nature of the imbalance. The results of the in-depth analysis, which were published in July 2012[7], concluded that in the 12 analysed countries macroeconomic imbalances do exist but are not excessive. The Council recommendations took into account the existing imbalance by proposing measures to address it.

If the in-depth analysis had concluded there were excessive macroeconomic imbalances, the mechanism's corrective arm would have been triggered and the Member State would have been placed in an "excessive imbalances position" (Chart 3). In this case, the Member State must submit a corrective action plan to the Council specifying concrete measures and a detailed schedule. The European Commission and the Council assess the corrective action plan, which is either sufficient, which leads to the issuing of regular progress reports from the Member State to the Ecofin Council and the Eurogroup, or the action plan is insufficient and the Member State is required to amend its action plan. If, after changing the plan, the measures remain insufficient, the Council adopts sanctions on the basis of recommendations from the European Commission, unless the Council supports the exceptional economic circumstances arguments with a reverse qualified majority.

Chart 3
The corrective arm of the mechanism



Source: European Commission

[7] http://ec.europa.eu/economy_finance/economic_governance/macroeconomic_imbalance_procedure/index_en.htm

5.3 The EIP scoreboard

From the outset it is impossible to select "one size fits all" indicators in the sense that 9 indicators cannot reflect both the economic specificity of each Member State and the statistical methodological problems facing the 27 Member States: one truth can hide another. Thus, it is now very important to complete the scoreboard with a deep macroeconomic analysis[8].

The scoreboard is based on four principles. Firstly, the selection of indicators focuses on the most relevant dimensions of macroeconomic imbalances, competitiveness loss and the proper functioning of the eurozone.

Secondly, the scoreboard (indicators and thresholds) must provide an efficient signalling device for loss of competitiveness and potentially harmful imbalances at an early stage of their emergence.

Thirdly, we should take into account the scoreboard's important communication role. The choice of indicators will send a clear awareness message to decision-makers and stakeholders on the types of macroeconomic developments that could be a source of doubt and that therefore need an increased level of surveillance at the European level.

Fourth, the indicators should be of high statistical quality in terms of speed and comparability between Member States.

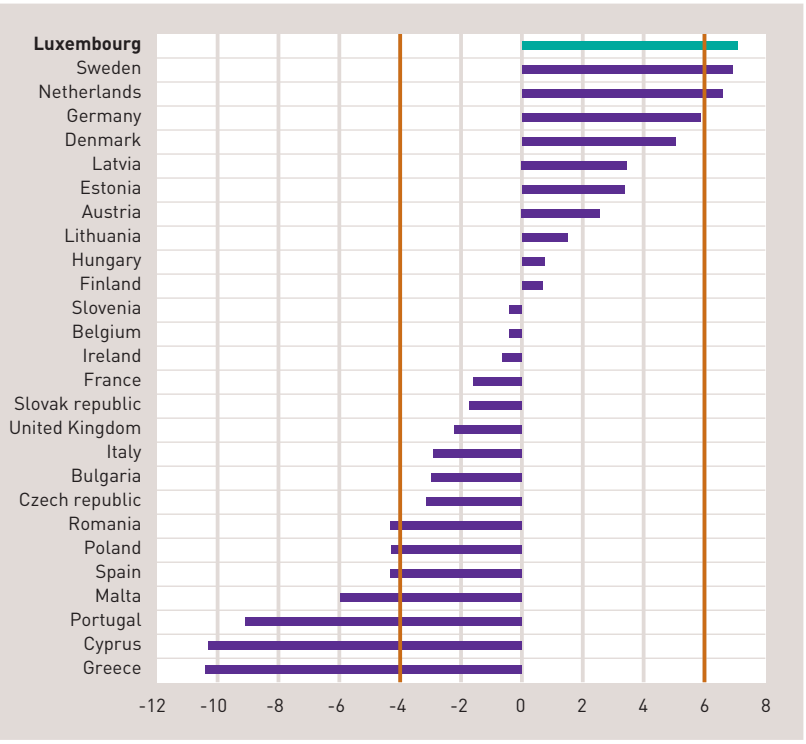
[8] Economic Policy Comittee, Draft Report, The design of the scoreboard for the surveillance of macroeconomic imbalances

5.4 The EIP scoreboard indicators

5.4.1 The current account balance as a % of GDP (average over 3 years)

The economic and financial crisis has a significant impact on the current account balance as a % of GDP at current prices for both Member States with a favourable balance and with an unfavourable balance. In fact, countries in a surplus position like Luxembourg have seen a decline in their surplus; the deficit of the majority of countries has decreased as a result of the crisis. In Luxembourg, the decline since 2008 is due to a significant decrease in exports of financial services (undertaking for collective investment sector), of non-financial services and of freight since late 2008 as a result of the financial crisis. In Luxembourg, only the services balance is in surplus and the financial services represent about 72% of that surplus. In fact, more than 85% of financial services exports are attributable to non-resident investors (investment funds sector). Surpluses are also present in the other business services, telecommunications services, transport and insurance. The other partial balances read negative. Contrary to the need for financing shown in some EU countries, the financing capacity of Luxembourg does not seem to be a sign of imbalance as it does not threaten, unlike financing needs do, the sustainability of external debt.

Chart 4
The current account balance as a % of GDP - Average over 3 years

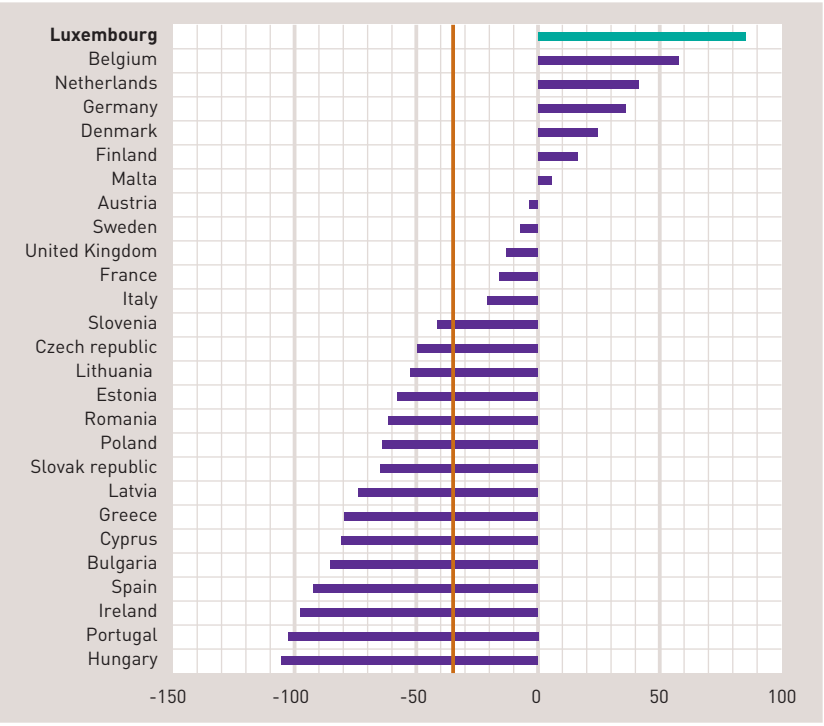


Source: Eurostat, orange bars thresholds -4% / 6% set by the MIP

5.4.2 Net external positions as a % of GDP

The net external position gives an indication about the relationship between assets of Luxembourg abroad and its external debt. Although between 2006 and 2007 the indicator was in decline, it remained stable since 2007 with about 85% of GDP in 2011, well above the alert threshold set by the scoreboard. In this context, the situation of Luxembourg is unique within the European Union as no other Member State has such a high percentage. Indeed, the size of the financial centre is disproportionate to the size of the country, so that the external assets and liabilities greatly exceed 100% of the national GDP.

Chart 5
Net external positions as a % of GDP - Annual Data in 2011



Source: Eurostat; orange bar threshold of -35% set by the MIP

5.4.3 The real effective exchange rate (36 trading partners, % change over 3 years)

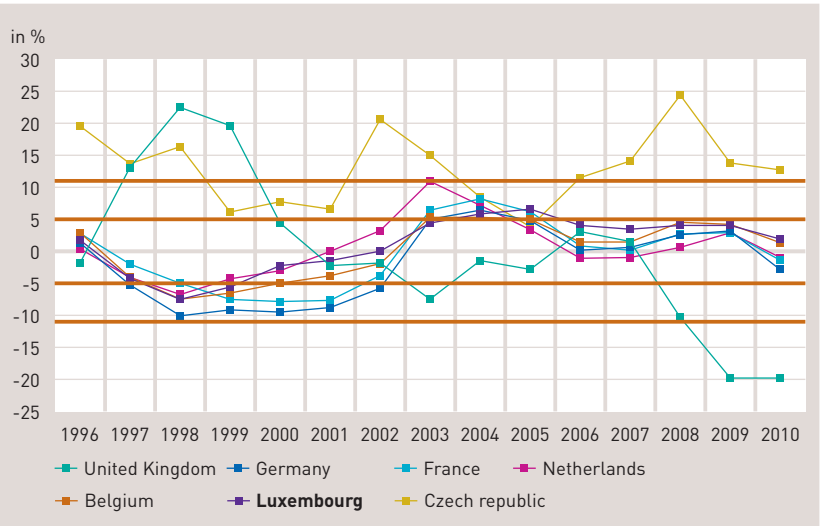
The real effective exchange rate (REER) traces the evolution of price competitiveness and cost competitiveness by analysing the relationship between, on the one hand, domestic prices or costs and on the other foreign prices or costs, expressed in euros. An increase in this rate is thus equivalent to a decline in the competitiveness of Luxembourg.

The nominal effective exchange rate is measured with nominal parities, therefore without taking into account differences in purchasing power between the two currencies, and the real effective exchange rate is measured by taking into consideration the price indices and their evolution.

Since a bilateral exchange rate can not reflect the competitive position of a country relative to all its major economic partners, it is necessary to analyse a weighted average (by weight of each partner in Luxembourg's exports), called the nominal effective exchange rate. Obviously, a different weights structure should be applied to the total economy, for the service sector and for industry. This reflects a different geographical breakdown of trade in goods and services.

The real effective exchange rate is constructed from the currencies of Luxembourg's major trading partners (Germany, Belgium, France, Italy, Netherlands, United States, United Kingdom and Switzerland). A weight, which reflects the average relative importance of the country in question within the structure of Luxembourg's commercial trade, is assigned to each bilateral exchange rate (for those countries not members of the eurozone, the others obviously have an exchange rate equal to one).

Chart 6
Evolution of the real effective exchange rate - 3-year average

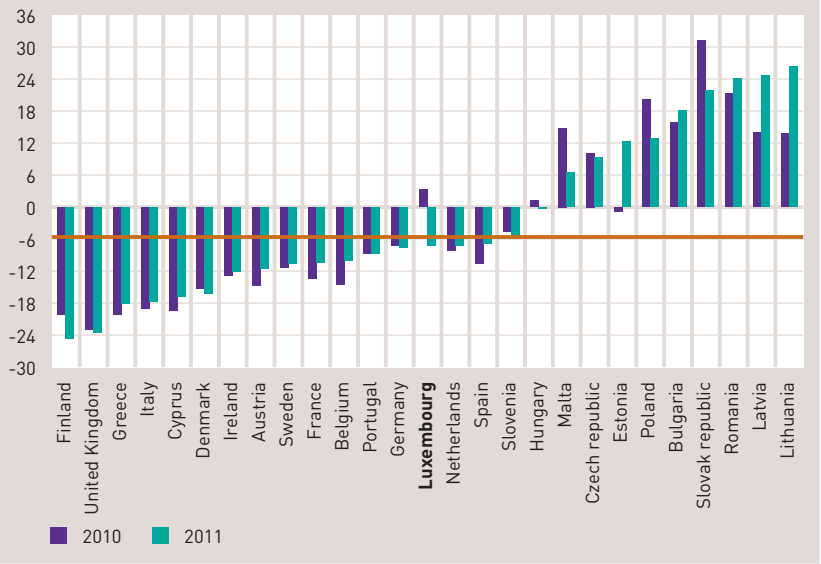


Source: Eurostat, orange bars, thresholds of +/- 5% for eurozone Member States, +/- 11% for the other Member States as established by the MIP.

5.4.4 Market share of world exports (% change over 5 years)

The scoreboard also includes an indicator for the rate of change of the market share of world exports of goods and services, in order to measure in volume the slow and persistent losses in competitiveness. It is an outcome indicator that captures the components of competitiveness such as non-price competitiveness or the ability to exploit new business opportunities due to increased demand from emerging economies. To capture the structural losses of competitiveness that can accumulate over long periods, the indicator is calculated as the percentage change over 5 years of the share of world exports of goods and services of each country. The indicator is based on the balance of payments statistics from Eurostat. The statistical distribution of the indicator provides a -6% lower threshold.

Chart 7
Market share of world exports - % change over 5 years



5.4.5 Nominal unit labour cost (% change over 3 years)

Real ULC or nominal ULC: some relations

Real GDP is the total value of all final goods and services produced in the economy during a given year, calculated by using the prices of a chosen base year.

Nominal GDP is the value of all final goods and services produced in the economy during a given year, calculated by using current prices of the year of production.

Hence the relation $nominalGDP = realGDP \cdot P$

Les formules du CSU réel et nominal sont les suivantes :

$$nominalULC = \frac{\frac{wages}{employment}}{\frac{realGDP}{employment}}$$

$$realULC = \frac{\frac{wages}{employment}}{\frac{nominalGDP}{employment}} = \frac{wages}{realGDP \cdot P} = wage\ share$$

The formulas for the real and nominal ULC are:

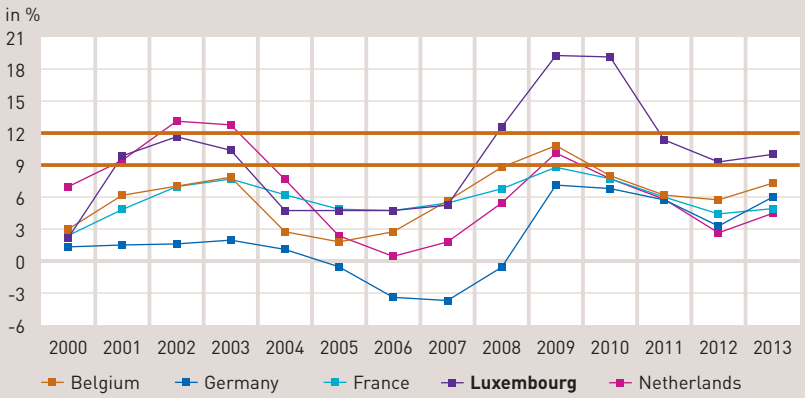
$$realULC = \frac{\frac{\frac{wages}{employment}}{P}}{\frac{realGDP}{employment}} = \frac{\frac{wages}{employment}}{\frac{realGDP \cdot P}{employment}} = \frac{\frac{wages}{employment}}{\frac{nominalGDP}{employment}} = \frac{nominalULC}{P}$$

Which indicator should be followed, the nominal or the real ULC?
The producer price is determined by taking the nominal unit labour cost to which we apply a certain margin. The formula is P=(1+m)·W/(Y/L). The price change ΔP depends on the variation in the margin (+), on the variation in wages (+) and the variation in the productivity of labour (-). The formula is:

ΔP/P=Δm/m+ ΔW/W- (Δ Y/L)/(Y/L)

Now, suppose that there is a positive shock on wage costs, for example by the indexing mechanism. In competition, the company is a "price taker", ΔP/P tends towards 0 so that any wage increase must be offset by an increase in labour productivity or a decrease in the margin. Therefore, it is best to follow the nominal ULC.

Chart 8
Nominal unit labour costs - Change over 3 years from 2000 to 2013

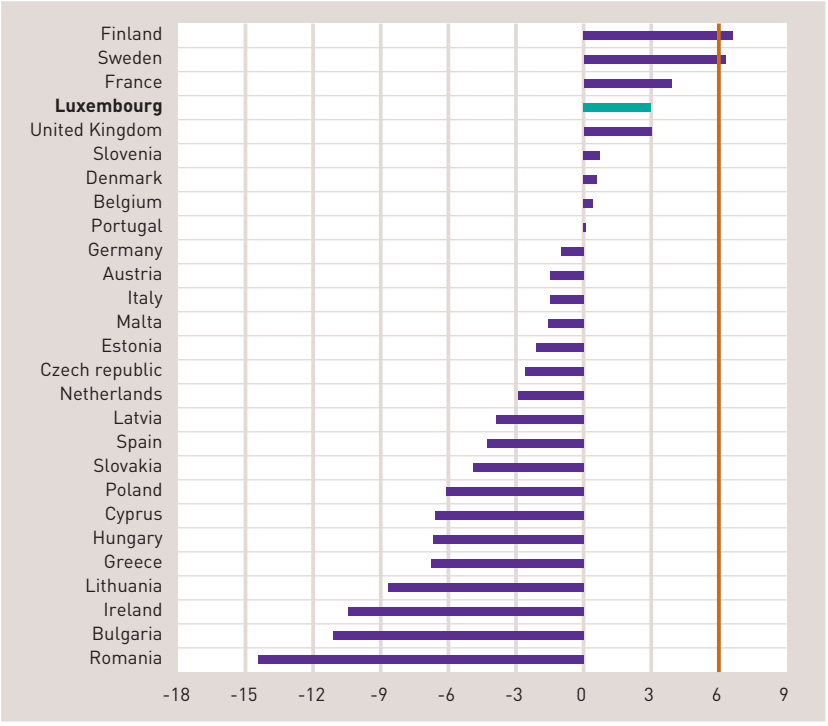


Source: Eurostat, orange bars: 9% threshold for the Member States of the eurozone and 12% for other Member States, fixed by the MIP.

5.4.6 Index of deflated housing prices (% change over 1 year)

This index is available for Luxembourg since the first quarter of 2007. The indices measure changes over time on the acquisition price of apartments in Luxembourg. They are based on the official prices indicated in notarial deeds. These acts are recorded in the Administration of Registration and Domains. Moreover, the indices only measure "pure" price changes, as the differences in quality of apartments sold at different times are neutralized (hedonic price index). In Luxembourg, this index covers only apartments, but indicates a good approximation for houses.

Chart 9
Deflated housing price index - Annual Growth Rate in 2010

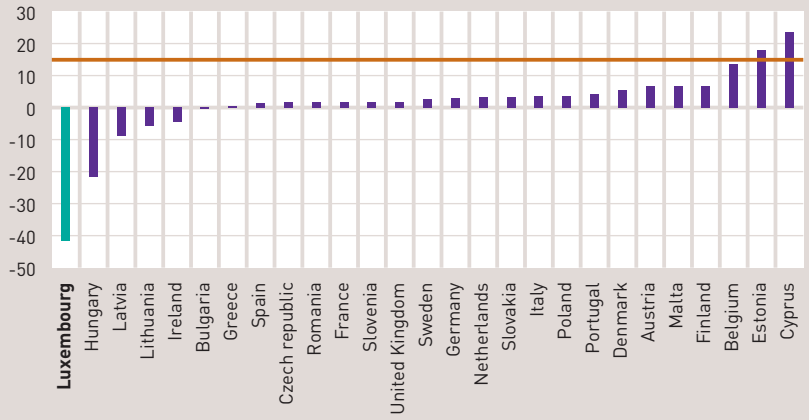


Source: Eurostat, orange bar: 6% threshold set by the MIP

5.4.7 The private sector credit flow (% of GDP)

The indicator on private sector debt is important given that excessively high levels of private debt imply significant risks for growth and financial stability. The indicator measures the level of private debt as a % of GDP and is calculated as the sum of loans and securities other than shares. Data sources are the annual financial accounts and reports (AFA) collected by Eurostat and the quarterly financial accounts (QFA) collected by the ECB. The threshold of private sector debt is 160% of GDP coming from the statistical distribution of the indicator. The indicator is based on unconsolidated data, that is to say that it includes intra-sector debts such intra-company loans. Once the availability of consolidated data improves, the relative merits of consolidated data compared to unconsolidated data will be reconsidered. However, to take account of economically relevant national specificities, consolidated data must be considered, where appropriate, in the context of an economic reading of the scoreboard. In particular, the reasons for the significant differences between the consolidated and unconsolidated data should be examined.

Chart 10
The private credit flow as a % of unconsolidated GDP in 2010

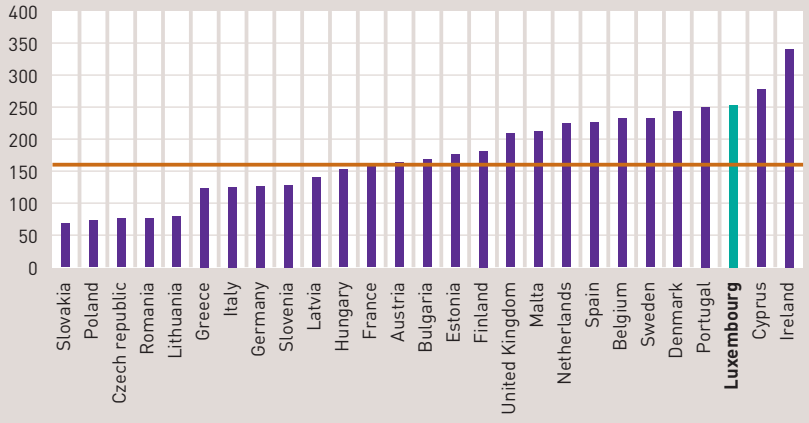


Source: Eurostat, orange bar: 15% threshold set by the MIP

5.4.8 Private sector debt (% of GDP)

In Luxembourg, this indicator should be interpreted with caution. The Commission's analysis highlights the problem behind this indicator in Luxembourg. In fact, in most cases, much of this debt is owed by non-financial corporations. Given the liquidity of certain financial markets, the experience in international transactions or another national specificity, it is very likely that a company may choose to incur debt in a country not for itself but for an entity within a group of companies and then make loans to "related companies" (intra-group loans). The total debt is divided by the national added value, but this indicator does not consider the added value produced in the rest of the world with the related debt. For a small and very open economy, this indicator tends to be higher.

Chart 11
Private sector debt as a % of unconsolidated GDP in 2010

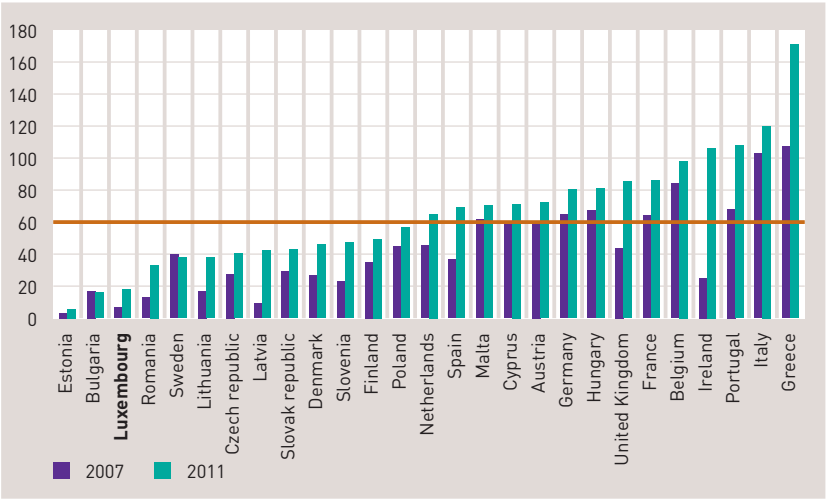


Source: Eurostat; orange bar: 160% determined by the MIP

5.4.9 Public sector debt (as a % of GDP)

The scoreboard includes an indicator for public sector debt as a percentage of GDP, to consider the potential contribution of public sector debt to macroeconomic imbalances. The definition used is that set by the excessive debt procedure and the Stability and Growth Pact (SGP). It should be noted that the indicator for public sector debt is not included in the scoreboard in order to monitor the risk of unsustainable public finances. This aspect is clearly covered by the SGP. On the contrary, it should be considered as a complement to the indicator on the private sector debt, which offers a wider picture of Member States' debt level and, consequently, their overall vulnerability. A high level of government debt is more alarming when it is accompanied by a significant level of debt in the private sector. However, a high level of public debt is a sign of vulnerability in itself. A high level of public sector debt cannot set off a low level of debt in the non-financial private sector (and vice versa). The 60% reference value of the Maastricht Treaty is considered as an indicative threshold for public sector debt.

Chart 12
Public sector debt as a % of GDP in 2007 and 2011



Source: Eurostat, orange bar: 60% threshold set by the Maastricht Treaty

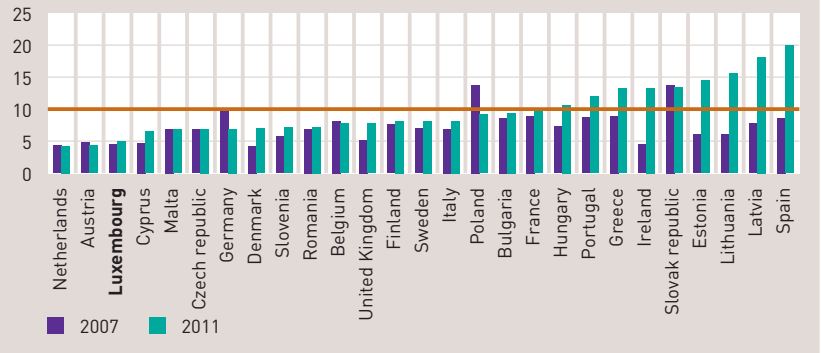
5.4.10 The unemployment rate (average over 3 years)

The unemployment rate has been added to the scoreboard after discussions between the European Parliament, the European Council and the European Commission and it reflects the legislation requiring an indicator that tracks the evolution of unemployment.

Also included in the scoreboard is an indicator that measures the evolution of unemployment. This indicator is intended to monitor high and persistent unemployment rates and it points to a possible misallocation of resources (incompatibility) and the general lack of additional adaptability 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 regarding their likely persistence and the adjustment capacity of economies. The statistical series comes from the Labour Force Survey by Eurostat. The statistical approach provides an indicative threshold that is higher than 10%.

The effect of the crisis cannot be denied, when observing the unemployment rate (3-year average) in 2007 and in 2011. In most Member States, there is a "slight" increase in the unemployment rate, but in five Member States the unemployment rate has doubled.

Chart 13
The unemployment rate in 2007 and 2011



Source: Eurostat; orange bar: 10% threshold set by the MIP

5.5 The list of indicators is not exhaustive - A financial indicator

The European Parliament, the European Council and the European Commission have requested indicators for *"internal imbalances, including those that can arise from public and private indebtedness, financial and asset market developments including housing..."*

The ECOFIN Council of 8 November 2011 decided to complete the scoreboard in 2012 with an indicator that takes into account macroeconomic imbalances from the financial sector, given that the economic crisis was triggered by a financial crisis in 2008.

In June 2012 the Lime working group discussed the options to include a financial indicator in the scoreboard. The discussion focused on two indicators: the financial liabilities' growth rate and the debt-to-equity leverage ratio.

Compared to the ratio debt-to-equity indicator, the financial liabilities indicator has the advantage that it may be an early-warning sign in a rapid financial sector expansion. Indeed, in retrospect, it seems to provide a timely and relatively good early warning for a number of countries. Secondly, it is an easy indicator to understand and to communicate to the general public. Finally, using it as a main indicator is not difficult in terms of data availability and it provides a reliable basis for comparisons between countries.

5.6 Analysis of Luxembourg by the European Commission

In the 2012 scoreboard Luxembourg exceeds 3 of the agreed thresholds, i.e. the current account, the nominal unit labour cost and the private sector debt. On exceeding the threshold for the current account and private sector debt, the European Commission does not worry too much because the excess can be explained in part by an enormous concentration of economic activity and secondly by companies intra-group financing. However, it emphasizes the fact that Luxembourg has lost price competitiveness due to higher wages and low productivity growth rate. In addition, the Commission noted a cumulative increase in property prices over the last decade.

In its *"Alert mechanism Report, Report Prepared in Accordance with Articles 3 and 4 of the Regulation on the prevention and correction of macroeconomic imbalances"* the European Commission has described the situation in Luxembourg as follows:

"Luxembourg: the value of the scoreboard indicator for the current account balance is above the threshold, caused by trade surpluses reflecting the country's strong specialisation in financial services. This, however, is not related to subdued domestic demand, but concentration of economic activities and jobs in the country. Luxembourg has lost price competitiveness as a result of high wage increases and low productivity growth, but it should be noted that at the same time Luxembourg is gaining export market shares in services. Private sector indebtedness is above the indicative threshold, coupled with large and volatile credit flows. This is mainly explained by lending and borrowing operations inside international non-financial corporations, rather than an excessive indebtedness of the private sector. The household debt level is relatively contained. Real house prices witnessed large cumulated growth during the last decade and the correction is limited so far."

After this observation, no deeper analysis has been requested for Luxembourg. Member States identified by the European Commission for a deeper analysis were: Belgium, Bulgaria, Denmark, Spain, France, Italy, Cyprus, Hungary, Slovenia, Finland, Sweden and the United Kingdom. The results of the analysis, published in July 2012[9], concluded that in the 12 analysed countries macroeconomic imbalances do exist but they are not excessive. The recommendations of the Council took into account the existing imbalance by proposing measures to address the imbalance.

5.7 Databases

The scoreboard data is available on the website of DG ECFIN, which provides a platform containing the data used in the Alert mechanism report of the European Commission (14 February 2012). Data as of January 30, 2012.

http://ec.europa.eu/economy_finance/indicators/economic_reforms/eip/

For revisions and updates, this site refers to the Eurostat platform that includes the most current data indicators used in the scoreboard.

http://epp.eurostat.ec.europa.eu/portal/page/portal/excessive_imbalance_procedure/imbalance_scoreboard

[9] http://ec.europa.eu/economy_finance/economic_governance/macroeconomic_imbalance_procedure/index_en.htm

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6 “Competitiveness Luxembourg – Singapore: partners or rivals?”

The official presentation of the study entitled "Competitiveness Luxembourg - Singapore: partners or rivals?" took place on 12 June 2012 at a conference organized by the *Observatoire de la compétitivité* in collaboration with the Luxembourg Chamber of Commerce and the company InSyDe. Speakers from the academic, diplomatic, entrepreneurial and public administration sectors were invited to discuss the results of the study and to share their professional experiences.

The director of the Luxembourg Chamber of Commerce, **Pierre Gramegna**, opened the conference and focused on the common characteristics of the two countries, especially in economic terms. He also highlighted various differences, including the gap in integration between the EU, a multilateral institution versus the Asia-Pacific Economic Cooperation (APEC), which is an intergovernmental economic forum that meets once a year. The "regional" obligations are therefore almost non-existent in Singapore while EU dossiers are an integral part of regulatory procedures in Luxembourg.

Marc Ungeheuer, the EU Ambassador in Singapore, presented general perceptions of Singaporeans about the EU and Luxembourg. From the Asian perspective, the European Union, and therefore also Luxembourg, often suffers from a negative image because of the many regulations. However, Singaporeans seem to have a more positive perception of Luxembourg than of the EU as a whole because of political stability. Nevertheless, the eurozone crisis will necessarily also affect the economic future of Luxembourg.

Thierry Paccoud, from the company InSyDe, presented the results of the study. The first part shows the indicators used by the ODC in its Competitiveness Report scoreboard and aims to compare the two countries. The second part is based on international benchmarks published by international organizations such as the World Economic Forum (WEF) or IMD.

For example, according to the 2011-2012 WEF report, the most problematic factors in the competitiveness of the two countries are as follows:

	Luxembourg	**Singapore**
1st problematic factor	Restrictive labour regulations	Inflation
2nd problematic factor	Inefficient Government bureaucracy	Restrictive labour regulations
3rd problematic factor	Inadequately educated workforce	Inadequately educated workforce
4th problematic factor	Inflation	Poor ethic in national labour force

Source: World Economic forum – Competitiveness report 2011-2012

Given the economic characteristics of the two countries[1], including their level of openness to foreign investment, it is important to emphasize these four factors that also show similarities between the two countries.

In this sense, Thierry Paccoud noted that inflation plays an important role both in Luxembourg and in Singapore. However, in comparison with neighbouring countries, inflation remains at a "reasonable" level even if in the case of Luxembourg the European Central Bank's pursued reference threshold rate of 2% is regularly exceeded.

[1] Especially considering the openness of the economy to foreign investment.

In this sense, the study by InSyDe notes that:

- In terms of infrastructure, both countries made considerable efforts. Efficient infrastructure is an important factor for innovation and the business environment. In addition, at the government level, Luxembourg and Singapore are trying to strengthen the modernization and efficiency of public services, in particular by implementing efficient information and communication systems;

- The legal and regulatory framework is a key determinant of the attractiveness and competitiveness of a country. In this regard, Singapore is ahead of Luxembourg. For instance, a businessmen survey reveals that it seems to be easier to start a business in Singapore than in Luxembourg;

- According to various benchmarks, Singapore ranks better than Luxembourg in terms of entrepreneurship. However, it must be taken into account that, at the institutional level, Luxembourg opted for social dialogue. In addition, the procedures are more complex in Luxembourg, given the integration of Luxembourg within the EU;

- Regarding the values for citizens and companies in both countries, the results are very similar. However, regarding the social responsibilities of business owners (health, safety and environment), they are more pronounced in Luxembourg than in Singapore.

Prof. Dr **Christopher Lingle**, professor at the Universidad Francisco Marroquin of Guatemala, highlighted entrepreneurship as the main driving force of the economy. Thus, an economy is supposed to be competitive when it allows entrepreneurial activity to flourish and businesses to prosper sustainably.

The Director of Statec (National Institute of Statistics and Economic Studies) and of the *Observatoire de la compétitivité* (ODC), Dr **Serge Allegrezza**, referred to the importance of having conducted a comparative study, the scope of which goes beyond the European Union and includes more dynamic economies such as Asian countries. In this regard, the ODC had commissioned a study from InSyDe to compare Luxembourg to a "small" and relatively comparable country, such as the Republic of Singapore.

In order to present the position of Luxembourg in terms of competitiveness compared to EU countries, **Martine Hildgen** presented the scoreboard used by the ODC in the annual analysis of the competitiveness of Luxembourg.

Prof. **Ashish Lall**, associate professor at the National University of Singapore (LKY School of Public Policy) presented his views on the factors of competitiveness of Singapore.

"The role of legacy in building competitiveness: The Singapore example"

Competitiveness

Competitiveness means different things to different people, but ultimately, competitiveness is of interest to policymakers because it leads to higher prosperity or a higher (economic) standard of living. Improving competitiveness is about increasing productivity, not just of labour but of all factors of production, including capital, land and other resources. Another way to view competitiveness is to think of it as diversification. Here diversification does not mean that a country must participate in a portfolio of unrelated industries; instead, it should be thought of as 'doing new activities'. However, the new activities that do develop will exploit 'existing capabilities' which are defined broadly to include markets, institutions and social norms, human and physical assets that were accumulated and developed for existing activities. In other words, path dependence is important; what we can reasonably aspire to tomorrow depends on what we can do today. In this way every country evolves on its own developmental trajectory which is intimately linked, not just to legacy, but also to chance events and choices of policymakers. These notions are explored below in the context of Singapore.

Legacy

According to International Monetary Fund data, the average Singaporean is the third richest in the world (GDP per-capita measured using PPP exchange rates) after Qatar and Luxembourg. The 2011 Global Competitiveness Report ranked Singapore as the second most competitive economy in the world. Singapore is no different from other countries as many of the sectors which drive its economy today, are linked directly or indirectly to its legacy. Legacy can be viewed as a foundation from which new (related) activities emerge. Singapore's story begins with its location both within South-East Asia and on world shipping lanes. Singapore has a natural (deep water) harbor and Sir Stamford Raffles set it up as a 'free port'. This was a policy choice of the British and gave British ports an edge over Dutch ports which had high tariffs. Due to its superior location, Singapore has historically also been a transshipment port for goods from the north (Malaysia) and the south (Indonesia). In 1862-63, 32% of Penang's trade and 79% of Malacca's trade was with Singapore. Both Penang and Malacca were also British ports at the time but due to Singapore's superior location, they became feeder ports. Dutch ports to the south lost trade to Singapore due to their high tariffs. Singapore also served as a transshipment center for China. European manufactured goods, opium from India and Straits (regional) produce was shipped to China and Chinese manufactures were shipped to Europe and America.

In the economic history literature, Singapore is often characterized as a 'staple port' or one that exported surplus natural resources from the hinterland. In the late 19th century tin was exported from the Malayan peninsula and later in the 1920's rubber from Malaya and petroleum from the Dutch East Indies. Staple ports need facilities to handle a large volume of goods and shipping. In addition they have facilities for the processing and marketing of the staple good as well as supporting trade and financial services. Further, there is close involvement of local business interests in hinterland production.

All these factors make a staple port a commercial center. By the First World War Singapore was the 7th busiest in the world in terms of shipping tonnage handled. After independence the government made an early bet by setting up a container terminal before container shipping was well established. In 1972 it commenced operations at its first container terminal and by 1982 it was the world's busiest port by tonnage. In 2011 the Singapore port handled 30 million TEU's (twenty-foot equivalents units), making it the second busiest port in the world after Shanghai.

After the First World War the region became a major producer of petroleum. Oil majors developed production facilities in British Borneo and the Dutch East Indies and used Singapore to collect, blend and distribute products such as petrol, kerosene and fuel oil for bunkering. Oil companies were drawn to Singapore because of its local and international geographical advantage and freedom from regulation. The islands around Singapore provided deep water anchorage and allowed oil companies to use the port facilities and safely store large quantities of petrol. There were few restrictions or taxes on the operations of oil companies. Today Singapore is a key regional refining and trading center with a refining capacity of about 1.385 million barrels per day (Exxon-Mobil and Royal Dutch Shell) making it the 11th largest refining country in the world.

In addition Singapore was influenced by events and technological changes that took place elsewhere. The opening of the Suez Canal in 1869 dramatically increased the shipping traffic between Singapore and Europe. In the late 1800's tin production and exports increased almost six-fold due to the use of tin for canned foods and barrels for transporting petroleum. In the inter-war period the development of the automobile market in the United States increased the demand for both rubber and petroleum. The increase in petroleum demand was also due to the conversion of the merchant marine industry from coal to oil.

All these legacy and historical factors led to the development of industries which continue to form the foundation of Singapore's economy today and Singapore has built on its legacy to diversify into new (but related) activities. The location for example, continues to support a strong transportation and logistics sector not only in marine but also air transportation. Air traffic grew by 11% in 2011 and the Singapore airport handled about 45.5 million passengers in 2011. In so far as shipping is concerned, Singapore has developed competence in managing ports and is now investing in and managing ports around the world. The same is true in the aviation sector. The air transportation networks and the associated aviation infrastructure have supported the development of a strong tourism industry and more recently, casinos. In 2011 Singapore had 13.2 million visitors, up from about 11.6 million in 2010. The petroleum refining and shipping legacy has led to the development of the entire petrochemicals value chain. Singapore had five dry docks as early as 1913 and this led to the development of the ship repair industry which has since diversified into the production of jack-up oil rigs. Singapore has a 70% global market share in the production of jack-up rigs and in the conversion of Floating Production, Storage and Offloading (FPSO) units. Singapore also has a vibrant financial services sector (ranked 4th in the 2010 Global Financial Centers Index), which has most recently diversified into private banking.

A 2011 ranking of wealth management and private banking centers by Pricewaterhouse Coopers ranked Singapore third from the top (after Switzerland and London) and expects Singapore to be in first place by 2013. A 2012 study by the Boston Consulting Group (BCG) indicates that private wealth in Asia Pacific (ex-Japan) is expected to grow at an annual rate of 11.1% between 2012 and 2016. This is the highest regional growth rate in the world and good news for Singapore as it draws a majority of its clientele from this region.

The historical presence of tin refining allowed Singapore to use its basic engineering skills to build the manufacturing sector which still accounts for between 20% and 25% of GDP (by design) and indeed this is the only sector that has shown some positive productivity gains recently. In the last quarter of 2011 labour productivity in manufacturing increased by 8.2%, but in all other sectors it declined, with the information and communication sector showing the largest decline of -8%.

Policy choices

In addition to legacy and chance, Singapore made some good policy choices along the way. While many countries were following inward looking import substitution strategies, Singapore adopted an open trade and investment environment. This not only provided capital for economic development but also led to the transfer of skills and international management practices. Singapore also focused on the fundamentals which include basic infrastructure such as electricity, water, roads and telecommunications. In addition it invested in primary and secondary education, housing and healthcare. Singapore continues to be focused on the business environment, looking for new ways to reduce the cost of doing business and this has led to huge returns for investors. The average annual return on investment for foreign investors in the banking services sector was 41.3% over the period 2001-2007. Singapore markets itself aggressively and uses tax and other incentives to attract investors. It has open immigration policies which allow it to fill any short-term skills gap and it trains its own people for the long term through various scholarships and skills development programs. Singapore also has sound macroeconomic policies and though it has few social safety nets, it facilitates structural adjustment through subsidizing skills re-development. The sound fiscal management and openness to foreign direct investment has led to budget surpluses and accumulation of foreign exchange reserves (about SG$ 308 billion or Euro 192 billion in 2011). These are re-invested through sovereign wealth funds as Singapore has no natural resources to fall back upon. Singapore is also governed effectively and efficiently which is critical for attracting foreign direct investment. Lastly, it is not afraid to copy. In fact it is prepared to learn from any country and adapts foreign models to suit local circumstances.

Challenges

Despite its considerable achievements, like any country, Singapore faces many challenges. The immediate issues relate to rising income inequality and inflation and declining productivity. Singapore's Gini coefficient was between 0.47 and 0.48 in 2011 and this is much higher than that for OECD countries. A recent report by BCG indicates that in 2011 Singapore had the highest density of millionaire households (17.1% of all households) in the world.

6. "Competitiveness Luxembourg – Singapore: partners or rivals?"

During 2011, consumer prices increased by 5.2% and producer prices (domestic supply price index) increased by 8.4%. In addition prices of housing, transportation and basic food items have been increasing and continue to be of concern. The initial phases of Singapore's growth were driven primarily by investment, or the accumulation of capital, more recently; growth has been driven by an increase in population. Thus productivity growth has shown a broad-based decline across most sectors over the last five years or so. Over the long term, Singapore has to contend with an ageing population.

Another major challenge for Singapore is moving from an efficiency driven economy to an innovation driven economy. The government has taken many steps, particularly in the area of manpower development which is essential as the economy is largely driven by services. In the initial stages of development, the focus of the educational system was to produce trained individuals who were employable. Now the focus is on the knowledge based economy which requires thinking and creativity. As a result the emphasis has shifted to higher education and research and development. Manpower training always goes hand in hand with promoting new sectors. The short-term skills gap is filled through immigration while the longer-term needs are addressed via training programs. When the government decided to promote private banking for example, in addition to attracting bankers and fiduciaries from places like Switzerland, the Monetary Authority of Singapore also set up a training institute in cooperation with UBS (Union Bank of Switzerland). In addition, local universities started offering degrees in wealth management.

Other sectors the government is trying to promote include biotechnology, nanotechnology, clean technology, interactive media, film and design. Though Singapore is often ranked highly in innovation rankings, this is due to the presence of supporting measures or inputs and not outputs. In other words, the venture capital funds, and other institutional support is available so the environment is very attractive, however given the nature of innovation, this does not automatically lead to outputs.

Innovation and research intensive sectors are very different from Singapore's legacy sectors and in fact they call for a change in mind-set. Invention and innovation are uncertain processes where outcomes are very difficult to predict and so the efficiency mind-set that has helped Singapore thus far will be less important in the future. The future calls for creativity, independent thinking, risk taking, entrepreneurial spirit and the acceptance of failure. This is not familiar ground for Singapore. The government has nonetheless invested money not just in funding research but also in training citizens and attracting scientists from other countries. In 2010, gross expenditure on R&D (GERD) was SG$ 6.5 billion and R&D intensity (GERD as a percentage of GDP) was 2.1%. Singapore's total expenditure is very small due to the small size of its economy; in fact many multinational companies spend more on R&D. Singapore's R&D intensity is well below countries such as Israel (4.3%), South Korea (3.4%), Denmark (3%), Germany and the United States (both 3.8%). Singapore's researcher intensity (full time equivalent researchers per 1,000 labour force) was 10.2 in 2010. This is slightly below Sweden (10.5), Japan (10.4) and Denmark (10.3) but slightly higher than South Korea (10.0). When one compares this with outputs, US-registered patent data show that Singapore's patenting rate per-million population is comparable to countries such as Denmark and the Netherlands.

However, countries like Finland, Israel, Switzerland, Japan, and South Korea continue to outperform Singapore. While Singapore has shown strong growth in the number of patents, countries such as India and China have outpaced Singapore by a factor of two to three.

Singapore is a global city that needs to continue to attract talent; so of late it is spending a lot of effort on the built environment and quality of life with a view to making Singapore a more livable city. While economic opportunities are important to attract talent, the quality of life, the environment and the culture of a city help to retain talent. In its quest for diversification, Singapore has not abandoned its legacy sectors such as transportation and logistics, tourism, shipping and ship-repair, petroleum refining and petrochemicals, financial services and manufacturing. Instead it has sought to expand its capabilities in the legacy sectors, giving the economy a solid foundation. This strong foundation affords Singapore the luxury to experiment in newer and more uncertain areas such as biotech, nanotech and clean technologies.

Participants in the roundtable, which followed the speakers' speeches, were Mr **David Arendt** (General Manager of Freeport Luxembourg), Mr **Loic Bertoli** (Officer of the the Ministry of Economy - Directorate of Foreign Trade), Mr **Robert Biwer** (Commissioner with the Maritime Affairs of the Grand Duchy), Prof. Dr **Christopher Lingle**, Prof. **Ashish Lall**, Dr **Paul Belche** (former Director of Commerce of ARBED Singapore) and Mr **Nicolas Buck** (CEO Victor Buck Services).

The members of the roundtable presented their opinions and professional experiences.

For Mr **Arendt**, manager of Freeport in Luxembourg which will initiate its activities in 2014, Luxembourg and Singapore have several common characteristics, in particular a stable political system and an internationally recognized financial centre.

For Mr **Buck**, CEO of Victor Buck Services, Luxembourg should absolutely continue to invest in the infrastructure development, especially in terms of the mobility of residents.

Mr **Biwer**, Commissioner with the Maritime Affairs of the Grand Duchy, highlighted that the shipping register has proactively adapted to the needs of the maritime community. Moreover, even if the shipping register of Luxembourg is not comparable to that of Singapore, he sees a similarity especially in terms of quality, which is a major priority.

For Dr **Belche**, former Director of Commerce of ARBED Singapore, Singapore's advantages include its long-term strategic vision and flexibility concerning the modernization of the legal and regulatory framework.

For Mr **Arendt**, the notable advantages of Luxembourg include the importance given to sustainable development by both government and businesses and the regulatory system for the construction of buildings.

For Dr **Belche** the population of Luxembourg is on average more international and more open to foreign cultures than Singapore's.

7 The *PIBien-être* project

At the international level, there are many initiatives dedicated to finding an alternative measure to GDP that captures the various dimensions of social progress of a country. In Luxembourg, the Observatoire de la compétitivité has been a pioneer in this field by organising a seminar "Towards new indicators of wealth." As a result of this seminar, the ODC has calculated an index of social health that includes categories of unemployment, health, working conditions, inequality, environment and education, as well as the related specific indicators.

In order to extend this social indicator to Luxembourg, the government stated in its 2009 programme that "along with the Higher Council for Sustainable Development (HCSD) and the Economic and Social Council (ESC), the *Observatoire de la compétitivité* is developing a composite indicator for well-being beyond the standard GDP per capita indicator, intended to measure progress in society and well-being in a long-term perspective. This indicator, which takes into account international developments in the area, is being implemented based on statistics and official databases provided by Statec."

The Economic and Social Council (ESC) and the Higher Council for Sustainable Development (HCSD) are since then in charge of implementing a "*PIB du bien-être*" (Well-being GDP), a system of indicators of well-being that goes beyond GDP/capita.

Since 2009, there have been many meetings, seminars and conferences dedicated to this topic[1].

In this context, on 27 and 28 May 2011 the Luxembourg Institute for European and International Studies, in collaboration with Statec and the *Observatoire de la compétitivité*, organized a conference entitled "How much is enough" to analyse and discuss the manuscript of Robert and Edward Skidelsky about the material and immaterial needs of an individual. In addition, the conference was an opportunity for the creators of the *PIBien-être* project, namely the Economic and Social Council (ESC), the Higher Council for Sustainable Development (HCSD) and the *Observatoire de la compétitivité*, to present to international experts the main results obtained to date, in terms of Luxembourg's *PIBien-être*.

Thus, the exchange of ideas at this conference has enriched the manuscript of Prof. Skidelsky as well as the *PIBien-être* project technical report.

The book by Robert and Edward Skidelsky was published in May 2012 under the heading "How much is enough - Money and the good life."

[1] These various events can be found on the official website of the *Observatoire de la compétitivité* as well as in the 2010 and 2011 editions of the Competitiveness Report.

7.1 Synopsis of the *PIBien-être* project in Luxembourg

Since the publication of the last *Observatoire de la compétitivité* Report in October 2011, several presentations and lectures about the *PIBien-être* project have been held. Similarly, after the completion of the technical report officially submitted on 9 March 2011 to the joint working group made up by the Economic and Social Committee (ESC) and the Higher Council for Sustainable Development (HCSD) as well as to the Prime Minister, work has continued to account amongst other things for international developments in measuring well-being, and it was decided to update first technical report.

The idea of creating a new technical report as a supplement to the first report of this kind was born at the OECD conference on 12 October 2011. French Ministers of Economy and Ecology, the OECD Secretary General and the Nobel Prize for Economics, Joseph E. Stiglitz, spoke at this conference aimed at establishing an inventory of initiatives taken in response to the recommendations in the Stiglitz-Sen-Fitoussi report and at highlighting the role of the new measures in public policy making.

Noting the rather comprehensive approach of the OECD and under the assumption that this work will serve as an international reference, the fact that the OECD report covers areas not identified by the Luxembourg project prompted the group to produce a new technical report merging these two analytical frameworks.

To facilitate the work on indicators, the results of consultations with ministries on the topic, and an assessment of the statistical quality of the indicators have been included in the new report. The purpose of this approach was also to ensure that the indicators collected would receive the approval of all the stakeholders. The work was done so that the discussions in the two institutions could begin immediately after the completion of the technical report 2, in late February 2012.

7.2 Continuing the work

At its plenary session of 12 January 2012, the ESC decided to deepen its analysis on the basis of the technical report 2, which was finalized a few weeks later. To this end, a "*PIBien-être*" Working Committee and a Drafting Committee were established by the ESC. These committees started their work on 21 March 2012 to go through and discuss all the indicators of the new report. It was also decided to keep working with the HCSD to achieve a system of common indicators.

The first joint ESC/HCSD meeting on 28 March 2012 was devoted primarily to exchange views on the philosophy underlying the concept of well being but also on the respective approaches to growth. Given that the points of view on this point were not diametrically opposed, a distribution of tasks between ESC and HCSD was agreed in order to accelerate the work. The ESC therefore analysed the indicators that fall under a "household" perspective of current well-being, while the HCSD focused more on indicators related to sustainability and future well-being.

As for the final report to be submitted to the government, the two institutions reaffirmed their commitment to produce a common view or at least to provide a common indicators proposal. Even if the proposal was likely to include parts that were assumed only by one or the other group, it was decided to produce a single coordinated document that includes, as appropriate, all views on this subject.

Regarding the work at the HCSD, a first internal exchange of views on the *PIBien-être* was held on 27 March 2012 and an ad hoc working group was institutionalized with a mandate to deal first with future well-being, focusing on sustainable development in the medium and long term.

In the context of its work, the HCSD commissioned Professor Christian Schulz of the University of Luxembourg to develop a proposal for a "system of well-being indicators", which includes:

- General advice in relation to the Technical Report 2, including an assessment of the relevance and feasibility of the indicators, the weighting of the areas analysed and the consistency of the concept with existing strategic documents (National Plan for a Sustainable Development, Sector plans, Eco-technologies national action plans, climate,...);
- A pre-selection of key indicators;
- A strategy for visualization and dissemination of monitoring results (frequency of publication, dissemination channels); and
- Prospects for the future development of the scoreboard.

In addition, the HCSD found it useful to consult the public, especially young people, but also foreigners and cross-border people, on what is important to their well-being and commissioned a survey from Ilres and Quest to detect the major concerns of the public in terms of sustainable development.

On the other hand, the HCSD initiated and co-financed a TEEB-type study[2] (The Economics of Ecosystems and Biodiversity) at the CRP Henri Tudor, to assess the economic value of biodiversity and ecosystem services.

On the occasion of the meeting of the ESC-HCSD *"PIBien-être"* joint working group of the 11 September 2012, it was agreed that the ESC would provide a short list of indicators to the HCSD upon the completion of work in this area, which was scheduled for late September 2012. This work is currently in progress and will provide a basis for HCSD reflections, which will focus at first on sustainable development indicators, keeping open the possibility to suggest other indicators in areas connected to "household" aspects. The two presidents reaffirmed their will to complete the work as soon as possible.

7.3 Consultation with civil society

Concerning the consultation with civil society during this period, three major events are noteworthy:

- The presentation of the PIBien-être technical report to the Economic and Social Council of the German-speaking Community of Belgium (WSR DG), on 6 December 2011. At the invitation of WSR DG, the work done by the joint technical group ESC-HCSD was presented to WSR DG members and representatives of civil society in the region. On this occasion, the original character of the Luxembourg project was stressed, since, for the first time, two separate institutions, one from the social dialogue, the other from the civil society dialogue, collaborated to measure the progress of Luxembourg's society. The selected indicators were presented and the participants expressed their questions as well as their views on the issue. Indeed, the WSR DG has done its own work on the subject, contained in a document entitled *"Wohlstandsindikatoren - Ist das Bruttoinlandsprodukt (BIP) die ideale Messgrösse?"*[3] ;

  http://www.ces.public.lu/fr/actualites/2011/12/bienetre-belgique/index.html

[2] The TEEB initiative (The Economics of Ecosystems and Biodiversity), launched in 2007 by the Potsdam G8 and five major developing countries, aims to assess the economic value of biodiversity and ecosystem services. TEEB is focused on the economic benefits of biodiversity and takes into account the costs of biodiversity loss. TEEB aims to integrate economic values of biodiversity and ecosystem services in the process of decision-making.

[3] www.wsr-dg.be

- The ESC-HCSD Public Lecture "What data to better understand the evolution of society and the quality of life of the citizens" on 18 January 2012. At this conference, Ms Martine Durand, Chief Statistician and Director of the Statistics Directorate of the OECD, presented the report "How's life?". This is an essential step in measuring progress at international level, giving a first response and outcome at international level, including a set of comparable and detailed indicators related to well-being. The conference was an opportunity to discuss the various aspects and factors of well-being in our society and to identify the key elements that will better measure and report on socioeconomic changes that make a society progress in a sustainable direction;

  http://www.ces.public.lu/fr/actualites/2012/01/ocde-durand/index.html

- The conference-debate with Prof. Dr Ulrich Brand from the University of Vienna on the German experience of *PIBien-être*, on 23 January 2012. At this conference, Prof. Brand presented the progress of the work of the German Bundestag on *PIBien-être*. In January 2011, it has established a Commission on "Growth, Well-being and Quality of Life" with the mission to explore, given the multiple dimensions of the current crisis, the question of economic growth and well-being. The exchange of views allowed various issues to be discussed, including the need for growth or the desirable type of growth, difficulties in implementing sustainable development, as well as issues related to resource scarcity and the involvement of civil society in these issues. Prof. Brand also took the opportunity to share some comments and reflections on the Luxembourg work in general, and in particular on the *PIBien-être* technical report.

  http://www.ces.public.lu/fr/actualites/2012/01/prof-brand/index.htm

7.4 Interview with Prof. Dr Ulrich Brand from the University of Vienna

Was ist das Ausschlaggebende an der Herangehensweise und der Arbeit der Enquete-Kommission im Bundestag das das Projekt erfolgreich macht oder machte?

Mit der Institution der Enquete-Kommission verfügt der Bundestag über ein Instrument, parteiübergreifend und über die Tagespolitik zukunftsweisende Themen intensiv zu bearbeiten und Empfehlungen abzugeben. Dies geschah in der Vergangenheit zu Themen wie Klimawandel, Nachhaltigkeit, Globalisierung oder bürgerschaftliches Engagement. Wenn das funktioniert, können neue Konsense und eine breite Basis vorbereitet werden für reformorientierte Politik oder zumindest mit der notwendigen analytischen Tiefe die tiefer liegenden Gründe für Differenzen in der politischen Auseinandersetzung deutlich werden.

Die Motivation für die hier vorgestellte Enquete-Kommission ist derart: Die jüngste Krise und vielfältige Herausforderungen haben „eine grundlegende Diskussion über gesellschaftlichen Wohlstand, individuelles Wohlergehen und nachhaltige Entwicklung angestoßen. Nicht nur in Deutschland, auch in anderen Industriestaaten gibt es eine Debatte darüber, ob die Orientierung auf das Wachstum des Bruttoinlandsproduktes (BIP) ausreicht, um Wohlstand, Lebensqualität und gesellschaftlichen Fortschritt angemessen abzubilden." (Antrag auf Einsetzung der Enquete-Kommission, Bundestagsdrucksache 17/3853 von Nov. 2010) Der Bundestag reagierte recht spät auf diese Diskussion, doch das muss kein Nachteil sein. Sie in Luxemburg haben damit ja früher begonnen. Das gilt auch für die Stiglitz-Sen-Fitoussi-Kommission, die durch den ehemaligen französischen Präsidenten eingerichtet wurde.

In den etwa monatlich stattfindenden, im Bundestags-TV öffentlich übertragenen Plenarsitzungen geht es um „große" Themen wie etwa das problematisch gewordene Fortschrittsverständnis und die Treiber von Wachstum, demographische Entwicklungen, Möglichkeiten und Grenzen von Ressourceneffizienz, Fragen von Wohlstand und (Aus-) Bildung.

Die eigentliche Arbeit auf einen Endbericht hin erfolgt in fünf Projektgruppen, die einzelne Zwischenberichte vorlegen, die möglichst im Konsens formuliert und dann gegebenenfalls mit Minderheitenvoten versehen werden.

Zu Ihrer Frage, was nun wichtige Erfolgskriterien sind. Nach gut eineinhalb Jahren haben sich die Verfahren eingespielt, mitunter sind Respekt und Vertrauen quer zu den Parteigrenzen und auch über die Linie Regierung-Opposition hinweg entstanden. Das ist sehr wichtig für solch eine Arbeit. Ich hatte in den Diskussionen in Luxemburg den Eindruck, dass bei Ihnen ein vertrauensvolles Verhältnis besteht. Im Bundestag gibt es aber auch Kräfte, die die Kommissionsarbeit bremsen oder in ihrem Sinne instrumentalisieren wollen. Und es existieren auch in solch einem Gremium politische und wissenschaftliche Konkurrenz und Profilierungsgehabe. Das ist mal mehr, mal weniger deutlich sichtbar.

Die Projektgruppe 3 zu „Wachstum, Ressourcenverbrauch, technischen Fortschritt – Möglichkeiten und Grenzen der Entkopplung", in der ich bislang mitgearbeitet habe, hat Ende September als erste ihren Bericht im Plenum vorgelegt. Dabei wurden einige interessante Konsense ausgearbeitet.[4] Zum einen reicht die Orientierung an relativer Entkopplung nicht aus, sondern es bedarf der absoluten Reduktion des Ressourcenverbrauchs und der Belastung der Senken. Dafür sind technologische Innovationen notwendig, aber letztlich zu wenig, um die Entkopplung von Wirtschaftswachstum und Ressourcenverbrauch zu erreichen; es bedarf der sozialen und politischen Innovationen (die allerdings noch etwas opak bleiben). Zum anderen wird es zwar zu Ressourcenverknappungen kommen (insbesondere auf lokaler Ebene), aber das drängende Problem sind die mit dem Ressourcenabbau und der -nutzung verbundenen Emissionen, also der Klimawandel.

Wir sollten nicht vergessen, dass es sich um einen Bericht handelt, noch nicht um Politik. Zudem wurde das 7. Kapitel des Zwischenberichts der Projektgruppe 3 verschoben, weil hier die politischen Handlungsempfehlungen formuliert werden. Das wird bis November geschehen. Der Gesamtbericht soll im Juni 2013 vorliegen.

Ein weiteres Erfolgskriterium liegt darin, dass die Enquete-Arbeit in der Öffentlichkeit diskutiert wird. Nur darauf zu setzen, dass der Bericht am Ende wirkungsmächtig wird, ist politisch naiv. Ende September, bei der Vorstellung des ersten Zwischenberichts, gab es durchaus Medieninteresse. Dieses ist übrigens meist größer, wenn sich inhaltliche Konflikte abzeichnen.

Worin besteht noch Handlungsbedarf, um das Projekt voranzutreiben?

Handlungsbedarf besteht in solch einer Kommission dahingehend, dass wirklich neue Denkräume geöffnet werden. Das gelingt nur zum Teil. Bislang fehlt vor allem eine intensive Diskussion um einen wirklich alternativen Wohlstandsbegriff, der sich eben nicht nur um qualitatives Wachstum, technologische Effizienz und Wettbewerbsfähigkeit dreht, sondern in dem soziale Innovationen, Erwerbsarbeit und andere Tätigkeiten wie Sorge- und Freiwilligenarbeit und ein breites Nachhaltigkeitsverständnis eine Rolle spielen. Das wird hoffentlich in den kommenden Monaten nachgeholt.

Auf der konkreten Ebene halte ich es für eine Schwäche, dass konkrete Erfahrungen und Diskussionen in anderen Weltregionen kaum berücksichtigt werden. Darauf gehe ich hier nicht ein, sondern möchte drei andere Aspekte hervorheben.

a) Ich habe mich daher für eine Position eingesetzt, die in etwa so skizziert werden kann: Wettbewerb ist ein „wesentlicher Bestandteil des Soziallebens" moderner Gesellschaften.[5] Er ist Teil von komplexeren Innovationssystemen, wobei die Gefahr, dass Wettbewerbsvorteile in politische und ökonomische Macht umgemünzt werden, durch Wettbewerbsregeln bearbeitet werden muss. Wettbewerb findet zwischen privaten wie öffentlichen oder genossenschaftlich organisierten Unternehmen statt, aber auch zwischen anderen gesellschaftlichen Organisationen wie etwa partei- und verbandspolitischen Akteuren oder zwischen Individuen. Erfolgreiche Prozesse relativer Entkopplung oder gar absoluter Reduktion können von fairem Wettbewerb profitieren.

[4] http://www.bundestag.de/dokumente/textarchiv/2012/40600161_kw39_pa_enquete_wachstum/index.html

[5] Gruppe von Lissabon: Grenzen des Wettbewerbs. München: Luchterhand (Original Limits of Competition. Cambridge/Mass.: MIT Press 1995), S.128.

Das Konzept der „wirtschaftlichen Wettbewerbsfähigkeit von Staaten" ist nicht eindeutig definiert und es liegen den unterschiedlichen Verständnissen normative Aussagen über die Bedeutung von Wirtschaftswachstum, von Innovation und von wünschbarer gesellschaftlicher Entwicklung zugrunde. Es handelt sich daher um keinen objektiven Indikator. Die Anforderungen an Wettbewerbsfähigkeit werden in vielen Branchen vom Weltmarkt her definiert, durch die Konkurrenzsituation von Unternehmen und von den Zinsansprüchen der Aktionäre und Finanzmarktakteure.

Daher muss gesellschaftlich und politisch ausgehandelt werden, wie sehr Wirtschaft und Gesellschaft sich an Wettbewerbsfähigkeit ausrichten, welche Mittel und Wege wünschbar sowie Zielkonflikte und Interessendifferenzen auszutragen sind: Welche Rolle spielen beispielsweise Lohnstückkosten? Ist Bildungs- und Hochschulpolitik an leistungsstarken Gruppen ausgerichtet oder verfolgt sie einen egalitären Anspruch? Inwieweit sollen weniger wettbewerbsfähige Branchen aus gesellschafts- oder umweltpolitischen Erwägungen zumindest teilweise und zeitweise geschützt werden?

So wies die „Gruppe von Lissabon" vor 15 Jahren darauf hin, dass sich seit den 1970er Jahren eine „Wettbewerbsideologie" herausgebildet hat. Der „faire Wettbewerb" als wirkungsvolles Innovationsinstrument wurde verdrängt von der „Ansicht, dass unsere Ökonomien und Gesellschaften auf globaler Ebene in einen technologischen, industriellen und wirtschaftlichen Krieg verwickelt sind".[6] Zudem würde mit dem Fokus der Wettbewerbsfähigkeit häufig Spitzenleistungen und technischen Systemen starke Bedeutung zugemessen, während soziale Fragen und die Tatsache zunehmender struktureller Ungleichheiten innerhalb und zwischen Ländern ausgeblendet würden.[7]

Ob auch Volkswirtschaften zuvorderst an ihrer Wettbewerbsfähigkeit zu messen sind, ist eine also gesellschaftspolitisch zu diskutierende Frage, die mitunter kritisch gesehen wird. Der Träger des Wirtschafsnobelpreises von 2008, Paul Krugman, argumentierte, dass die „Obsession der Wettbewerbsfähigkeit nicht nur falsch ist, sondern gefährlich, da dadurch die Innenpolitik verzerrt und das internationale wirtschaftliche System gefährdet" würden"[8] Die Orientierung an Wettbewerbsfähigkeit könne auch zu ineffizienten Politiken führen.

b) Deutschland und die Welt. Es ist naheliegend, dass der zentrale Bezugspunkt eines Gremiums des Deutschen Bundestages die bundesdeutsche Gesellschaft ist. Hier besteht viel Wissen um aktuelle Probleme, hierfür sollen politische Vorschläge erarbeitet werden. Das hat aber eine gewichtige Kehrseite. Das Internationale wird zu einer Art diffusem Äußeren in einer unübersichtlichen Welt – als problematisches Umfeld, als Konkurrenz im globalen Wirtschaftswettbewerb. Völlig unverständlich bleibt entsprechend die weitgehende Ausblendung der Europäischen Union als gesellschaftliche und wirtschaftliche Realität sowie als politischer Handlungsraum.

„China" beispielsweise ist eine Art Abziehbild der ökologisch desaströsen Entwicklung. Das führt dazu, dass immer wieder darauf bestanden wird, „Deutschland" alleine könne selbst mit noch so progressiven Politiken ohnehin nichts bewirken. Andere Länder („China") seien das Problem.

6 Gruppe von Lissabon, S. 133, auch 137 ff.; vgl. auch Joachim Hirsch: Der nationale Wettbewerbsstaat. Amsterdam: ID-Archiv.

7 Gruppe von Lissabon, S. 142; vgl. den zusammenfassenden Kasten S.144.

8 Krugman, Paul: Competitiveness: A dangerous obsession. Foreign Affairs, 73(2), 1994, S. 28-44, hier S. 30; vgl. auch Altvater, Elmar/Mahnkopf, Birgit: Grenzen der Globalisierung. Münster: Westfälisches Dampfboot 2007 (7. Auflage), S. 246-250.

Es bedürfe dafür der internationalen Kooperation (der Wille daran wird der deutschen Regierung unterstellt). Und implizit schwingt immer wieder mit, dass „bei uns" die Verhältnisse eigentlich ganz in Ordnung seien.

Das zentrale, wenn nicht gar einzige sozialstrukturelle Merkmal ist die Existenz von Nationalstaaten, für die von einer Art Durchschnittsbevölkerung ausgegangen wird. Gemessen wird das an durchschnittlichen Einkommensniveaus und durchschnittlichem Ressourcenverbrauch. Dass es – um im Bild zu bleiben – in China heftige Auseinandersetzungen gibt um andere sozio-ökonomische und vor allem ökologische Entwicklungen, dass viele Menschen in den Regionen des Ressourcenabbaus überhaupt nichts vom Wirtschaftswachstum haben, dass es sich auch dort um eine Klassengesellschaft handelt, in der vor allem die urbanen Mittelklassen, Parteikader und Vermögensbesitzer bedient werden, bleibt beim Draufblick auf „die Chinesen" außen vor.

Weitgehend ohne Interesse bleibt auch, das deutete ich an, ob es in anderen Gesellschaften – europäischen wie außereuropäischen – vielleicht positive Erfahrungen mit anderen Verständnissen und Praktiken von Wohlstand und Lebensqualität gibt. Irgendwie seltsam bleibt die Kommissionsarbeit trotz einer globalen ökologischen Problemstellung politisch in den bundesdeutschen politischen und wirtschaftlichen Gefilden verhaftet. Es scheint ein implizites Krisenbewusstsein zu geben, dass „Deutschland", also seine politischen Institutionen, in der Krise ganz gut agiert.

c) Schließlich besteht eine gewisse Ignoranz gegenüber den Positionen und Erfahrungen unterschiedlicher zivilgesellschaftlicher Akteure. Das wäre vor zehn Jahren so nicht möglich gewesen. Die gegenwärtige Krisenpolitik scheint eine Orientierung zu stärken, derzufolge die zentralen gesellschaftlichen Bereiche „Staat" und „Markt" sind. Die heterogenen zivilgesellschaftlichen Gruppen, aber auch die Menschen und ihre alltäglichen Praktiken spielen kaum eine Rolle. Das hat enorme Implikationen für den Typus von Wissen, der als wichtig erachtet wird.

Wissen wird weitgehend gleichgesetzt mit dem verfügbaren politischen und inhaltlichen Wissen der Abgeordneten, das um wissenschaftliches Wissen angereichert werden soll. Andere Wissensformen wie Alltagswissen oder das inhaltliche wie Erfahrungswissen gesellschaftspolitischer Akteure spielt eine deutlich untergeordnete Rolle.

Innerhalb des wissenschaftlichen Wissens dominiert das ökonomische Wissen neoklassischer Provenienz, dazu spielen keynesianisches und ökologisch-ökonomisches Wissen eine Rolle. Darüber hinaus besteht wenig Bereitschaft der Wirtschaftswissenschaftler zur Interdisziplinarität. Das ist einerseits erstaunlich, da die aktuelle Krise insbesondere dem neoklassischen Denken die Grenzen aufzeigt. Andererseits spiegelt sich darin der Machtanspruch der Wirtschaftswissenschaften, den sie nicht ohne Not aufzugeben gedenkt.

Das hat für das Kommissionsthema „Wachstum, Wohlstand und Lebensqualität" eine wichtige Folge, denn zugespitzt könnte man den Konsens derart fassen: Wirtschaftlich relevant ist das, was an Gütern und Dienstleistungen über den Markt gehandelt wird. Dann ist es zum einen naheliegend, dass Natur einen Preis erhalten soll, um sie zu schützen.

Begrifflich wird das untermauert durch das Wortungetüm des „Naturkapitals". Das sollen der Markt selbst oder – im Falle von Marktversagen – staatliche Rahmenbedingungen gewährleisten. Dass aber Natur als Ressource oder Senke zu sehen und potentiell zu verwerten ist, steht für die Mehrheit außer Frage.[9]

Und es wird zum anderen erklärbar, warum die Bereiche der unbezahlten Erziehung-, Sorge- und Freiwilligenarbeit beim Nachdenken über Wohlstand und Zukunft kaum eine Rolle spielen. Ein Kommissionsmitglied nannte diese Ausblendungen mal ganz putzig eine *déformation professionelle*. Etwas ernsthafter könnte es aber auch die gesellschaftspolitisch folgenreiche Ausblendung zentraler Bereiche unserer Gesellschaft und ihres Verhältnisses zu ihren natürlichen Lebensgrundlagen bezeichnet werden.

Durch diese Ausblendungen werden die Lösungen dann entweder auf der Ebene der Unternehmen (mit mehr oder weniger starken Rahmenbedingungen) oder jener des Staates gesehen; gegebenenfalls ergänzt um die Gewerkschaften. Die Verbraucher agieren im Sinne des homo oeconomicus nach einer Art Reizschema nach Kosten-Nutzen-Kalkülen. Umwelt- und Sozialverbände als wichtige Einrichtungen, die nicht nur Probleme anzeigen, sondern auch zu deren Lösung etwas beizutragen haben, kommen gar nicht vor.

Das luxemburgische Modell unterscheidet sich darin, dass nicht das Parlament mit der Aufgabe befasst wurde, sondern der Wirtschafts- und Sozialrat zusammen mit dem Rat für eine nachhaltige Entwicklung. Wie schätzen sie die luxemburgische Herangehensweise ein?

Das luxemburgische Modell hat den Vorteil, dass es an der Exekutive angesiedelt ist. Im Globalisierungsprozess hat ja die Rolle der Parlamente abgenommen und die Regierungen wurden aufgewertet. In der Bundestags-Enquete kommt es immer wieder zu Diskussionen entlang von Parteilinien, die sich von der Sache wegbewegen. Und: Der Antrieb, angemessene politische Handlungsempfehlungen für den Bundestag aussprechen zu können, droht dann doch im Alltagsstress der Abgeordneten und Sachverständigen, in den Routinen des parlamentarischen Betriebs, in den tief verankerten wissenschaftlichen Selbstverständlichkeiten und Animositäten sowie letztendlich wohl auch in der parteipolitischen Konkurrenz unterzugehen.

Ein zweiter Vorteil besteht in der Kooperation zwischen Wirtschafts- und Sozialrat einerseits und dem Rat für nachhaltige Entwicklung. Mit solch einem hochrangigen Gremium können wichtige Impulse in der Gesellschaft gesetzt werden. So etwa ein Überdenken der traditionellen Orientierung an Wachstum und Wettbewerbsfähigkeit, die ja ökologisch oft problematisch ist. Kann eine breite und glaubwürdige gesellschaftliche Debatte um „Wohlstand jenseits des Wachstums" vorangetrieben werden?

Zentrale Fragen sind hier: Was ist der Stellenwert einer „Grünen Ökonomie"?[10] Wie können Industrie- und Dienstleistungssektoren umgebaut werden? Welche Rolle spielt die Finanzwirtschaft?

[9] Vgl. auch Brand, Ulrich (2012): Wachstum und Herrschaft. In: Aus Politik und Zeitgeschichte. Nr. 27/28. 5. Juli, 6-12; http://www.bpb.de/apuz/139184/wachstum-und-herrschaft-essay

[10] Brand, Ulrich (2012): After Sustainable Development: Green Economy as the Next Oxymoron? In: GAIA - Ecological Perspectives for Science and Society 21(1): 28-32.

Solch ein hochrangiges Gremium muss den Mut haben, Zukunftsfragen zu stellen, sie aber mit aktuellen Entwicklungen – etwa den Krisenpolitiken und dem Ausblenden von Fragen der Nachhaltigkeit in der aktuellen Wirtschafts- und Finanzkrise – zu verbinden.

Wo wird es Ihrer Meinung nach an seine Grenzen stoßen?

Ich habe bereits einige Aspekte oben angesprochen, etwa die Frage, welches Wissen als relevant erachtet wird und welches ausgeblendet bleibt (und damit die entsprechenden Erfahrungen). Die Gefahr der Exekutivlastigkeit liegt natürlich darin, dass es sich um ein Expertengremium handelt, das zu wenig die heterogenen gesellschaftlichen Bedürfnisse berücksichtigt.

Eine potentielle Grenze liegt darin, dass der Wirtschafts- und Sozialrat nicht nur Nachhaltigkeitsperspektiven vertritt, sondern auch andere. Welche setzen sich im Konfliktfall durch?

Ich empfehle Ihnen aufgrund meiner Erfahrungen im Bundestag nicht, bei den politischen Empfehlungen Konsense zu suchen. Bei der Analyse kann das durchaus der Fall sein, aber auch hier nicht um jeden Preis. Doch bei den Handlungsempfehlungen besteht die Gefahr, dass der kleinste gemeinsame Nenner dominiert. Zeigen Sie eher das Spektrum von unterschiedlichen Handlungsmöglichkeiten auf, die dann die Politik ergreifen kann. Benennen Sie auch mögliche Probleme und Interessenkonstellationen, etwa der Vermögenden und Industrie- sowie Finanzunternehmen, der Gewerkschaften und Konsumenten.

Schließlich: Die Grenze könnte darin liegen, sich als Expertengremium zu überschätzen. Meines Erachtens bedürfen wir für den Prozess einer sozial-ökologischen Transformation mehrere Jahrzehnte. In den ökonomisch wohlhabenden Ländern geht es ja darum, neue attraktive Produktions- und Lebensweisen zu schaffen, um die „imperiale Lebensweise" zu überwinden.[11] Dafür legen wir heute die Grundlage und dafür benötigen wir Einsichten und Lernprozesse, an vielen Stellen wahrscheinlich auch Konflikte. Das gelingt nur, wenn die relevanten Gesellschaftlichen und politischen Akteure beteiligt werden. In Deutschland etwa die Belegschaften und Gewerkschaften bei der notwendigen Konversion der Automobilindustrie. Das geht nicht nur mit Experten, sondern mit breiten öffentlichen Diskussionen, aber auch mit internen beispielsweise innerhalb der Gewerkschaften, in denen dann zukunftsorientierte Positionen gestärkt werden.

[11] Brand, Ulrich / Wissen, Markus (2012): Global Environmental Politics and the Imperial Mode of Living. Articulations of State-Capital Relations in the Multiple Crisis. In: Globalizations 9(4), 547-560.

8 Thematic studies – Beyond the crisis – Some structural changes in the competitiveness of Luxembourg

8.1 Introduction

Luxembourg's external performances show a remarkable resilience. There is no doubt that they are based on real comparative advantages especially in the service activities. The dynamism of these activities that are undergoing a strong expansion compensates for the sluggishness experienced by the Luxembourg's main partners. The analysis of these performance indicators shows for example that the deterioration of the current account balance coincident with the crisis was particularly short and relative, compared to other countries. At the structural source of these outstanding results, there are different factors that went through particularly contrasting developments. For example, (nominal) unit labour costs increase faster than in neighbouring countries, Germany in particular. This rapid growth is the result of the relationship between the slowing evolution of labour productivity and that of a growing nominal wage. Payroll increases in particular result from a faster growth in quantity of jobs than in production. However, these elements are associated with a particularly modest rise in real wages. In fact, the ongoing dynamics are difficult to interpret if we do not distinguish between industry and services, and within each of these categories, the steel industry and the financial services must be analysed separately. It appears then that the results are partly due to the rapid increase in production and employment, supporting a strong and extensive expansion in a small number of sectors but also to a marked slowdown in the total productivity factors in the industry. The short contributions presented in this chapter shed light on several key aspects of Luxembourg's competitiveness and on the ongoing dynamics at the macroeconomic level - through the review of regular key indicators and the measurement of environmental performance - and at the microeconomic level of companies whose productive performance and capacity for innovation are at the root of the country's competitiveness. These contributions result from the work of the Statec Research team (EPR2), some of which are conducted together with the *Observatoire de la compétitivité*.

1. **The productivity of companies:** this contribution is a non-technical presentation of the preliminary results from the implementation of a new method to measure the capital stock in companies. The proposed method is based on the theory of production to assess the capital stock and establish the link between capital stock and productivity at the company level. It uses an algorithm that can either be used for the estimation and analysis of the productivity of companies or just for an estimate of the capital stock. In this preliminary stage, the method was applied to the analysis of the dynamics of productivity and capital formation in industrial firms in Luxembourg. The results show a significant growth of production in industry, this growth is mainly driven by the increase in intermediate inputs used and, secondarily, by the growth of total factor productivity. This study also provides a descriptive analysis of efficiency in the allocation of production factors and identifies a number of industry sectors with very low allocation efficiency.

2. **Classification of companies according to their technological skills:** this work proposes a ranking of Luxembourg companies based on their technological skills. Technological skills are analysed according to three dimensions: innovation skills, the ability to use advanced technology and human resource development. The ranking is achieved using data from the Community Innovation Survey conducted in Luxembourg, covering the period from 2006 to 2008. Companies were grouped into four classes according to their technological intensity using hierarchical clustering techniques.

3. **Determinants of electronic commerce and its impact on the economic performance of Luxembourg companies:** e-commerce has a prominent place in Luxembourg economy: establishment of AOL Europe Services, opening of a subsidiary of Amazon in 2003 and installation of iTunes Music Store by Apple in 2005. But beyond these important facts, what is happening in most companies in Luxembourg? What are the determinants of e-commerce and its impact on the economic performance of companies that have proposed and used it during the period 2007-2010? Data from the annual survey on information and communication technology (ICT) and data from the Community Innovation Survey (CIS) are the basis for the construction of a panel used to shed light on these issues. The results of the econometric model clearly indicate a positive and significant relationship between the adoption of e-commerce, in particular online shopping, and labour productivity of a company. This effect differs by industry. For instance, the sectors of electricity, gas and water, and commerce seem to be more likely to increase the revenue per head with online purchasing, and commerce seems to be more able to increase the economic performance with online selling.

4. **Eco-innovative companies:** indeed, if "innovation has long been regarded as a key element of economic performance and social well-being, it also emerges increasingly as a driver of green growth. Recently, industry leaders and policy-makers have seen [in innovation] a powerful lever to improve the environmental practices and performance of companies" (OECD 2010). The information collected from companies within the context of the Community Innovation Survey is the basis for exploratory work intended to identify the factors of eco-innovation. Preliminary results support the theory on several important respects, and in particular on the significant role of regulatory constraints in this area.

5. **Access to finance:** the determinants of access to finance for businesses were modelled from the data collected by the community survey conducted in 2010. The results show the influence of habits in funding research. So, companies that rely on external financing tend to do it regularly. Second, the survey shows that when a company decides to use external financing, in the vast majority of cases (88%), its applications are successful and, until 2010, though not unaware of the deterioration in economic conditions, the companies do not seem to have suffered from finance rationing or have reduced their demand for external financing.

6. The emphasis on green growth and sustainable development at the level of the highest international bodies calls for a reconsideration of the measurement of output and productivity at the macroeconomic level. This contribution goes back over the measurement of green GDP through the implementation of a non-parametric approach to compare **the environmental performance of the EU-15 countries and of the United States**. It shows that the choice of an index has a significant impact on productivity measures and on comparison of the resulting performance. For instance, for Luxembourg, the average annual growth of TFP measured over the period 1995-2010 is nil if it does not include any measure of environmental performance but becomes negative when greenhouse gas emissions are considered. In a sequential approach where technological declines are not possible, the average growth of total factor productivity is positive for Luxembourg.

8.2 A Note on Measuring Firm-Level Capital Stock and Productivity in Luxembourg's Manufacturing Sector[1]

8.2.1 Introduction

Firm-level productivity indices can be used as an empirical tool to analyze the determinants of growth as well as to observe ongoing microeconomic restructuring of an economy. Besides providing insights into micro- and macro-level production performance, empirical analysis of firm-level productivity contributes in our understanding of the patterns of factor allocation and creative destruction through which more productive establishments drive inefficient ones out of the market. In applied research, however, working with a firm-level productivity index is cumbersome because of several measurement issues among which measuring firm-level capital stock is of particular importance.

Capital stock at the firm level is often unobserved in the raw input-output tables, while reported capital data is generally based on some computational methods that utilize investment series or financial indicators together with various assumptions on the evolution of capital assets. Among these computational techniques, the perpetual inventory method (PIM) is probably the most common one, while its empirical application considerably deviates among alternative studies. This report is based on a preliminary draft of a paper from an ongoing project that offers a structural method to construct firm-level capital stock to be used in the estimation of productivity, which is also a version of the PIM. The aim of the paper is to adopt some inevitable assumptions of the PIM into a structural basis and to establish a link between the measurement of productivity and capital.

This report will summarize preliminary findings together with a discussion over the robustness of the results. Unlike the original paper, I do not fully describe the technical parts but mention them briefly within the technical notes. The next section describes the dataset and mentions the methodology briefly. Section 3 evaluates aggregate dynamics of the production factors as well as the total factor productivity in Luxembourg's manufacturing sector. Section 4 conducts the analysis at the firm level and provides descriptive statistics on factor usage and productivity. The final section studies the efficiency in the allocation of production factors among producers that is known to be an important source of productivity growth.

[1] Non-technical report from a work undertaken by Umut KILINC and that will be published in the STATEC series "Cahier Economique", Umut.Kilinc@statec.etat.lu.

8.2.2 The Dataset and the Perpetual Inventory Method

This analysis utilizes an aggregate and a micro level dataset. The aggregate data is based on National Accounts used in the LuxKlems project by DiMaria and Ciccone (2006) and Peroni (2012). The LuxKlems data is at the 2-digit industry level covering the period 1995-2010. It contains nominal observations for output, labor (in terms of number of employees), capital and intermediate inputs as well as input and output price indices for each industry. The firm-level data is the Structural Business Survey (SBS) that contains over 100 variables for the period 1996 to 2009. The SBS, however, includes a lot of imputed observations, extraction of which leaves an unbalanced sample of 388 firms and 3408 firm*time observations for all manufacturing sector. The firm-level variables used in this study are revenues, number of employees, intermediate goods and service expenditures, investments, sales of capital goods and amortization. Each nominal firm-level variable is deflated by respective 2-digit input or output price indices when necessary. Technical note 1 describes the method to construct the capital series at the firm level.

Technical Note
An Iterative Version of the Perpetual Inventory Method

The PIM method defines that the capital stock at the end of time t consists of the undepreciated part of previous period's capital plus net investments.

$$k_{it} = (1-\delta)k_{it-1} + I_{it} \qquad (1.1)$$
$$= (1-\delta)^t k_{t0} + \sum_{j=1}^{t}(1-\delta)^{t-j} I_{ij}$$

In the above equation, k, I and δ are the ex-post capital stock, investment and the rate of depreciation.

The first step of the algorithm finds an initial value of the aggregate capital of the sample ($K_0 = \sum_i^N k_{i0}$) that is to be disaggregated to obtain firms' initial capital stock. The procedure starts with a reduced form production function that is defined at the macro-level.

$$\frac{\Delta Q_t}{Q_{t-1}} = s_t\left(\frac{\Delta L_t}{L_{t-1}} - \frac{\Delta K_t}{K_{t-1}}\right) + \lambda\frac{\Delta K_t}{K_{t-1}} + \frac{\Delta \Theta_t}{\Theta_{t-1}} \qquad (1.2)$$

In equation 1.2, Q_t, L_t and K_t represent value added, labor and capital at the sector-level, Θ_t is the total factor productivity, s_t is the labor expenditures' share in revenue and λ is the total returns to scale parameter. Equation 1.2 is based on Hall (1988) and can be defined under certain conditions. Using equation 1.2, one can retrieve the growth rate of total sample capital ($\Delta K_t / K_{t-1}$) for given λ and aggregate TFP growth rates ($\Delta\Theta_t / \Theta_{t-1}$) which are initially assumed in the first step and will be updated in the later steps of the iteration. An initial guess for $\Delta K_t / K_{t-1}$ is calculated by assuming constant returns to scale ($\lambda^{(0)} = 1$)and an initial value for $\Delta\Theta_t / \Theta_{t-1}$ is calculated using LuxKlems data.

The second step starts with defining the equation of motion for aggregate capital stock, $K_t = (1-\delta)K_{t-1} + I_t$, which can be written in the following form.

$$K_{t-1} = \frac{I_t}{\frac{\Delta K_t}{K_{t-1}} + \delta} \qquad (1.3)$$

In equation 1.3, I_t is the total sample investments (net of capital sales) and δ represents the aggregate rate of depreciation that is estimated by solving a non-linear minization problem.

The third step disaggregates the initial capital over firms using their intermediate input shares in the sector. In this step, I combine the initial capital and investments to form firm-level capital through equation 1.1.

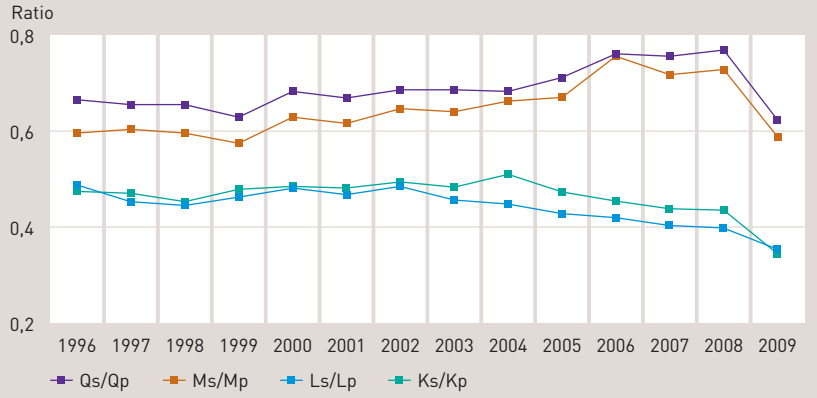
The above procedure provides an initial guess for firms' capital stock ($k_{it}^{(0)}$). In the final step of the algorithm, I estimate the following Cobb-Douglas type production function ($v_{it} = \theta_{it} l_{it}^{\beta} k_{it}^{\alpha}$) using the initial approximation of the capital stock, where v_{it}, l_{it} and k_{it} represent firm-level value added, labor and TFP, while β and α are the respective factor elasticity parameters. I estimate the production function using Levinsohn and Petrin's (2004) method and the programming routine provided by Poi et al. (2008). The final step, therefore, provides the initial estimates of the factor elasticities, $\beta^{(0)}$ and $\alpha^{(0)}$, and the firm-level TFP ($\theta_{it}^{(0)}$).

The estimation results retrieved in the final step are used to update the initial guesses of λ and $\Delta\Theta_t / \Theta_{t-1}$ that were employed in the first step of the algorithm. The iterative algorithm is run with the updated values $\lambda^{(1)}$ and $\Theta_t^{(1)}$, and new values for β and α are retrieved in each iteration. The iteration continued until the factor elasticity parameters β and α converge. The estimated values of the factor elasticities in the final iteration are $\hat{\beta} = 0.673$ and $\hat{\alpha} = 0.348$, and the bootstrapped standard errors are 0.048 and 0.077 respectively.

8.2.3 Aggregate Dynamics

Chart 1 provides the sample to population ratios of output (Q), intermediate inputs (M), labor (L) and the constructed capital stock (K) by the iterative algorithm. As before, "the sample" represents the set of firms in the SBS firm-level dataset that is the main concern of this study. "The population", however, is the macro data that is reported at the sector-level and is referred to LuxKlems database. In both datasets, the output is measured by total turnovers deflated by producers' price index at the 2-digit industry level. The intermediate inputs are the total expenditures on materials and services used without any additional processing. It is deflated by intermediate input's price index at the 2-digit level. Labor input is in terms of the annual average of the number of employees. The investment series used in the construction of capital stock is deflated by 2-digit capital input deflator that is taken from LuxKlems database.

Chart 1
Sample to population ratios



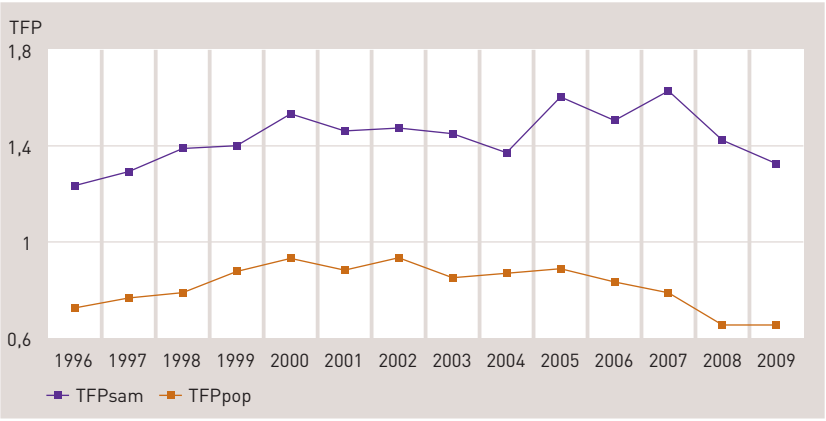
Source: Author's calculations based on SBS and National Accounts database

According to Chart 1, the ratio of the sample to population capital (Ks/Kp) follows a time path that is similar to labor and exhibits a declining pattern after 2002. Conversely, the sample to population shares of output and intermediate inputs are continuously increasing over the sample period except in the year 2009. Since intermediate input is a more flexible factor of production, it instantly reacts outside shocks and follows a similar time path with the output. For instance, if a manager of a firm observes a negative demand shock, she can cut back the amount of output produced and the usage of intermediate inputs. The number of employed workers or the amount of acquired capital stock that can be in the form of a machinery, building, land, vehicle or office supply, however, might not be possible to adjust as quickly as the intermediate inputs.

The two quasi fixed production factors, labor and capital, therefore, behave differently over time. In particular, the gap between fixed and flexible factor shares of firms expands in the second half of the sample period. This may indicate that the coverage of the SBS database shrinks, or relatively inefficient establishments are replaced by more efficient ones in the later periods of the sample.

However, there is no such a dramatic firm turnover for the population, namely for the entire sector including the unobserved production units. Alternatively, it may be the case that the firms in the sample start producing more output with fewer amounts of inputs after 2002 which may be due to a positive productivity shock that only hits particular firms in the economy. Chart 2 shows the aggregate productivity trends in the sample and population.

Chart 2
Sample vs. population productivity

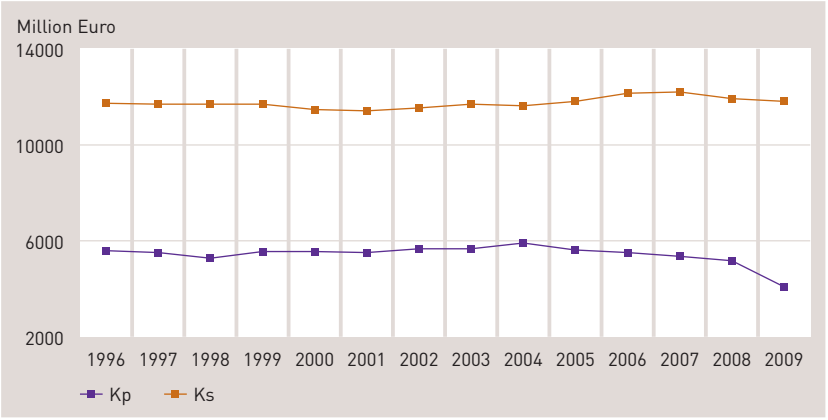


Source: Author's calculations based on SBS and National Accounts database

Chart 2 provides evidence that the sample is populated by the sector's more productive producers, so that the average productivity of sample is higher than those of the population for all the years. In particular, the deviation of the sample from the population becomes more severe after 2002. One reason for this is that smaller firms that are potentially less productive are not included in the database. Moreover, it may be also the case that relatively inefficient firms that are in the sample before 2002 exit the market afterwards. It is also arguable that the recent global financial crisis (2007-2012) causes some firms to shrink and disappear from the sample, while they are actively operating in the market and are accounted for in the aggregate statistics. The TFP gap between sample and population, therefore, is larger in the periods after 2002 with a sharp decline in the sample in 2009. The SBS data regarding the year 2009, however, is subject to measurement errors and is not expected to provide reliable information.

Chart 3 displays the time paths of the sample and population capital. In line with the previous discussions, the aggregate capital stock of the sample notably decreases in the period after 2002 during which it slightly increases for the population. Excluding the year 2009, there is a noticeable downward trend in the total sample capital starting from 2004, which indicates that capital is reallocated from the sample firms to the firms of Luxembourg that are out of the SBS data. Nevertheless, it is possible to conclude that the capital follows a rather stable pattern that is captured in both lines of Chart 3, which is also consistent with the economic theory that capital is a rather fixed factor of production.

Chart 3
Sample vs. population capital

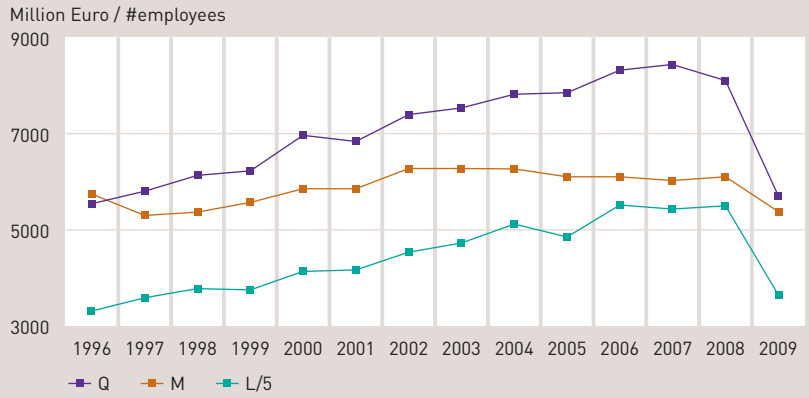


Source: Author's calculations based on SBS and National Accounts database

Chart 3 also provides information, at some degree, on the robustness of the assumptions used in the measurement of the capital stock. If one would start with an assumption of initial capital that is much lower than the real value, I would expect the aggregate capital to rapidly increase in the first years of the sample and follow a stable path in the last years. This is because the share of the initial capital in total capital stock of a given year decreases considerably as time passes, because more recent years' capital stock rely more on actual data rather than the assumption. Similarly, if the assumption of initial capital would be too high, there would be an immediate decrease in the sum of sample capital in the first years'. The initial capital assumption made in this paper, however, is on the long-run path of the sample total of the capital stock and is not followed by any dramatic fluctuation.

Chart 4 displays the total sample output, intermediate inputs and labor for the period between 1996 and 2009. Unlike the capital stock, firms' total output and intermediate inputs increase significantly until 2007, while labor follows a rather stable time line until 2008. However, the difference between total output and intermediate inputs, which is identical to the total value added, do not change noticeably. Therefore, the boom in output until 2007 seems to be mostly driven by the increase in intermediate input usage of manufacturing firms. A more detailed analysis is required to discover the reason behind the distinctive behavior of intermediate input usage for instance, a sharp decrease in international prices or a positive supply shock may be responsible for the upward shift observed in the chart. It is also possible that the barriers on the reallocation capital and labor are large enough to restrict firms to increase their input usage proportionally. The increased demand, therefore, is met by a rise mostly in the usage of the intermediate inputs.

Chart 4
Input-output sample totals, 1996-2009



Source: Author's calculations based on SBS and National Accounts database

8.2.4 Firm-Level Capital and Productivity Dynamics

This section presents and discusses the results at the firm level. In addition to the constructed capital stock, in this part, I also analyze a productivity index retrieved from an estimation methodology based on Levinsohn and Petrin (2003) and using the programming routine by Poi et al. (2008). The total factor productivity (TFP), therefore, is estimated by a control function approach using value-added version of a Cobb-Douglas production function. Moreover, I introduce a labor productivity index into the analysis that is the ratio of value-added to total number of employees in a given firm and year.

Table 1 presents the mean, standard deviation and the coefficient of variation for the firm-level variables and productivity indices. Labor is reported in terms of number of employees, and all other production factors are in 1 million LUF deflated by 2-digit input and output price indices. STD represents the standard deviation, C.Var. is the coefficient of variation that is STD divided by mean.

The coefficient of variation is used to measure dispersion in the respective variables. Accordingly, capital is the least dispersed production factor, while labor is the second least and intermediate input is the most dispersed input. This is in line with the previous discussions, so that capital stock is expected to be mostly fixed over time due to high adjustment costs, financial constraints and sunk costs of investing in new capital stock. Labor is also partially fixed especially when it is measured by number of employees due to various hiring and firing costs. Consistent with the production literature (e.g. Olley and Pakes, 1996; Levinsohn and Petrin, 2003) intermediate inputs are found to be the most variable factor of production that would also serve a good proxy for the unobserved productivity.

Table 1
Descriptives (Million Euro, #employee)

Variables	Mean	STD	C.Var
Output	28.96	79.77	2.76
Intermediate I.	18.20	51.98	2.86
Labor	121	255	2.11
Capital	27.27	48.07	1.76
Labor Prod.	2.72	4.41	1.62
TFP	1.31	1.03	0.79

Source: Author calculations based on SBS database

The degree of the dispersion in productivity provides valuable information for the analysis of the productivity performance of an industry. In a perfectly competitive, frictionless market, production factors would be accumulated in the most productive establishments, so that the industry attains the highest possible productivity level for a given production frontier. In real industries, however, producers exhibit different productivity performances with different factor shares. The driving forces of the dispersion in producers' productivity, therefore, are also determinants of the productivity performance of an economy.

The coefficient of variation (C.Var.) displayed in the last column of Table 1 is a measure of dispersion or the degree of heterogeneity in firms' productivity performances. Accordingly, the dispersion is higher in the TFP index than in the labor productivity. This is somewhat an expectable result, because firms' can exhibit heterogeneity in terms of their production technology. Some firms' may use labor more intensively in the production, while there are also capital-intensive establishments operating in the same industry. As a ratio of output to labor, the labor productivity index may reflect low-productivity for labor intensive producers and vice versa. In a labor-intensive production process, however, capital is used less intensively, so that the TFP index balances the extreme values in the labor productivity and exhibits a less-dispersed distribution.

When productivity is dispersed in an industry, it is also important to know whether there is a proportional dispersion in the factor shares. This is because the weighted average of productivity (the aggregate productivity) depends not only on absolute values of the productivity index but also on the weights of each firm in the sector. The search for a positive correlation between producers' factor shares and productivity, namely, an analysis of the allocative efficiency in Luxembourg's manufacturing sector will be elaborated in the next section. Table 2 displays the correlation coefficients among alternative firm-level variables to obtain preliminary insights on the efficiency in resource allocation and to robustness checks on the measurement method of capital applied in his paper.

Table 2
Correlation C. (Variables in Logs, #obs=3408, #firms=388)

	Int. Inputs	Labor	Capital	Labor Pr.	TFP
Output	0.97	0.86	0.88	0.45	0.31
Int. Inputs		0.81	0.88	0.41	0.23
Labor			0.75	0.10	0.13
Capital				0.37	0.04
Labor Prod.					0.85

Source: Author calculations based on SBS database

Table 2 provides correlation coefficients among the logs of firm-level variables used in this analysis.[2] The results show that the correlation between output and capital is 0.88, while the correlation of capital with labor is slightly lower 0.75. Intermediate input exhibits the highest correlation (0.23) with the TFP and (0.41) LP among all other production factors. As the least variable factor of production, capital is expected to exhibit slow response to instant productivity shocks. Results in Table 2 shows that capital exhibits a significant correlation of 0.04 with TFP and 0.13 with labor productivity. As the other quasi-fixed factor of production, labor also exhibits relatively weak but significant correlation with the two productivity indices.

8.2.5 Descriptive Analysis of the Efficiency in the Allocation of Production Factors

This section evaluates the efficiency in the allocation of production factors within the manufacturing industries of Luxembourg. In an industry with efficient allocation of production factors, one would expect to see more productive establishments to accumulate a higher share of production factors. The efficient allocation then would mean that most of the resources in an industry are used in a productive way, namely, by the most efficient producers.

Recently, a large literature has emerged showing that much of the differences in income per capita among countries can be explained by the efficiency in the factor allocation (e.g. Banerjee and Duflo, 2005; Jeong and Townsend, 2007; Alfaro et al., 2008; Hsieh and Klenow, 2009; Bartelsman et al., 2009). Various factors such as the level of competition, the degree of openness to trade, entry-exit costs and barriers to firm development are found to be the determinants of allocative efficiency and directly related to the quality of the institutional and regulatory environment. These factors or their impact on firm dynamics, however, may significantly differ among the industries of an economy.

In the section, I utilize a productivity decomposition methodology in order to quantify the allocative efficiency. The method provides the covariance between productivity and factor shares of producers in the industry. A higher index (OP-gap) value, therefore, corresponds to a more efficient allocation of production factors. Technical Note 2 explains the details of the methodology.

[2] Table 2 displays absolute correlation coefficients among the variables, while I also calculated partial correlation coefficients using time and industry dummies. Results do not significantly vary with partial correlations.

Technical Note 2
Olley-Pakes Productivity Decomposition

Olley and Pakes (1996) decompose aggregate productivity into two components that are the unweighted average productivity and the covariance term that is referred to the OP-gap.

$$\sum_{i}^{N} s_{it}\theta_{it} = \bar{\theta}_t + \sum_{i}^{N}\left(s_{it} - \bar{s}_t\right)\left(\theta_{it} - \bar{\theta}_t\right) \qquad (2.1)$$

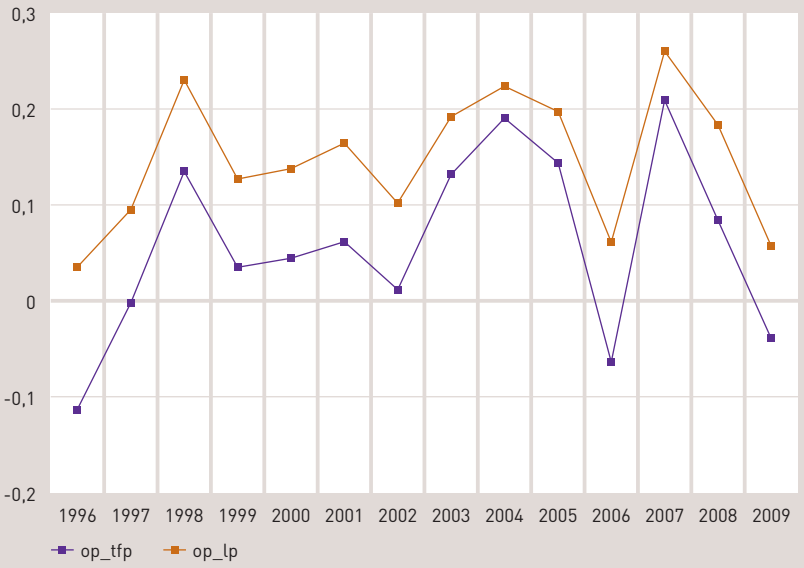
In equation 2.1, $\bar{\theta}_t = \sum_i^N \theta_{it} / N$ is the unweighted average productivity, s_{it} is the market share of firm in the sector, N is the total number of firms and $\bar{s}_t = 1/N$. The main concern of this part is the last term on the right hand side of equation 2.1, the OP-gap. By calculating the covariance between the market share and productivity, one can retrieve an index to measure whether firms that have larger shares in an industry are also more productive. In other words, the OP-gap measures the static efficiency of an industry for a given point in time.

In the calculation of the OP-gap, I consider productivity in logarithms and retrieve the covariance term annually for overall manufacturing sector. In the second step, I calculate annual OP-gap for each 2-digit industry and then average the result over time. In the calculation of OP-gap with labor productivity, firms' labor shares are used as the weights, while composite input shares, $s_{it} = l_{it}^{\beta} k_{it}^{\alpha} / \sum_i^N l_{it}^{\beta} k_{it}^{\alpha}$, are used in the TFP based OP-gap calculations.

Chart 5 depicts the results of the decomposition methodology. In order to quantify the allocative efficiency, one needs a productivity index. Throughout the discussion in this paper, I utilize a TFP and a labor productivity index, both of which are also used in the OP-gap calculations. The orange line in Chart 5, therefore, represents the OP-gap in terms of labor productivity and the purple line is the OP-gap based on the TFP index.

The covariance between market share and productivity can be considered as a countercyclical component. This is because the least efficient firms are the ones that first exit the market during a recession period, while their share in the economy can be expected to be highest by the end of economic booms. According to Chart 5, labor productivity and TFP based covariances follow similar time paths with significant downturns in 2006 and 2008. Taking 2007 as the starting point of recent global financial crisis (2007-2012), one can attribute the decrease in the allocative efficiency in 2006 and the increase in 2007 to the firm-level turnover due to financial distress. The significant downturn in 2009, however, is hard to interpret with available data due to previously mentioned issues in data collection.

Chart 5
Olley-Pakes decomposition



Source: Author's calculations based on SBS database

Chart 5 shows two distinctive periods in the Op-gap's time path. The first one covers the years between 1996 and 2004 where the allocative efficiency follows and overall increasing time path with a one-year peak in 1998 and an instant temporary drop in 2002. In the second period starting from 2005, however, OP-gap is more volatile and no significant upward trend is observed for the firms in the sample. This would mean that there have been no productivity gains from factor reallocation realized in the recent years in manufacturing sector of Luxembourg.

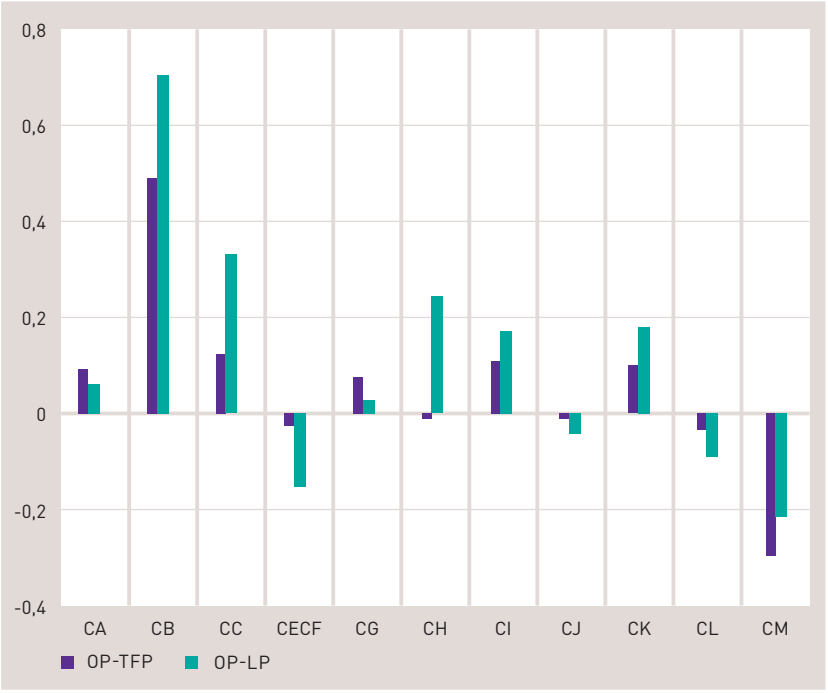
According to Chart 5, the time path of OP-gap based on TFP is below the curve representing OP-gap with labor productivity for all time points in the sample. Therefore, introducing capital into the analysis further worsens the allocative efficiency, while in some periods the TFP based OP-gap takes negative values indicating a negative correlation between size and productivity.

The OP-gap drops down immediately for instance, when a highly productive firm with a large market share exits the industry. Such cases may happen in times of economic distress where some producers of the economy suffer from adverse shocks asymmetrically. Alternatively, frictions on firms operative activities may stem from poorly designed institutional and regulatory environment, inefficient tax system or policy failures that prevent efficient firms to shrink or exit while providing expansion opportunities to inefficient ones.

These frictions can be in the form of implicit or explicit liquidation cost, taxes or mandatory payments that reduces the value of an exit decision (the expected gains from exiting the market) for inefficient units.

In addition, firms that receive subsidy or favorable treatment from regulatory authorities may be responsible for disrupting the efficiency in the allocation. Bartelsman et al. (2004) finds that the OP-gap in transition economies is significantly lower than in Western European countries due to the inefficiently large firms that are mostly established during the planned period and continue to operate without private incentives. Moreover, the productivity gap between the U.S. and Western Europe is attributed to the inefficiencies in the factor allocation of production factors (e.g. Bartelsman et al., 2005). Thus, the OP-gap comparisons among economies or industries provides valuable information on the regulatory environment and the degree of implicit or explicit frictions affecting firms' survival decisions, even though these factors are not observable for researchers.

Chart 6
Olley-Pakes decomposition at 2-digit



Source: Author's calculations based on SBS database

Chart 6 provides a closer look at the factor allocation dynamics in manufacturing industries of Luxembourg. The labels on the horizontal axis represent 2-digit industries with respect to NACE rev.2 sector classification. Accordingly, the OP-gap calculations significantly vary among 2-digit manufacturing industries with 4 industries having negative OP-gap according to both labor and total factor productivity. Although the OP-gap based on TFP is in general lower than the labor productivity based OP-gap, the introduction of capital into analysis do not significantly alter the distribution of OP-gap values among manufacturing industries and the story line stays the same with alternative indices. The analysis of the factors behind the low efficiency in the allocation of resources in some particular industries is in the research agenda and will be studied together with the quality of the overall institutional and regulatory framework in the future papers.

8.2.6 Conclusions

The analysis of productivity and efficiency in the allocation of production factors is crucial to understand the dynamics of the ongoing microeconomic restructuring in an economy. The robustness of the findings from such an analysis, however, depends on consistent measurement of firm-level variables including capital stock and total factor productivity. This study attempts to construct firm-level capital stock series from investment data using the perpetual inventory method. Unlike the original approach, this paper accommodates the inevitable assumption into a structural basis. This is done by introducing the theory of production into the evaluation of capital and obtaining a total factor productivity index together with the capital stock.

The preliminary results of this ongoing project show that the total output produced by the manufacturing firms in the sample increases considerably during the period between 1996 and 2008. The increase in the output of Luxembourg's manufacturing sector, however, was mainly driven by an increase in the usage of intermediate inputs and partially by an increase in the total factor productivity. The two quasi-fixed factors of production, the number of employees and the capital stock is rather fixed over time. The aggregate total factor productivity of the manufacturing sector displays an increasing pattern until the last three years of the sample period, while it fluctuates considerably in recent years. This may be due to the recent financial distress that causes a number of producers shrink or exit the market, so that the average of productivity follows a volatile time path.

In line with the standard theory, the usage of intermediate inputs exhibits the highest correlation with productivity, while the correlation between productivity and labor or capital is rather weak at the firm level. This is mainly because firms can quickly alter their intermediate input usage according to productivity shocks, but the adjustment of capital and labor is slow due to hiring and firing expenses, sunk and liquation costs.

The efficiency in the allocation of production factors among producers is an important determinant of productivity. A more efficient allocation would shift the producers of an economy towards a given technological frontier which in turn raises the overall productivity of the sector and fosters the economic growth. The allocative efficiency is calculated to be in an increasing trend with a sharp fall in 2006 followed by a peak in 2007. I attribute these movements in the efficiency of the allocation to the recent financial crisis that clears the market out of inefficient unit. The low-productivity producers, therefore, shrink or exit during the crisis period which leads a dramatic difference in the allocative efficiency index between any two years.

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8.3 A taxonomy of manufacturing and services firms in Luxembourg according to technological skills[1]

8.3.1 Introduction

Developed economies are evolving into "knowledge economies where skills, human capital, and innovativeness are prerequisites for success" (Baldwin and Gellatly, 2000). This process however is not uniform across industries and also involves important changes in the structure of the economies.

This short article presents a taxonomy of firms in Luxembourg based on their technological skills. This classification is achieved using a multidimensional approach (Baldwin and Gellatly, 2000) which measures technological skills according to three dimensions:

1) Innovation competencies, that is, the ability to improve or introduce new products or processes.

2) Technology used, which measures the ability to apply advanced technologies.

3) Human capital development: this dimension captures the ability to develop human capital strategies, such as hiring skilled workers or developing training programs to allow employees to work with the new technology developed or used.

A classification of industries based on technological skills is relevant to innovation policy. Governments are interested in undertaking policy measures to foster innovation. This is because innovation and technological progress are viewed as an important determinant of economic growth (Solow, 1956; Romer, 1990). Indeed, increases in output (GDP) can be achieved in two ways: 1) increasing the amount of inputs used in the production process, or 2) obtaining more output from the same amount of inputs. The latter is related to technological skills and innovation. Although technological and innovation activities are decided and controlled by the firms themselves, policies can influence firms' technological skills. Public funding and new regulations can motivate firms to develop more their technological ability. Furthermore, innovation policies are undertaken by governments in order to maximise the consumer surplus and the profits of firms (Tirole 1988). The direct effect of innovation policies is to increase the firms' profits and by consequence increase total wages and taxes.

Innovation policies however affect different industries in different manners. One may also argue that they are better targeted to those industries/firms that are more likely to maximize the innovation effort. For these reasons, it is important to study how innovation and technological skills vary across industries.

[1] Short resume of the Master thesis presented by Sarah El Joueidi at the Department of Economics (Luxembourg University) and developed during her stage in STATEC.

An element of complication of this analysis is that the intensity and effectiveness of technological innovation is related to variables such as competitiveness, market structure, etc. Schumpeter (1943) considers that policy makers should accept less competition within industries in order to motivate innovative behaviour. Romer (1990) argues that large market leader firms perform most of the innovations. The link between market structure and competitiveness of industries to innovation behaviour is very much debated.

This issue is important for Luxembourg. So far, no specific classification based on technological skills exist for our country. Luxembourg is a small open economy which is characterised by a rate of exports of goods and services equal to 165% of GDP in comparison to an average of 40.6% for the Euro area in 2010[2]. Furthermore, 49.7% of firms report to sell more goods and services in international market than in national market[3]. Luxembourg economy is also highly specialised and dominated by banking activities, insurances and investment funds; the financial industries account for about 30% of value added (OECD, 2008). According to Peroni (2012) who analyses the productivity and competitiveness in Luxembourg from 1995-2010, Luxembourg uses inputs in a fully efficient way since 1995. Thus, the country is on the productivity efficient frontier. As a result, the sole manner to improve competitiveness is to achieve a sustained rate of technological progress. Thus, Luxembourg is expected to perform a high innovation effort to continue to be competitive in international market. Because of the importance of services in Luxembourg, a classification of technological skills for both manufacturing and services industries is needed.

8.3.2 Taxonomies in the economic literature

The economic literature propose different methods to achieve classifications of firms or industries based on technological skills. Peneder (2003) argues that there are two reasons for the creation and use of industry taxonomies: first, "industrial taxonomies facilitate investigations into the impact of specific characteristics of the market environment on the economic activity" (Peneder, 2003). So, classifications condense all information about technological skills of industries and they allow to identify similarities and differences between industries. Taxonomies are also useful to compare data with different format across countries. Despite the benefits of taxonomies, in the field of economics (unlike in biology, psychology or sociology), there is little methodological discussion about it. In the literature, industry classifications are used in empirical studies on competitive performance (e.g.: Aghion et al., 2005), technological development (e.g.: Malerba and Orsenigo, 1996), international trade (e.g.: Lawrence, 1984), and industrial economics (e.g.: Davies and Lyons, 1996). In competitive performance studies, research tries to find whether there is or not a relationship between competition and innovation using a classification of industries to control the fixed effect of the behaviour of industries to innovate (OECD[4]).

[2] Net exports of goods and services for Luxembourg are 7.73% of GDP and -0.3% of GDP for the Euro area. Data are from The World Bank for 2010.

[3] Source : Data are from Community Innovation Survey for 2004-2006.

[4] The project "Market incentives to innovate", OECD Working Party on Industry Analysis- OECD-WPIA.

Concerning, the technological development field, Malerba and Orsenigo (1996) define a technological regime as dependent on the technological environment. They describe the technological regimes of industries by the characteristics of the process of innovation. To study the technological development of industries, they compare industries classification based on the process of innovation during several periods. International trade studies the factor intensities such as capital, labor, or natural resource. This field classifies generally goods in two groups: Ricardo goods which needs resource intensively to be produced and Hecksher-Ohlin goods which use standardized production technologies. However, Lawrence (1984) adds a group of high technology goods, which is characterized by a high proportions of R&D or R&D employees to be produced. In industrial organisation, Davies and Lyons (1996) try to see the impact of competitive mechanisms on concentration, integration, diversification and multi-nationality. In order to consider the product differentiation, they created a taxonomy which groups industries according to the intensity of intangible R&D expenditures.

The most known taxonomy is the Pavitt classification, which classifies manufacturing industries in four main categories: supplier dominated, production intensive, specialized suppliers, and science based. The first one is the least innovative group. Pavitt (1994) argues that different principal activities generate different technological behaviours. These differences in technological behaviour are explained by sectoral differences in three characteristics: sources of technology, requirement of users, and means of appropriating benefits.

However, according to Archibugi (2000), Pavitt's classification presents some drawbacks.

First, Pavitt's taxonomy classifies only innovating firms. It does not take into account non-innovative firms. Moreover, some papers (Geroski et al., 1997; Malerba and Orsenigo, 1999) demonstrate that the intensity and persistence of innovation varies highly during the years. Hence, excluding non-innovative firms prevents us from analysing the change in the innovation behaviour of firms. Second, for convenience, Pavitt groups firms into industries on the basis of their main output. However, industries' classification does not take into account the heterogeneity within the industry. Indeed, Archibugi (2000) argues that "two firms can be in the same industry without using the same technological base; e.g. slippers and moon-boots belong to the footwear industry". Pavitt (1994) rightly states about his taxonomy "its weakness is the high degree of variance found within each category".

The second important classification is the OECD taxonomy revised by Hatzichronoglou (1997) using research and development (R&D) intensity as an indicator of innovation. The aim of this classification is to try to identify the technological intensity of manufacturing industries to analyse the impact of technology on industrial performance. Indeed, Hatzichronoglou(1997) argues that firms which are technology-intensive innovate more, win new markets, are more productive and offer higher remuneration to their employees. Hence, to be able to compete on international trade an industry should be innovating. Moreover, an innovating sector could lead to an improvement in performance for other sectors by spillover effect (externalities).

The OECD sectoral approach groups industries in four groups: i) high-technology, ii) medium-high-technology, iii) medium-low-technology, iv) low-technology. I believe Archibugi (2000) remark concerning the within industry heterogeneity of industries classification is also applicable in this case.

The use of Pavitt's ane OECD taxonomies in Luxemboug poses several problems. Firstly, Luxembourg's financial sector is the main driver of the Luxembourg economy. Secondly, Luxembourg economy is characterised by heterogeneity in structures between manufacturing and services sector and heterogeneity in technological behavior within each industry.

In Luxembourg, the service industry accounts for two thirds of the economy's value added with a financial industry which represents 26,3% of value added and 11% of total employment. Luxembourg is the largest financial centre in the Euro zone and one of the most important in the world (OECD Economic surveys, 2008). Thus, to preserve this important rank among international financial centers, and because all inputs are already used efficiently (Peroni, 2012), financial firms should be more innovative. The latter statement is consistent with the Community Innovation Survey (CIS) for 2006 which highlights that more than 65% of financial firms are engaged in innovation activities. The structure of manufacturing and services industries are quite different. Luxembourg's services industry contains a large number of small firms whereas manufacturing industries are often dominated by few big firms alongside of several small firms (Peroni, 2012). Indeed, there are 853 manufacturing firms which account for 3.2% of total firms opposing to 19 600 services firms which represent 73.6% of total firms. 12% of manufacturing firms employ more than 50 employees. In contrast, there are only 1.88% of services firms which employ more than 50 workers[5].

Other taxonomies have been also created. For example, Evangelista (2000) develops a services industries classification using a cluster analysis. From 1990, due to the implementation of innovation surveys, data become available. Thus several papers (e.g.: Cesaratto and Mangano, 2003) developed classifications of technological behaviour at the firm level as argued explicitly by Archibugi (2001) to avoid heterogeneity.

[5] Source: STATEC, Répertoire systématique 2008 : les entreprises luxembourgeoises.

8.3.3 A first description of Luxembourg firms

This article classifies firms surveyed in Luxembourg's Community Innovation Survey (CIS) for the year 2006-2008. This database contains some basic firms information: the name of the company, its main activity and primary market in which it operates. The CIS includes variables describing the effort and the output of innovation, such as product and process innovation, innovation activity and expenditures, effects of innovation, organisational innovation, marketing innovation, knowledge management, etc.[6] The sample includes 576 firms, of which 19.7% operate in the manufacturing sector and 80.3% in the services.

Table 1
Structure of firms in the CIS 2006-2008

		Percent
	Foreign-owners	33.4
	National Market	51.0
	International Market	49.0
Industry	Manufacturing	19.7
	Total services	80.3
	Wholesale and Retail	19.4
	Transport	20.7
	Financial	20.2
	IT consulting	20.1

Source: Author's calculation from CIS data for 2006-2008

Table 1 shows that 33.4% of firms have their headquarters abroad and thus can be categorized as foreign-owned companies. 49.0% of firms have as primary market the international market, whereas 51.0% of firms earn the majority of their turnover in Luxembourg. The services industry in Luxembourg counts for 80.3% of total firms. Concerning the size of the firms in Luxembourgish economy, 71.4% firms have between 10 and 49 employees (data are available from the authors).

Table 2
Percentage of innovating firms on total firms by sector and size

		% of innovators	% of product innovators	% of process innovators
	All firms	44.1	35.2	34.6
	Foreign	52.7	44.2	42.9
	National Market	34.8	26.8	26.9
	International Market	53.7	43.8	42.5
Industry	Manufacturing	44.5	34.7	36.4
	Total services	43.1	34.5	33.8
	Wholesale and Retail	29.8	24.6	25.7
	Transport	33.9	20.1	26.9
	Financial	60.4	52.7	47.6
	IT consulting	51.4	43.5	36.1

Source: Author's calculation from CIS data for 2006-2008

[6] Eurostat: CIS Regulation No 1450/2004. The CIS considers only firms with more than 10 employees and positive turnover at the end of the period covered by the innovation survey. Moreover, for confidentiality issue the electricity, gas and water supply industry has been withdrawn due to small number of firms.

One important feature emerging from table 2 is that 44.1% of firms innovate in 2006-2008. In average, in 2006-2008 the share of firms that innovate in products is equal to the share of firms that innovate in process, respectively 35.2% and 34.6%. It is also relevant to point out that the share of innovating firms which earn in majority their turnover from Luxembourg (National market) is 34.8%. The percentage of innovative firms which have their headquarters abroad is equal to 52.7%. Another important feature is that innovation in manufacturing industries and services sector are approximately the same, respectively 44.5% and 43.1%. In this table, a remark can be done on the heterogeneity within the services industry; 60.4% of financial firms are innovative whereas only 29.8% of wholesale and retail firms innovate. The general hypothesis made in the literature that the shares of innovating firms increase with the size of firms is verified. Indeed, only 42.9% of firms which have between 10-19 employees make an effort of innovations whereas 81.1% of firms with more than 249 employees innovate (data are available from the authors).

Table 3
Characteristics of R&D and technological expenditures, in 1000 euros

		R&D and technological expen.			R&D per emp.	R&D/ turnover
		Mean	**Std. dev.**	**Median**	**Mean**	**Mean (%)**
	All firms	1 220	282	150	10	0.78
Industry	Manufacturing	2 029	912	213	10	0.62
	Total services	1 067	284	100	9	0.89
	Wholesale and Retail	205	80	41	4	0.69
	Transport	511	200	48	3	1.60
	Financial	1 176	305	450	7	0.41
	IT consulting	1 629	823	100	36	11.63

Source: Author's calculation from CIS data for 2006-2008

In table 3, firms spend on average 1 220 000 euros (about 0.78% of firms' turnover). This result should be considered with special care, information might be biased due to big R&D performers. Indeed, in order to have an idea about the importance of this issue, the medians of total R&D expenditures by sector are also reported. Thus, 50% of firms spend 150 000 euros in R&D. This means that the distribution of the total R&D expenditures is also skewed but less than in 2004-2006 where the median was equal to 0 euros.

The manufacturing industry has invested twice as much on R&D that the services industry, 2 029 000 euros for the manufacturing industry and 1 100 000 euros for the services industry. This table also shows evidence of heterogeneity in services industries. Financial firms spend 1 176 000 euros (6.00% of turnover) whereas wholesale and retail spend 205 000 euros (0.3% of turnover).

Table 4
Mean of R&D in-house expenditures, acquisition of R&D, acquisition of machinery and external knowledge, in 1000 euros

		Mean of R&D expenditures		Mean of acquisition	
		in-house	extramural	Machinery	external knowledge
	All firms	637	141	351	91
Industry	Manufacturing	1 542	56	405	26
	Total services	437	168	351	111
	Wholesale and Retail	17	22	123	42
	Transport	45	148	276	42
	Financial	471	207	348	150
	IT consulting	822	192	484	131

Source: Author's calculation from CIS data for 2006-2008

Table 4 shows that firms spend more in in-house R&D expenditures (637 000 euros), followed by acquisition of machinery (351 000), R&D extramural (141 000 euros) and acquisition of external knowledge (91 000 euros). Manufacturing industry spends 1 542 000 euros in in-house R&D. In contrast, total services industry spends only 437 000 euros in in-house R&D. However, total services industry acquires more external knowledge than manufacturing, respectively 111 000 euros and 26 000 euros. Financial firms and IT consulting represent the highest contribution to R&D and technological development. Transport industry expends 276 000 euros in acquisition of machinery. IT consulting spends a lot in in-house R&D (822 000 euros) and in acquisition of machinery (484 000 euros). I can point out here the fact that the size is an increasing function of in-house R&D expenditures. The highest expenditures in all categories come from the bigger firms (250 and more). One must be careful with these results because only 306 on 576 firms have answered on questions about these categories of expenditures. Moreover, 182 firms on 306 have zero in-house R&D expenditures, 236 firms have zero extramural R&D expenditures, 113 of the total sample have zero acquisition of machinery, and 218 have zero acquisition of machinery. This proves that distributions of the different expenditures are highly skewed, and there are big R&D and technological performers.

Table 5
Characteristics of human skills management (%)

		% offer trainings	% of high educated emp.	R&D pers. (mean)
	All firms	82.5	37.9	13
Industry	Manufacturing	83.8	14.1	18
	Total services	82.2	43.2	11
	Wholesale and Retail	93.4	21.4	6
	Transport	63.7	12.3	14
	Financial	85.5	63.5	7
	IT consulting	84.3	77.9	14

Source: Author's calculation from CIS data for 2006-2008

Table 5 shows that 82.5% of firms offer to their employees training programs in order to adapt to innovations. 85.5% of firms in the financial industry allow employees to follow trainings and 93.3% of firms in wholesale and retail industry. The worst performer is the transport industry with 63.7%. In average, manufacturing and total services offer trainings in the same proportion, respectively 83.8% and 82.2%. Firms with more than 249 employees propose trainings in more or less 95.6% of cases. The percentage of high educated employees is the proportion of graduates of higher education among employees. 43.2% of employees in the services industry are high educated. In contrast, only 14.1% in the manufacturing industry. The IT consulting industry contains the highest proportion of high educated employees with 77.9%. Concerning the size, the proportion of high educated employees does not depend on the size, the percentage is about 30% for all sizes. Furthermore, firms with only between 10 and 19 employees employ the most high educated employees. Concerning the amount of R&D personnel, the total average is 13 R&D employees. Manufacturing employs 18 R&D experts, in contrast the total services hires 11 researchers. IT consulting employs the most R&D personnel in the services industry with 14 researchers. Firms with more than 250 employees hire in average 46 R&D employees.

In conclusion, these descriptive statistics allow to highlight two important stylized facts:

1) The importance of services industry in Luxembourg.

2) High heterogeneity inter- and intra-industries.

In order to take into account these issues, I propose to develop a new classification of manufacturing and services firms based on technological skills opposing to the OECD and Pavitt's classification which consider only manufacturing industries.

8.3.4 A classification of Luxembourgish firms

Our main goal is to uncover evidence of different types of firms according to technological skills in our data. In particular, we apply cluster analysis to the data. Cluster analysis is an exploratory data analysis technique which seeks to uncover groups (or "clusters") in data (Everitt, 2007). The idea is, by and large, to minimise some measure of "distance" within a group and maximise the distance between the groups, using some formal statistical criteria.

Table 6
Variables used for the cluster analysis

Technological skills variables
1. Innovation competencies
a) Input oriented measures
In-house R&D amount
b) Output oriented measures
Innovation in production and in process (yes/no)
Innovation in production (yes/no)
Innovation in process (yes/no)
Patents or other protection methods (yes/no)
c) Outcome measures
Cost reduction generated by process innovations
Turnover generated by product innovations
2. Technology used
Acquisition of R&D (extramural R&D)
Acquisition of machinery, equipment and software
Acquisition of external knowledge
3. Human skills
Training for your personnel (to adapt to innovation)(yes/no)
Proportion of graduates of higher education among your employees
Total R&D personnel
4. Firms variables
Size (number of employees)
Market reference (national, Greater Region, Europe, and others)
Sector (Manufacturing or service)

The cluster analysis on the dataset of CIS 2008 distinguishes four groups. According to their characteristics, I suggest to name the groups in the following way:

1) High-technology firms

2) Medium-high-technology firms

3) Medium-low-technology firms

4) Low-technology firms

The four groups are different in terms of technological skills, but also in terms of general characteristics as in size, or in market where they sell. In order to define and compare the different groups, it could be great if an analysis of the characteristics of each groups would be done.

Table 7
Characteristics of firms in each cluster, 2006-2008

Cluster	% of total firms	% of services firms	Mean	
			employees	turnover (1000 euros)
High-technology	25.65	76.80	162	230 600
Medium-high-technology	9.51	76.36	114	75 304
Medium-low-technology	8.92	75.87	92	59 133
Low-technology	55.92	79.55	44	26 643

Source: Author's calculation from CIS data for 2006-2008

Table 8
Proportion of firms which are innovative and use protection methods, 2006-2008

Cluster	Prod. and proc. innovator (%)	Prod. innovator (%)	Proc. innovator (%)	Protection method (%)
High-technology	100	0	0	77.65
Medium-high-technology	0	100	0	49.13
Medium-low-technology	0	0	100	36.02
Low-technology	0	0	0	25.12

Source: Author's calculation from CIS data for 2006-2008

Table 9
Average of expenditures in 2006-2008, in 1000 euros

Cluster	R&D expenditures		Acquisitions	
	in house	extramural	machinery	external knowledge
High-technology	1 115	253	457	150
Medium-high-technology	123	6	391	34
Medium-low-technology	29	15	148	12
Low-technology	3	0	4	0.07

Source: Author's calculation from CIS data for 2006-2008

Table 10
Outcome of innovation, 2006-2008

Cluster	% of turnover generated by prod. innovation	% reduced cost by proc. innovation
High-technology	8.88	3.24
Medium-high-technology	11.18	0
Medium-low-technology	0	2.39
Low-technology	0	0

Source: Author's calculation from CIS data for 2006-2008

Table 11
Human capital development dimension, 2006-2008

Cluster	% of training	Mean of % high educated employees	Average of R&D employees
High-technology	87.60	49.64	8
Medium-high-technology	77.19	52.12	1
Medium-low-technology	77.44	38.59	2
Low-technology	4.12	30.54	0

Source: Author's calculation from CIS data for 2006-2008

Table 7 highlights the following features. In 2008, the high-tech group represents 25.65%. The Luxembourgish economy is characterized by an important number of firms which are in low-technology group (55.92%). However medium-high-tech and medium-low-tech groups represent respectively only 9.51% and 8.92% of total firms. The services sector has more or less the same weight in each group; 76.80% in high-tech, 76.36% in medium-high-tech, 75.87% in medium-low-tech, and 79.55% in low-tech. As expected the average of the number of employees is higher in the high-tech group (162) and lower in low-tech (44). This is consistent with the literature which argues that big firms are more technological intensive. Concerning the turnover, it is also an increasing function of the level of technology. Indeed, there is a positive relationship between the average of turnover and the technological effort. The turnover of the high-tech group is 230 600 000 euros in average, that of the medium-high-tech group is 75 304 000 euros, that of medium-low-tech group is 59 133 000 euros, and finally that of the low-tech group is 26 643 000 euros.

Table 8 shows the proportion of firms which innovate in product and in process, only in products, and only in process. It also demonstrates the proportion in each group of firms which protect themselves by patents, registration of design patterns, trademarks, copyright, and secrecy. The high-tech group innovates at 100% in products and process, and 77.65% of them protect their innovation. 100% of the medium-high-tech group innovate only in products and 49.13% of them use a protection method. The medium-low-tech group contains 100% of firms which are innovative in process. 36.02% of them use a protection method. The low-tech group does not innovate neither in product nor in process. Although no firm has to innovate during the period 2006-2008, 25.12 % of them use a protection method. Indeed, the question in the CIS 2008 does not specify whether these protection methods are used for innovation done between 2006-2008.

Table 9 demonstrates that the high-tech group invests an important amount in in-house R&D, 1 115 000 euros (0.48% of turnover). The second higher expense is acquisition of machinery with 457 000 euros (0.20% of turnover), followed by extramural R&D expenditures with 253 000 euros (0.11%), and finally acquisition of external knowledge with 150 000 euros (0.06%). The medium-high-tech group invests the most in acquisition of machinery afterwards in R&D in-house, acquisition of external knowledge, and extramural R&D respectively 391 000 euros (0.52% of turnover), 123 000 euros (0.16% of turnover), 34 000 euros (0.05% of turnover), and 6 000 euros (0.001% of turnover). The medium-low-tech group invests more in acquisition of machinery with 148 000 euros (0.25% of turnover), it spends 29 000 in in-house R&D (0.05% of turnover), 15 000 in extramural R&D (0.03% of turnover) and 12 000 in acquisition of external knowledge (0.02% of turnover). Concerning the low-tech group, firms invest 4 000 euros (0.02% of turnover) in acquisition of machinery, 3 000 euros (0.01%) in in-house R&D, 70 euros (0.00% of turnover) in acquisition of external knowledge, and 0 euros in R&D extramural (0.00% of turnover).

In table 10 the percentage of turnover generated by product innovation and the percentage of reduced cost generated by process innovation are reported. The product innovation of high-tech group generated in average 8.88% of turnover, and the process innovation reduced the cost in 3.24%.

Because the medium-high-tech group innovates only in products, its innovations generate 11.18% of their turnover. Concerning firms which are in the medium-low-tech group, their process innovations reduce 2.39% of cost. Concerning firms in the low-tech group, they do not generate profit or reduce their costs because they do not innovate.

Regarding the human capital development dimension in table 11, 87.60% of firms in high-tech group offer training to their employees, 77.19% in medium-high-tech, 77.44% medium-low-tech, and 47.12% in low-tech. 49.64% of employees are high educated in the high-tech group. Firms in this group have 8 R&D employees in average. Firms in the medium-high-tech group and firms in the medium-low-tech group engage high educated employees in respectively 52.12% and 38.59% and have in average 1 and 2 R&D employees. The low-tech group has in average only 30.54% of high educated employees and has 0 R&D employees in average.

Comparison of clusters in CIS 2004-2006 and 2006-2008

In this section I compare the classification in terms of technological skills of the same firms in Luxembourg in CIS 2006 and in CIS 2008. The aim of this section is to see whether there is or not a persistence in technological behaviour. Whether a firm which was classified in high-tech group in 2006 is in the same group in 2008. There are 292 firms which are in the CIS 2006 and in the CIS 2008.

Table 12
Comparison of clustering in 2004-2006 with 2006-2008

Groups 2006	Groups 2008				
	High-technology	Medium-high-technology	Medium-low-technology	Low-technology	
High-technology	11	3	3	15	32
Medium-high-technology	27	9	4	27	67
Medium-low-technology	12	6	4	24	46
Low-technology	56	20	19	52	147
	106	38	30	118	292

Source: Author's calculation from CIS data for 2004-2006 and for 2006-2008

Table 12 highlights that the technological profile of a firm is not stable during the time. Indeed, only 11 firms which are in high-tech group in 2006 are still in the high-tech group in 2008. However, 15 firms which are in the high-tech group in 2006 are in the low-tech group in 2008. Due to the variables chosen the classification cannot be stable for a firm as it does not invest every year in R&D and does not innovate every year. Then, the question is: is there an "innovation" cycle firms moving from one group to another? This question could be interesting to evaluate the probability of moving from one cluster to another. Thus, a possible extension of this paper is to run a cluster analysis on the CIS 2008-2010 which will be available from October 2012. Then, to construct a model to estimate the probability of moving from one cluster to another using for example a probit model for the three CIS period: 2004-2006, 2006-2008, and 2008-2010.

8.3.5 Conclusion

We have presented a classification of Luxembourg's firms according to their technological skills. Luxembourg firms can be classified in four groups: i) high-technology, ii) medium-high-technology, iii) medium-low-technology, iv) low-technology.

First, the high-technology group has the largest number of employees, so, the largest size. This is consistent with the literature. According to Schumpeter (1943), large corporations with monopoly power were likely to innovate because of better access to capital, ability to diversify risks, and economies of scale in R&D activities. Moreover, this group has the highest average turnover. Bound, Cummins, Griliches, Hall, and Jaffe (1984) find that R&D expenditures increased with turnover and gross plant size in 1976. Firms in the high-technology group innovate in product and in process and use in majority a protection methods. Their highest expenditures is in-house R&D and in acquisition of machinery. Regarding the human capital development dimension, they are the most efficient.

Second, the medium-high-technology group is characterized by the second largest firms in terms of number of employees. Firms in this group innovate only in product. They spend considerable amounts in acquisition of machinery and develop human capital strategies.

Third, firms in the medium-low-technology group are smaller than firms in the medium-high-technology group. These firms are process innovators. The highest expenditure of this group is in acquisition of machinery. They have few or none R&D personnel.

Fourth, firms in the low-technology group are the smallest. They have the lowest turnover in average. They perform limited process innovation. Moreover, they do not invest in developing human resources.

8.3.6 References

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8.4 Determinants of electronic commerce and its impact on the economic performance of Luxembourg companies[1]

8.4.1 Introduction

Over the last decade, Luxembourg has become the new Eldorado for companies specialized in e-commerce. It all started in 1999 with the establishment of AOL Europe Services, followed by the opening of a subsidiary of Amazon in July 2003, who decided a few months later, in December 2004, to establish its European headquarters in Luxembourg. In 2005, Apple installed iTunes Music Store, its European online music platform in the country.

This (non-exhaustive) list of companies specialized in e-commerce setting up in Luxembourg reflects the attractiveness which many business leaders and politicians have echoed in the media. Luxembourg has many advantages that make it particularly attractive for a "company like ours", in the words of Senior Vice-President of the International Consumer Business section of Amazon. The first advantage is geographic, i.e. the country is located in the heart of Europe, allowing companies which decide to settle to easily reach 450 million potential customers on the continent. Secondly, the country has a highly skilled information technology workforce, which it succeeded to attract through (among others) very competitive wages. Third, the penetration rate of these technologies is very high thanks to the modern infrastructure put in place by the Luxembourg State in the telecommunications field. In addition, the State behaves proactively and openly towards the e-commerce stakeholders. For example, Luxembourg is the first EU country to have transposed the European Directive on e-commerce. Other steps were subsequently taken in the same direction, such as the creation of LuxTrust SA, by the Luxembourg State and the private sector, and whose role is to issue digital certificates for authentication, security and electronic signatures in Internet and Intranet transactions.

E-commerce therefore holds a prominent place in the economy of Luxembourg. Despite its importance, e-commerce within Luxembourg companies is rarely studied and the few studies that do exist are a cross sectional analysis, that is to say, considering only one year.

For all these reasons, we analyse in this study the determinants of e-commerce in Luxembourg companies and their impact on the economic performance of those companies over the period 2007-2010. For that purpose we use data from the annual survey on information and communication technology (ICT) complemented by community innovation survey data (CIS).

[1] Short version of an article to be published in the series Cahier Économique from STATEC "E-Commerce Adoption, Intensity of Usage and Productivity: Panel Evidence from Luxembourgish Firms"; wladimir.raymond@statec.etat.lu and leila.ben-aoun@statec.etat.lu.

8.4.2 Benefits of e-commerce

Even before the analysis is initiated, it is worth mentioning the benefits of e-commerce. Among the strategies for stimulating employment and growth in the eurozone, the Commission highlights the need to double the share of e-commerce in retail sales (estimated at 3.4% in 2012) and that of the Internet economy in European GDP (estimated at less than 3% in 2012) by 2015. According to the Commission, "the development of electronic commerce and online services offers enormous potential for beneficial economic, social and societal change." It estimates that 2.6 jobs are created by the Internet economy for every "off-line" job lost. The Commission has also stated that "the gains brought by lower online prices and a wider choice of available products and services are estimated at 11.7 billion euros, equivalent to 0.12% of European GDP." By developing e-commerce so as to reach 15% of the total retail trade and by eliminating the obstacles to the internal eurozone market, "the gains for consumers might be as much as 204 billion euros, or 1.7% of European GDP."

At the company level, the gains resulting from the reduction of transaction and information costs, the ability to offer better prices and the profit related to the Internet market are reflected in the improvement of productivity, hence the subject of our study.

8.4.3 E-commerce and economic performance

In this section, we study the determinants of e-commerce in Luxembourg companies and their impact on the economic performance of these firms by using methods of descriptive statistics and econometrics of panel data applied to ICT and CIS survey data.

8.4.3.1 Data

The data come from four waves of annual ICT surveys in Luxembourg and two waves of the biennial community innovation surveys. The ICT survey data refer to the years 2007-2010, while those of the CIS survey relate to the periods 2004-2006 and 2006-2008. Data from those two surveys are collected at company level by CEPS/INSTEAD and then processed by STATEC. A thorough investigation is carried out in the case of the ICT survey while a census or stratified sampling is performed in the case of the CIS survey according to employment, turnover and economic activities criteria. The population of interest for this study includes firms with 10 or more employees with a positive turnover throughout the studied period and from all sectors of the Luxembourg economy, with the exception of the financial and insurance sectors[2].

Before presenting the descriptive statistics and the results of the econometric modelling, it is important to define the variables used in the study.

[2] These areas are unfortunately not covered by the ICT survey.

E-commerce

We study two types of activity, namely online purchase (e-purchase) and online sales (e-sale)[3]. Thus, our two e-commerce dependent variables are dichotomous, taking the value 1 if a company is engaged in the activity in question, and 0 otherwise. These two variables were constructed at the company level from the ICT survey questions. For each activity, we have also constructed at 2-digit NACE level of e-buyers and e-sellers in each industry. As we will see later, this variable will be used as an explanatory variable in modelling the likelihood of engaging in electronic commerce.

Economic performance

Our measure of economic performance is the revenue per capita (number of employees), which is also a measure of labour productivity, constructed from the ICT survey data. We have log-transformed the variable to reduce its variance, which can be very large, and to be as close as possible to the ideal setting of a normal distribution.

Innovation

Four types of innovation are taken into account, namely product and process innovations, also called technological innovation, and the organizational and marketing innovations, also called non-technological innovations. Innovation variables come from the CIS survey and represent the average innovation behaviour during the three years preceding the adoption of e-commerce. These variables were constructed at 2-digit NACE level and capture the percentage of innovative firms in each industry.

ICT infrastructure

The infrastructure which is available in the company is taken into account by the inclusion of three variables. The first is an index constructed as an arithmetic average of different indicators of intranet, extranet, video conferencing, electronic forum, electronic group calendar and group project management usage[4]. This first variable is called "ICT infrastructure" in our study. The second captures the percentage of employees with Internet access in the company. The third is a dichotomous variable taking the value 1 if the company has a website, and 0 otherwise. These three infrastructure variables come from the ICT survey or were constructed from that survey.

[3] Online purchase or sale includes orders or sales of goods or services carried out over computer networks which are not limited only to the Internet (see e.g. EDI system).

[4] Before the construction of the index, we calculated Cronbach's alpha to determine the relevance of the presence of these indicators in the calculation of the average.

Sector of activity

We take into account the following sectors: high-tech and low-tech manufacturing industries according to the OECD classification (2007); transportation, electricity, water and gas industries, and the ICT and HORECA industries within the service sector[5]; and the trade sector (wholesale and retail). A dichotomous variable taking the value 1 if the firm belongs to the sector in question and 0 otherwise is constructed for each sector. Intersectoral differences capture the observed heterogeneity.

Employment and status in the group

The employment variable, measured by the number of employees, is used as a proxy for size. We log-transformed it in the analysis for the same reasons as for economic performance. In a table of descriptive statistics (see Table 1), we have split it into three dichotomous variables where each dichotomous class takes the value 1 if the number of employees in the company satisfies the condition of the class, and 0 otherwise. The number of employees of the company comes from the ICT survey.
A dichotomous variable for the belonging to a group which captures an economy of scale effect is included in the analysis. This variable also comes from the ICT survey.

8.4.3.2 Descriptive statistics

In tables 1 to 3 we show descriptive statistics on the adoption of e-commerce, the relationship between e-commerce and innovation and the relationship between e-commerce and the economic performance of the company.

Table 1 shows the proportions of e-buyers and e-sellers in the full sample and by class of employment, status in the group and in the industry. Luxembourg companies engage more frequently in e-purchasing than in e-selling: the proportion of e-buyers is twice that of e-sellers. While the majority of companies (over 76%) have fewer than 50 employees, the largest percentage of e-buyers and e-sellers are in the category of companies with over 250 employees. This seems to indicate a positive relationship between the size of the company and its adoption of electronic commerce. Surprisingly, 64% of companies are independent. However, they seem less likely to engage in e-commerce than companies which are part of a group. The majority of firms in the sample belong to the trade sector (about 42%) while the largest percentage of e-buyers can be found in the ICT sector (over 73%) followed by trade sector (over 50%). On the other hand, the "distribution" of the proportion of e-sellers across sectors is much more uniform.

Table 2 shows the correlations between the adoption rates of the two types of e-commerce and the success rate in the four types of innovation. The correlations are all positive and significant, the biggest being that between e-sales and marketing innovation.

[5] HORECA is the English acronym for Hotel, Restaurant and Catering.

Table 3 shows the difference in economic performance between adherents and non-adherents of e-commerce. This difference is clearly significant and indicates greater turnover per head, so greater labour productivity, for companies engaged in e-commerce. The increase in turnover and in employment seems greater for e-sales than for e-purchases.

Table 1
The adoption of e-commerce by class of employment, status in the group and industry, and in relation to the full sample

	Full sample	E-buyers	E-sellers
E-buyers	0,475	-	-
E-sellers	0,207	-	-
Class of employment			
# employees < 50	0,764	0,443	0,182
50<# employees 250	0,203	0,562	0,269
# employees > 250	0,033	0,694	0,408
Status in the group			
independent	0,641	0,438	0,176
subsidiary	0,360	0,542	0,263
Business sector			
Industry			
high-tech	0,034	0,490	0,220
low-tech	0,147	0,406	0,169
Services			
HORECA	0,111	0,377	0,295
ICT	0,110	0,732	0,220
transport	0,167	0,363	0,193
electricity, gas, water	0,014	0,463	0,146
Other			
commerce	0,417	0,502	0,200
# observations	**2979**	**1416**	**617**

The figures in the table represent proportions.

Table 2
Correlation between the adoption rate of e-commerce and the success rates in different types of innovation

	E-purchase	E-sale	Innovation			
			product	process	organisation	marketing
E-purchase	1,000					
E-sale	0,286*	1,000				
Innovation						
product	0,182*	0,198*	1,000			
process	0,168*	0,183*	0,901*	1,000		
organisation	0,162*	0,127*	0,845*	0,887*	1,000	
marketing	0,173*	0,278*	0,823*	0,768*	0,819*	1,000

* Significance threshold: 1%.

Table 3
Difference in economic performance between adherents and non-adherents of e-commerce

	Productivity[a]		Turnover		Employment	
	Average	Standard error	Average	Standard error	Average	Standard error
E-purchase						
non-adherents	-1,871	0,025	1,415	0,033	3,286	0,021
adherents	-1,699	0,027	1,841	0,041	3,540	0,028
difference	-0,172 *	0,018	-0,426 *	0,052	-0,254 *	0,035
E-sale						
non-adherents	-1,825	0,021	1,510	0,028	3,335	0,018
adherents	-1,653	0,041	2,028	0,065	3,681	0,045
difference	-0,172 *	0,046	-0,518 *	0,071	-0,346 *	0,049

[a] Turnover/ employment, in million euros.
A log-transformation is performed on the three variables. Significance threshold: 1%.

Although interesting, descriptive statistics alone are not sufficient to study the relationship between e-commerce and economic performance. Actually, in each descriptive analysis, the remaining variables are not taken into account, hence the need for an econometric modelling.

8.4.3.3 Modelling

Given the studied relationship, the available data and the characteristics of dependent variables, the estimated model is a binary endogenous variable model including a Probit equation followed by a linear regression.

The Probit equation explains the probability of the company of adopting e-commerce (e-purchases or e-sales) by company size, the percentage of companies that have already adopted e-commerce in its industry, the percentage of innovative companies in its industry, its infrastructure and its status in the group.

The regression explains labour productivity by the adoption of electronic commerce in each of the seven areas mentioned above, employment, the four innovation measures and labour productivity in the previous year. By including this last variable, we use the feature panel of data to estimate the persistence of economic performance.

In each equation, we included six industry dichotomous variables to capture the observed heterogeneity and two time dichotomous variables to capture structural changes in the economy.

8.4.3.4 Results

Table 4 reports the estimation results of the model. The higher the percentage of companies that have already adopted e-commerce within a company's industry is, the higher the company likelihood of adopting e-commerce is. This probability increases significantly with the size of the company. The relationship between the success rates in the four types of business industry innovations and the likelihood of adopting e-commerce is not very clear. Having adequate infrastructure is a prerequisite for the adoption of electronic commerce. Finally, the status of the company in a conglomerate has no influence on the probability of adopting e-commerce, all other things being equal.

The second part of the table shows clearly a positive and significant relationship between the adoption of e-commerce, in particular e-purchase, and the labour productivity of the company. This effect differs by industry as shown by the Wald tests at the bottom of the table. It is significant for all the sectors studied in the case of e-purchases and it is not significant in the case of e-sales, except for the retail sector. In other words, the sectors of electricity, gas and water, and the retail sector seem to be more likely to increase the turnover per head in the case of e-purchase and, in the case of e-sales, the retail sector seems to be more likely to increase the economic performance. We observe a negative marginal product of employment in the case of e-purchases, and zero in the case of e-sales. As with the adoption of e-commerce, the relationship between success rates in the four types of innovation in the company's industry and its labour productivity is not well defined. Finally, all other things being equal, the turnover per head seems persistent, i.e. a high per capita turnover in the previous year seems to guarantee a high per capita turnover the year after.

Table 4
Maximum likelihood estimate of the effect of the adoption of e-commerce on productivity during the period 2007-2010[a]

Variable	Coefficient		Standard error	Coefficient		Standard error
	E- purchase			E-sale		
	Adoption of e-commerce					
% adopt. € industry (t-1)	0,009	**	0,002	0,023	**	0,003
Employment, log	0,137	**	0,030	0,144	**	0,033
% innov. € industry[b]						
product	-0,006		0,005	-0,009		0,006
process	-0,005		0,005	0,013	*	0,007
organisation	0,011	*	0,005	-0,010		0,005
marketing	0,002		0,005	0,015	*	0,006
% Internet usage (t-1)	0,004	**	0,001	0,002	*	0,001
Infrastructure ICT (t-1)	0,584	**	0,103	0,766	**	0,127
Website available (t-1)	0,046		0,052	0,326	**	0,076
Group (t-1)	-0,023		0,049	0,024		0,063
Constant	-1,479	**	0,133	-2,112	**	0,159
	Productivity, i.e. turnover/job, log					
Productivity (t-1)	0,866	**	0,008	0,870		0,008
E-commerce						
manufacture						
high-tech	0,375	**	0,096	0,013		0,116
low-tech	0,464	**	0,055	0,104		0,071
Service						
HORECA	0,443	**	0,050	0,044		0,056
ICT	0,398	**	0,049	0,112		0,071
transport	0,473	**	0,051	0,107		0,062
electricity, gas, water	0,736	**	0,117	-0,014		0,175
Other						
commerce	0,551	**	0,042	0,232	**	0,054
Employment, log	-0,026	**	0,010	0,000		0,009
% innov. € industry[b]						
product	0,002		0,002	0,002		0,002
process	-0,002		0,002	-0,003		0,002
organisation	0,002		0,002	0,004	**	0,001
marketing	-0,002		0,002	-0,003		0,002
Constant	-0,363	**	0,050	-0,333	**	0,046
# observations	2979					
Log-likelihood	-3269,158			-2778,743		
Wald test	X2 (6) = 26,68 ; p-value = 0,000			X2 (6)= 21,05 ; p-value = 0,002		

[a] We have included in each equation six industry dichotomous variables and two time dichotomous variables.
[b] These variables represent an average innovation behaviour during the three years preceding the adoption of e-commerce.
Significance threshold: *: 5% **: 1%.

8.4.4 Conclusion

We demonstrated in this study the determinants in the adoption of e-commerce by Luxembourg companies and the relationship between e-commerce and the economic performance, which is measured by the company turnover per employee. The results indicate that the (very) large companies more frequently engage in electronic commerce and that the appropriate infrastructure must be in place beforehand. The adoption rates within the industry of a company in the previous period also appear to influence its decision to adopt it. The adoption of e-commerce contributes greatly to labour productivity, especially in the sectors of electricity, gas and water, and in the retail sector in the case of e-purchasing, and in the retail sector in the case of e-selling. Finally, the companies' turnover per head seems persistent.

8.4.5 References

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8.5 Access to finance for small companies in Luxembourg[1]

8.5.1 Introduction

The 2007 financial crisis has highlighted the potential difficulties of small and medium enterprises (SMEs) in accessing external financing. The issue is also important in Luxembourg where SMEs are predominant and account for approximately 64% of value added, 69% of employment and 99% of companies. In 2010 the survey "Access to Finance"[2] was developed and conducted in order to verify the conditions of access to finance for SMEs that might be the most weakened by the 2007 crisis. Actually, for small companies, access to finance is often one of the major obstacles to their survival and growth. The creation of new businesses is also hampered when the conditions for access to credit become stricter. The European survey conducted in 2010 under the auspices of Eurostat of a sample of SMEs employing at least 10 persons is intended to identify the difficulties, but also the financing methods sought in 2007, 2010 and those anticipated for the future (2011-2013). Twenty countries[3] have undertaken this survey, including Luxembourg. This specifically involved knowing to what extent these companies consider their sources of external funding to be threatened[4].

Based on survey responses, a first line of study might have been to represent the process in two steps, in which the company first decides whether or not to seek funding and then finds out whether it succeeded not. However, this approach faces a dual constraint. The first one is inherent to the survey since it observes the behaviour of companies that make a decision to apply for funding but not the behaviour of financiers who decide to grant funding. Thanks to the survey, we can see the result of company efforts but few variables are available to try to discover the factors that influence this result. In fact, and this is a specific difficulty with Luxembourg's survey results, most companies that have applied for any kind of funding received it. In the specific context of this survey, there is no way to distinguish the factors that influence the demand for finance from those that determine its approval. Therefore the results merely identify the determinants of seeking finance in 2010 and the seeking finance projected for 2013.

1 The summarized results in this chapter are taken from the Working Paper to be published in the STATEC series Économie et Statistiques: "Access to Finance of SMEs in Luxembourg: consequences of the crisis", S. Allegrezza, L. Ben Aoun Peltier, A. Dubrocard, S. Larue. The bibliography is also derived from this document.

2 Access to Finance: Access to finance means the possibility that companies have to access financial services, including credit, deposits, payments, insurance and other risk management services (Demirgüç-Kunt et al., 2008).

3 Germany, Belgium, Bulgaria, Cyprus, Denmark, Spain, Finland, France, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, United Kingdom, Slovakia, Sweden.

4 Detailed statistics from the survey have been the object of a STATEC Bulletin (Larue et al., 2011).

8.5.2 Survey description

Let us note that the target population of this survey was intentionally restricted by the criteria imposed at EU level. Thus only stand-alone SMEs running their business since 2005 and employing more than 10 people in 2010 were interviewed. In the case of Luxembourg, these criteria have excluded many foreign subsidiaries operating in the country.

Frame 1
The European Access To Finance survey (ATF)

Within the framework of the EU Regulation's flexible module for structural business statistics, the Commission wished to collect qualitative data through a survey in order to analyse the situation of small and medium enterprises (SMEs) in the European Union in terms of access to financing. This refers more specifically to analysing the constraints related to the availability of funding, their evolution over time, future funding needs and also the preferred sources of funding.

This survey collects qualitative data, it does not collect any quantitative information and, in particular, it does not include any amount for requested funding.

The statistical unit of the access to finance survey is the enterprise. "The enterprise is the smallest combination of legal units that is an organizational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making, especially for the allocation of its current resources. An enterprise carries out one or more activities at one or more locations. An enterprise may be a sole legal unit."

Table 1
Total population, target population and response rates per branch of economic activity

	Branch of economic activity (NACE Rev.2)	Total population of firms in 2008	Population of firms with 10 or more employees	Target population ATF	Relative share of (c) in (b)	Number of processed questionnaires	Response rate
		(a)	(b)	(c)	(b)	(d)	(d)/(c)
B - E	Mining and quarrying, Manufacturing	983	367	126	34 %	109	87 %
	Energy						
F	Construction	2.942	947	478	50 %	405	85 %
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	6.857	836	336	40 %	283	84 %
H	Transportation and storage	1.156	336	90	27 %	77	86 %
I	Accommodation and food service activities	2.728	336	153	46 %	123	80 %
J	Information and communication	10.300	845	213	25 %	184	86 %
M-N	Professional, scientific and technical activities, administrative and support service activities						
	Total	**24.966**	**3.667**	**1.396**	**38 %**	**1.181**	**85 %**

Source: STATEC, Démographie des entreprises en 2008 and Enquête sur l'accès au financement des entreprises en 2010
Among these companies only those that meet the following conditions are selected:
- having been created before 2006;
- and still being active during the reference year 2010;
- employing between 10 and 249 people in 2005 and at least 10 people in 2010;
- having a centre of economic interest on the Luxembourg economic territory and being stand alone, i.e. not being a subsidiary of another company in the same Member State or abroad.

The Luxembourg target population was defined by applying the different criteria to the total business population.
The companies concerned were given the questionnaire in September 2010 and have responded by post before December 2010.

8.5.3 Descriptive statistics

Nearly 47.7% of respondents didn't apply for any funding in 2007 or in 2010. More companies applied for funding in 2010 than in 2007. They were 39.5% in 2007 and 44.3% in 2010, representing a 15% increase in the proportion of companies seeking funding. In addition, 31.9% of companies within the scope of the survey have used funding in 2007 and 2010. Finally, the majority of respondents (64%) do not intend to apply for funding between late 2010 and December 2013.

Frame 2
Types of financing

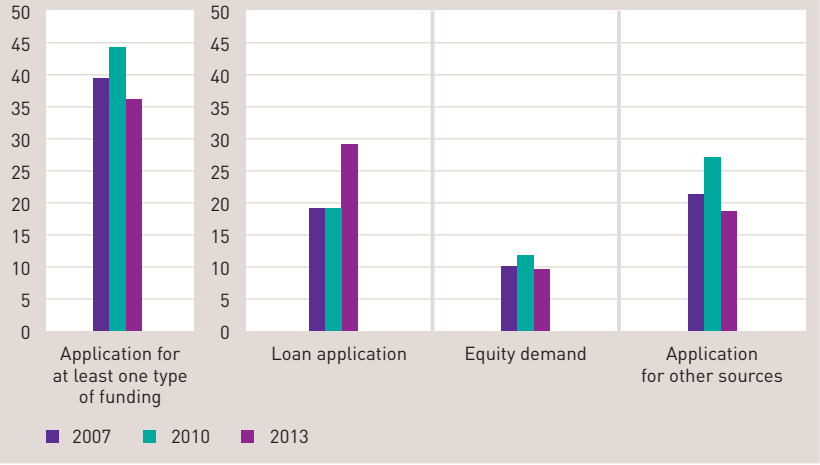
1 "Debt financing" refers to the amounts borrowed and refundable over an agreed period of time. This excludes: bank overdrafts or lines of credit, leases, senior debts, subsidized loans and subordinated debts.

2 "Equity financing" refers to money or assets obtained in exchange for corporate shares and stocks of the company.

3 "Other financing sources" includes leases, factoring, bank overdrafts and/or lines of credit, subsidized loans, trade credit from suppliers, advances received on contracts (by clients), the export credits, mezzanine debt and grants from the Luxembourg State, foreign States or international organizations.

If we distinguish between the types of funding application, we observe that loan applications and other sources are the most sought. However, if the number of applications for debt financing remained stable between 2007 and 2010 (19%), the applications for other sources have much increased (21-27%). This trend is reversed in the future prospects since 29% of companies are considering applying for a debt financing while "only" 19% of them wish to use other sources of funding. Equity financing is the type of financing that is less frequently sought and has experienced little changes over the time period (from 9.5 to 11.8%).

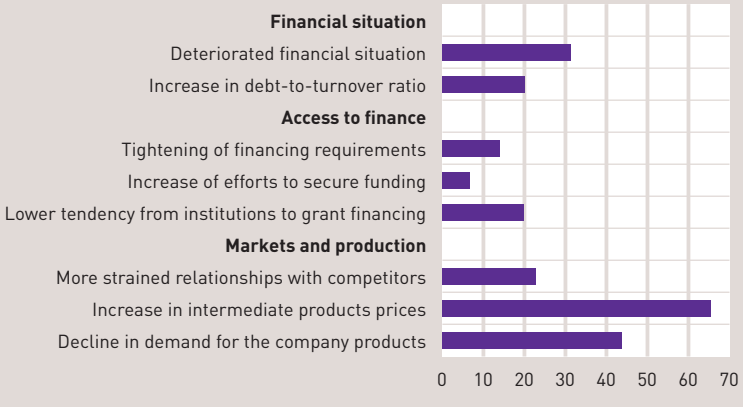
Chart 1
Types of financing sought



Source: STATEC, Enquête sur l'accès au financement des entreprises en 2010

The perception of the effects of the crisis by companies is also a factor that influences the demand for external financing. To describe this perception, companies were asked to give their views on the evolution of a number of items relating to their financial situation, the conditions for securing funding and the situation in their market. They assessed the extent and the positive or negative nature of the perceived changes by a scale ranging from "much better" to "worse". The following chart shows the proportion of companies that perceived a deterioration regardless of its intensity. So, slightly more than 30% of companies consider their financial situation has worsened and 20% recorded an increase in the amount of their debt in relation to their turnover.

Chart 2
Perception of changes between 2007 and 2010

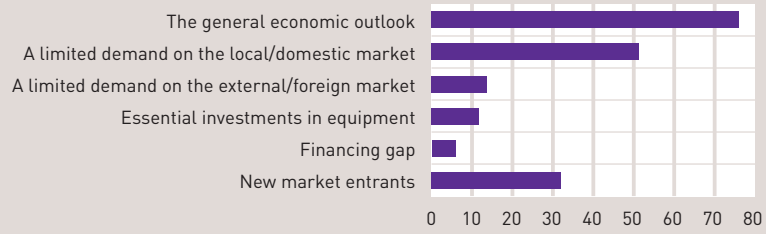


Source: STATEC, Enquête sur l'accès au financement des entreprises en 2010

Concerning the financing requirements, few companies think they have become tighter between 2007 and 2010. Even if nearly 20% of them consider that credit institutions are less willing to grant a loan, this is not the main negative aspect perceived. In addition only 14% of companies surveyed believe that interest costs have increased and less than 7% of them find that more effort is necessary to secure funding. In general, the changes on the market conditions are perceived most negatively. 23% of companies are concerned about an increased competition between 2007 and 2010. This goes hand in hand with the fact that 44% of the surveyed companies have experienced a weakening demand for their products. Finally, for 66% of companies, the price of intermediate products was what evolved most unfavourably during the period 2007-2010, as they sharply increased.

A second set of factors may influence the decision to seek external funding: the limits that the crisis has imposed upon the growth prospects of companies. In particular, 76% of respondents believe that the general economic outlook will have a negative impact on the development of their future activities.

Chart 3
The main risks to companies' growth prospects



Source: STATEC, Enquête sur l'accès au financement des entreprises en 2010

In addition, about half of the companies believe that a decrease in the local market demand will affect their dynamic potential (against less than 14% who think the same thing when it comes to foreign markets). Finally, for 32% of companies, the unexpected arrival of new competitors on the market is perceived as a threat to their development.

8.5.4 Company behaviour

To better understand the behaviour of firms and the determinants of demand for funding, two qualitative dependent variable models have been developed and tested. These models strive to identify the variables that had a significant impact on the decision to apply for external funding in 2010 (and also consider on the likelihood to applying for funding by 2013).

In the first model the dichotomous endogenous variable takes the value 1 when the company claims to have applied for external funding in 2010 and 0 otherwise. The likelihood of applying for funding is estimated using a probit model.

In the second model, three endogenous variables, also dichotomous, take each the value 1 (or 0) if the company:

1. has applied for a loan (or not);

2. has tried to increase the share capital (or not);

3. has called for another source of funding (or not).

The outcomes of the three decisions are simultaneously observed at the time of the survey but facts may have come to light sequentially, and the decisions are linked. It is therefore necessary to assess all applications together for the three types of funding using a triprobit model. This specification allows testing the existence and nature of links between decisions.

The same specifications are deployed to explain both the decision to apply for funding in 2010 and the projected decision to apply for funding in 2013. The results in Table 2 show the estimates of applications in 2010 and in Table 3 the projected applications in 2013. In each table, the first columns (1-3) show the marginal effects of the determinants of application for finance for the entire sample and then estimate industrial and service companies separately. The results of the second model are listed in the last columns (4-6) where the coefficients of the simultaneous estimation of the likelihood of applying for each type of funding in the survey are presented[5].

[5] Marginal effects cannot be calculated satisfactorily for this type of specification. We will therefore interpret the signs of the parameters regardless of their magnitude.

8.5.5 Determinants of seeking finance in 2010

In addition to its own characteristics, the company's decision may be influenced by several types of factors:

1. Earlier funding applications, that is to say, the past behaviour regarding funding application which is described by having or not applied for funding in 2007 (in 2007 or 2010, respectively);

2. The deteriorations observed between 2007 and 2010, especially with regard to its financial situation, the economic situation on its market and the general economic conditions;

3. The anticipated changes of these elements (financial situation, market prospects and the economy in general) for the period 2010-2013.

8.5.5.1 The influence of prior funding applications

The decision to seek funding in 2010 is mainly influenced by the fact of having already applied for funding in 2007. The request for funding appears as a recurring form of action by some companies that regularly seek external funding (and remember, most often secure the requested funding). The observation remains true when considering the type of funding request. For each type of financing, the likelihood of application in 2010 increases in the cases where the company sought any funding in 2007.

8.5.5.2 The impact of deteriorations observed between 2007 and 2010

However, the likelihood that a company requests funding in 2010 also varies under the influence of other factors, particularly when they perceived the negative effects of the crisis on their financial situation, their market or on the access to financing conditions.

The surveyed companies were asked to describe the trends they have observed through their financial situation, the costs of securing financing (interest, etc.), their debt-to-turnover ratio, other financing conditions (e.g. maturity, bank covenants, etc.), the procedures or efforts to secure financing, the credit institutions' willingness to grant funding, the relationships with competitors in the same industry, the prices of intermediate products (raw materials, oil, etc.), and through the demand for their products or services.

Five changes are likely to have a significant impact on seeking finance in 2010. The decrease in the demand for company products leads to a relative decrease in the likelihood of a funding application in 2010 only in the service sector. This effect disappears in the overall sample and when a distinction is made between the types of funding applications. The other effects remain significant in all the tested models.

A general financial situation that has deteriorated (for industrial undertakings) or the increase in prices of raw material (regardless of the branch of activity and only for loans in the second model) reduce the probability of funding applications in 2010. In addition, a worsened financial situation has a negative impact on the likelihood of a loan application or a capital increase but is not significant with respect to other sources of funding.

In contrast companies which have experienced an increase in their debt-to-turnover ratio are a little more likely to seek funding in 2010: the impact is stronger for industrial companies and remains positive and significant when we distinguish each type of financing. The past deterioration of this ratio is therefore not an obstacle for new funding applications.

Curiously, companies which have experienced an increase in the administrative burden associated with applying for funding are significantly more likely to apply for funding in 2010, particularly in the service sector. This result, which seems counter-intuitive at first, is actually quite frequent since companies that are most likely to seek funding are also more likely to perceive an increase in requirements and obstacles related to application procedures. However, this effect is significant only for other sources of funding.

8.5.5.3 The impact of anticipated changes (2010-2013)

Companies were also asked to quote - from a list of proposals - the main factors they believe may limit their future growth. These factors reflect the developments expected by the company and which are assumed to influence its current efforts to secure funding. In the first analysis and in a somewhat simplified way, the growth prospects of a company should condition its investment decisions, which in turn lead a decision on seeking external financial sources. The factors that may limit future growth according to the respondents are: the general economic outlook, a limited demand on the local/domestic market, a limited demand on the external/foreign market, difficulties to invest in necessary equipment, insufficient financing, new competitors on the market.

Quite logically, companies which believe that their growth may be constrained by limited demand on the local market or which anticipate inadequate funding are more likely to apply for funding. On the opposite, those who expect new competitors to enter on their market are less likely to seek funding in 2010. This effect is only significant (and negative) for services. For them, a future growth that is limited by a weak expected evolution on the local market or by the scarcity of funding has a positive impact on finance seeking in 2010. Finally, for industrial companies, the willingness to seek funding today is stronger if there are expected equipment investments to be made, even when the general economic context puts the company at risk of over-burdening its future growth potential.

In addition, each type of application for funding is determined by a combination of different factors. The anticipation of constraints on the growth of the company, whatever their nature, has no significant impact on finance seeking through a capital increase. Loan applications are more common for companies which anticipate that new equipment will be needed and that funding will be scarce (the latter is also significant for applications for other funding sources). Loan applications are less frequent when firms anticipate an application required by the arrival of new competitors on their market.

Table 2
Determinant of seeking finance in 2010

	PROBIT (mfx)			TRIPROBIT (coefficient)		
	All	**Industry**	**Services**	**Loans**	**Equity financing**	**Other sources**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Seeking finance						
Seeking finance in 2007	0.601 ***	0.656 ***	0.589 ***	0.790 ***	0.979 ***	1.313 ***
	(0.026)	(0.039)	(0.044)	(0.095)	(0.117)	(0.092)
Characteristics of the company						
Turnover (2009) *(ln)*	0.007	-0.037	0.025	-0.071	0.164 **	0.044
	(0.019)	(0.037)	(0.019)	(0.074)	(0.083)	(0.070)
Number of employees (2009)						
[10 ; 19]						
[20 ; 49]	0.028	0.039	0.042	0.154	-0.145	-0.074
	(0.032)	(0.056)	(0.037)	(0.119)	(0.138)	(0.114)
[50 ; 99]	0.041	0.186	-0.017	0.191	-0.562 **	0.005
	(0.056)	(0.123)	(0.048)	(0.197)	(0.239)	(0.183)
[100 ; max]	-0.019	0.081	0.012	0.239	-0.192	-0.460
	(0.074)	(0.159)	(0.091)	(0.294)	(0.323)	(0.291)
Age	-0.001	-0.003 *	0.000	-0.001	0.000	-0.003
	(0.001)	(0.002)	(0.001)	(0.003)	(0.003)	(0.003)

Negative changes that were perceived between 2007 and 2010						
Financial situation of your company	-0.042	-0.115 ***	0.029	-0.250 **	-0.293 *	0.059
	(0.029)	(0.043)	(0.040)	(0.126)	(0.152)	(0.119)
Debt-to-turnover ratio of your company	0.110 **	0.267 ***	0.020	0.270 **	0.506 ***	0.279 **
	(0.046)	(0.084)	(0.042)	(0.127)	(0.149)	(0.126)
Cost (interests and other) of securing a funding	0.028	0.081	-0.011	0.117	0.132	-0.107
	(0.041)	(0.071)	(0.042)	(0.138)	(0.161)	(0.138)
Procedures or efforts to secure a funding	0.143 **	0.084	0.155 **	0.243	0.142	0.365 **
	(0.060)	(0.083)	(0.077)	(0.156)	(0.192)	(0.158)
Credit institutions' willingness to grant financing	0.004	-0.009	0.022	0.194	0.136	-0.051
	(0.041)	(0.062)	(0.049)	(0.149)	(0.180)	(0.148)
Relationships with competitors of your branch of activity	0.012	0.041	-0.017	0.196	0.079	-0.009
	(0.033)	(0.057)	(0.034)	(0.121)	(0.142)	(0.118)
Prices of intermediate products (raw materials, oil, etc.)	-0.072 **	-0.104 **	-0.048 *	-0.248 **	-0.145	-0.045
	(0.029)	(0.048)	(0.028)	(0.109)	(0.128)	(0.105)
Demand for your products	-0.012	0.074	-0.049 *	-0.110	0.016	-0.108
	(0.031)	(0.063)	(0.029)	(0.125)	(0.145)	(0.121)
Constraints on future growth						
The general economic outlook	0.037	0.084 *	0.007	0.061	0.103	0.083
	(0.031)	(0.051)	(0.034)	(0.114)	(0.139)	(0.110)
A limited demand on the local/domestic market	0.078 **	-0.017	0.135 ***	0.105	0.104	0.107
	(0.031)	(0.040)	(0.043)	(0.097)	(0.115)	(0.095)
A limited demand on the external/ foreign market	0.021	-0.003	0.026	0.186	-0.135	0.044
	(0.039)	(0.061)	(0.044)	(0.135)	(0.168)	(0.134)
Essential investments in equipment	0.070	0.199 **	-0.021	0.288 **	-0.180	0.189
	(0.046)	(0.085)	(0.039)	(0.135)	(0.177)	(0.138)
Financing dap	0.171 **	0.055	0.275 **	0.363 **	0.297	0.406 **
	(0.075)	(0.101)	(0.108)	(0.178)	(0.202)	(0.178)
New market entrants	-0.059 **	-0.017	-0.060 **	-0.246 **	-0.020	-0.115
	(0.025)	(0.042)	(0.027)	(0.105)	(0.120)	(0.100)
Sectors						
(Industry)						
Construction	-0.026	-0.041		-0.120	-0.395 **	-0.013
	(0.044)	(0.049)		(0.165)	(0.200)	(0.164)
Trade	-0.024			0.034	-0.079	-0.297
	(0.048)			(0.183)	(0.213)	(0.184)
Transport	-0.016		0.034	-0.056	0.145	-0.038
	(0.061)		(0.056)	(0.220)	(0.252)	(0.220)
HORECA	-0.052		0.022	0.051	0.219	-0.512 **
	(0.053)		(0.049)	(0.207)	(0.239)	(0.222)
Other services	-0.055		-0.011	-0.521 **	0.016	0.058
	(0.049)		(0.037)	(0.205)	(0.223)	(0.186)
Constant				-1.217 ***	-1.879 ***	-1.280 ***
				(0.216)	(0.262)	(0.214)
				rho21	0.231 ***	(0.078)
				rho31	-0.240 ***	(0.071)
				rho32	-0.251 ***	(0.077)
N	1.129	493	636		1.129	
LogL	-528.882 ***	-219.485 ***	-287.269 ***		-1310.254 ***	
Pseudo R2 (%)	31.79	35.59	33.74			
Forecast (%)	80.34	81.95	80.03	*Ratio test Max. likelihood rho21 = rho31 = rho32 = 0: chi2(3) = 27.6324 prob > chi2 = 0.0000*		

Notes: The marginal effects are calculated by reference to the value 0 for discrete variables, 20 for the age and to the average for other continuous variables.
The reference classes are in italics.
Standard deviations are in parentheses. *** p<0.01 ; ** p<0.05 ; * p<0.10

8.5.6 Determinants of funding applications in 2013

The same groups of exogenous variables have been used in models seeking to shed light on the determinants of funding applications that companies plan to use in 2013.

8.5.6.1 The influence of prior funding applications

Here, the influence of past behaviour is represented by three variables: seeking finance only in 2007, seeking finance only in 2010 and seeking finance in 2007 and in 2010. Whether we consider the whole sample or sub-samples of industrial and service companies, the effect of the past is always significant and the marginal effect is largest for the third variable. This result confirms the intuition from previous results that companies which rely on external financing have a strong inclination to do so on a regular basis. Thus, the past explains not only the present but also the future as is confirmed by the triprobit estimation of probabilities of funding application per type. Indeed, it appears that the earlier applications are highly significant for all considered types of financing (except for capital increase in 2007).

8.5.6.2 The impact of deteriorations observed between 2007 and 2010

Unsurprisingly, all variables describing the perception of deterioration of the economic environment during the crisis have limited explanatory power to explain the projected behaviour. However, industrial companies see their willingness to consider a funding application increase slightly in 2013 when they experienced a weakened financial situation between 2007 and 2010. On the opposite, all companies - but especially service companies - which have felt increasing competition, consider most frequently making use of external financing in 2013. This positive effect related to the deterioration of relationships with competitors in their sector of activity is new compared to previous estimates. Finally, the positive impact of the increase in the administrative burden on the willingness to seek funding in 2013 reappears: it is significant especially in service companies and for other funding sources.

8.5.6.3 The impact of anticipated changes (2010-2013)

The main significant effects are those that also determine the willingness to seek funding in 2010, but they become more common and more stable across the different estimates made. As in the previous model, the most important significant effect is measured for those companies which anticipate that inadequate funding will be a major obstacle to their growth. This effect becomes significant also for the industrial companies when taken separately and not just for service companies. This applies also to essential equipment investments, whose important marginal effect becomes significant also for service companies in the probit model and for which the coefficient remains significant for other sources of funding in the triprobit model. The other significant effects have a lower marginal impact. As for the 2010 model, a limited anticipated demand on the local market encourages the corporate finance demand but this time mainly of industrial companies. The effect is significant for loan applications as well as for the considered capital increases. As before, the only negative effect concerns the arrival of new competitors that slightly discourages applications for finance of service companies. The effect of this factor is still only significant for loan applications.

Table 3
Determinants in seeking finance in 2010

	PROBIT (mfx)			TRIPROBIT (coefficient)		
	All	**Industry**	**Services**	**Loans**	**Equity financing**	**Other sources**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Seeking finance						
Seeking finance only in 2007	0.224 ***	0.172 **	0.236 ***	0.788 ***	0.308	0.604 ***
	(0.061)	(0.081)	(0.081)	(0.157)	(0.242)	(0.178)
Seeking finance only in 2010	0.145 ***	0.134 **	0.147 **	0.409 ***	0.727 ***	0.486 ***
	(0.046)	(0.066)	(0.057)	(0.137)	(0.179)	(0.156)
Seeking finance in 2007 and in 2010	0.345 ***	0.317 ***	0.357 ***	0.832 ***	0.964 ***	1.038 ***
	(0.052)	(0.070)	(0.066)	(0.100)	(0.138)	(0.113)
Characteristics of the company						
Turnover (2009) *(ln)*	0.006	0.020	-0.005	0.016	0.030	0.004
	(0.012)	(0.023)	(0.012)	(0.067)	(0.087)	(0.075)
Number of employees (2009)						
[10 ; 19]						
[20 ; 49]	0.013	-0.002	0.014	0.094	0.038	0.038
	(0.020)	(0.029)	(0.022)	(0.108)	(0.140)	(0.120)
[50 ; 99]	0.014	0.011	0.008	0.196	0.057	0.024
	(0.033)	(0.055)	(0.034)	(0.177)	(0.228)	(0.197)
[100 ; max]	0.007	0.013	-0.029	0.292	0.203	-0.154
	(0.050)	(0.080)	(0.040)	(0.272)	(0.323)	(0.297)
Age	-0.001	-0.000	-0.001	-0.000	-0.000	-0.003
	(0.000)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)

Negative changes that were perceived between 2007 and 2010						
Financial situation of your company	0.018	0.090 *	-0.018	0.076	-0.078	-0.044
	(0.022)	(0.051)	(0.018)	(0.111)	(0.149)	(0.125)
Debt-to-turnover ratio of your company	0.002	-0.018	0.010	0.058	0.083	-0.046
	(0.022)	(0.027)	(0.026)	(0.120)	(0.151)	(0.132)
Cost (interests and other) of securing a funding	-0.017	-0.000	-0.024	-0.164	-0.022	-0.113
	(0.021)	(0.032)	(0.021)	(0.131)	(0.165)	(0.141)
Procedures or efforts to secure a funding	0.086 **	0.108	0.051	0.194	0.191	0.377 **
	(0.043)	(0.067)	(0.043)	(0.145)	(0.177)	(0.155)
Credit institutions' willingness to grant financing	0.021	0.003	0.032	0.202	-0.063	-0.032
	(0.028)	(0.035)	(0.036)	(0.136)	(0.168)	(0.147)
Relationships with competitors of your branch of activity	0.075 **	0.041	0.097 **	0.264 **	0.169	0.251 **
	(0.032)	(0.037)	(0.046)	(0.108)	(0.137)	(0.117)
Prices of intermediate products (raw materials, oil, etc.)	0.001	0.006	-0.003	0.079	0.101	0.070
	(0.018)	(0.029)	(0.019)	(0.102)	(0.133)	(0.113)
Demand for your products	0.011	-0.018	0.034	-0.044	0.153	0.115
	(0.021)	(0.026)	(0.030)	(0.111)	(0.140)	(0.120)
Constraints on future growth						
The general economic outlook	0.025	0.022	0.024	0.093	-0.030	0.066
	(0.020)	(0.028)	(0.024)	(0.105)	(0.137)	(0.115)
A limited demand on the local/domestic market	0.046 **	0.060 *	0.024	0.209 **	0.268 **	0.144
	(0.022)	(0.034)	(0.021)	(0.089)	(0.117)	(0.098)
A limited demand on the external/ foreign market	0.010	-0.000	0.024	0.107	0.143	0.143
	(0.024)	(0.034)	(0.030)	(0.127)	(0.159)	(0.137)
Essential investments in equipment	0.131 ***	0.134 *	0.110 **	0.590 ***	0.142	0.407 ***
	(0.047)	(0.070)	(0.053)	(0.128)	(0.162)	(0.134)
Financing dap	0.260 ***	0.263 **	0.202 **	0.661 ***	0.138	0.379 **
	(0.081)	(0.122)	(0.092)	(0.168)	(0.202)	(0.171)
New market entrants	-0.027 *	-0.009	-0.031 *	-0.249 ***	0.016	0.010
	(0.016)	(0.023)	(0.017)	(0.095)	(0.121)	(0.104)
Sectors						
(Industry)						
Construction	-0.012	-0.015		-0.072	0.170	-0.280 *
	(0.027)	(0.028)		(0.159)	(0.220)	(0.163)
Trade	-0.032			-0.169	0.183	-0.559 ***
	(0.030)			(0.176)	(0.240)	(0.188)
Transport	0.049		0.075	-0.093	0.526 **	0.108
	(0.047)		(0.049)	(0.210)	(0.267)	(0.212)
HORECA	-0.011		0.007	-0.034	0.570 **	-0.484 **
	(0.034)		(0.029)	(0.200)	(0.262)	(0.218)
Other services	-0.038		-0.013	-0.330 *	0.386	-0.468 **
	(0.030)		(0.022)	(0.186)	(0.245)	(0.196)
Constant				-1.376 ***	-2.535 ***	-1.471 ***
				(0.211)	(0.308)	(0.230)
				rho21	0.525 ***	(0.056)
				rho31	0.617 ***	(0.043)
				rho32	0.421 ***	(0.061)
N	1.129	493	636		1.129	
LogL	-586.456 ***	-269.454 ***	-308.851 ***		-1261.797 ***	
Pseudo R2 (%)	21.19	18.87	24.70	*Ratio test Max. likelihood rho21 = rho31 = rho32 = 0: chi2(3) = 247.417 Prob > chi2 = 0.0000*		
Prédiction (%)	74.84	71.60				

Notes: The marginal effects are calculated by reference to the value 0 for discrete variables, 20 for age and to the average for other continuous variables.
The reference classes are in italics.
Standard deviations are in parentheses. *** p<0.01 ; ** p<0.05 ; * p<0.10

8.5.7 Conclusion

The survey on access to finance of companies was conducted on a representative sample of independent firms and therefore the most likely to witness a drying-up of external financing sources in the economic context of 2007-2010. Finally, the results of the survey show that these companies have not particularly suffered, even if the situation can change very quickly and should be followed with appropriate tools (barometer types). In the longer perspective which fits this study of structural determinants, it should be borne in mind that the investigation cannot observe the investment decisions of the company, but simply the decision to seek funding. On the one hand, the company can invest without resorting to external financing and on the other hand, it can apply for funding which is not intended for investment. Actually, other sources of funding cover short-term instruments that could be used for other purposes such as cash advances[6].

Despite these important limitations, the contribution of the survey and of the models is significant. First, the models were used to highlight the weight of habits on funding requests. Thus, companies that rely on external financing tend to do it regularly. Second, the survey shows that when a company decides to use external financing, in the vast majority of cases (88%), its applications are successful. Models cannot determine whether this result is due to a kind of self-rationing from companies that would integrate in advance the constraints that could be imposed by financial institutions and that would prevent access to external financing. However, they clearly show that a clear perception of potentially negative effects of the crisis influences the probability of having used or planning to use external financing primarily in order to invest.

[6] To account for the investment behaviour of those companies which do not rely on external funding, other essential sources of information - such as measuring the cash flow of the companies surveyed - proved to be unproductive.

8.5.8 Bibliography

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8.6 Attempt at characterizing eco-innovative companies in Luxembourg[1]

8.6.1 Introduction

According to Rennings (2000), eco-innovation is to identify and promote technologies that contribute to the achievement of sustainable development. From the outset eco-innovation differs from innovation in that its content has a social and ecological purpose. Eco-innovation is evaluated through its "reduced" environmental impacts of greenhouse gas emissions, air and water pollution, energy consumption and soil contamination[2]. From this point of view, a major innovation in its contribution to the reduction of environmental damage may have a low technological content, be deployed on the market or off-market, come from institutional arrangements, changes in the behaviour of households and individuals as well as significant changes in products and production processes of industrial or service companies. Yet it is only this last category that enters the field of innovations as defined in the Oslo Manual of the OECD (2005) and that we consider through the data and models presented in this study.

If one examines the sources of innovation, two hypotheses have been proposed by Schumpeter 30 years apart: the first hypothesis presented in the "Theory of economic development" (1912) emphasizes the central role of the individual entrepreneur which "is to reform or revolutionize the pattern of production by exploiting an invention, an untried technical possibility." This role is central because it is the driver of innovation and economic progress through the changes, imbalances and finally through the creative destructions that it imposes upon the economic fabric. In this "Demand Pull" model, demand pulls innovation. The second hypothesis is derived from "Capitalism, Socialism and Democracy" (1942) where Schumpeter notes with disillusion the "twilight of the entrepreneurial function". "Innovation itself is being reduced to routine. Technical progress is increasingly becoming the business of teams of trained specialists who turn out what is required and make it work in predictable way"[3]. This model called "Technology Push" is based on the production of basic and applied knowledge, organized on a large scale. Subsequently, authors agreed on the one hand, to separate the determinants and types of companies, and on the other hand, to observe that, in fact, innovation seems to be both pulled by demand and pushed by technology through partnerships and alliances between start-ups and large companies as well as public and private research organizations and funders.

[1] Contact: Leila Ben-Aoun Peltier (leila.ben-aoun@statec.etat.lu) and Anne Dubrocard (anne.dubrocard@statec.etat.lu) – STATEC – EPR2. This is a very preliminary analysis still in progress and the results must still be considered very cautiously.

[2] That is to say, according to P. James (1997) who first defined eco-innovation as "new products and processes which provide customer and business value but significantly decrease environmental impacts".

[3] Quoted by A. Hamdouch in *Dictionnaire de l'économie*, article "Innovation" (2007).

In this context, eco-innovation should be seen as a subset of products or processes innovations and of organizational changes, characterized by a double externality and for which, therefore, regulation plays an essential role (regulatory push-pull effect) alongside the traditional factors of supply and demand (technology push and demand push). Indeed, Belin et al. (2011) point out that eco-innovations generate positive externalities both during the dissemination of knowledge phase and during the dissemination of eco-innovation phase. In the first phase, it is the standard positive effects of the dissemination of knowledge, for which private costs and social costs diverge, making profit appropriation from investments in R&D difficult and leading sub-optimal level of investment. Or, to put it another way, "the private return (which only goes to innovators) is lower than the social return, which is appropriated partly by imitators and partly also by consumers. As a result, in a decentralized economy, the equilibrium level of investment in research and development is a priori less than a socially optimal level" (Cohendet et al. (1999)). In the phase of adoption and diffusion of innovation, the positive effects on the environment result in lower external costs compared to those of goods and services in market competition.

The Porter Hypothesis and its disruption

As a consequence of the underinvestment resulting mechanically from this double "market inefficiency", the regulatory environment is a crucial determinant of corporate eco-innovative behaviour. In contrast to the usual approach which considers that the development of standards and regulations for protecting the environment is only a source of cost and thus a negative externality for the companies that are subject to it, Porter and Van der Linde (1995) develop the assumption that: "Properly designed environmental standards can stimulate innovations that may partially or more than offset the costs of compliance with these standards"[4]. To support this hypothesis, they rely on a four-point argument taken up by Gallaud et al. (2012). Pollution should be considered as a waste of resources by the company, the pollutants are expensive to produce and to use, and regulation is a sign for the company. The authors take the example of waste: made aware of the waste through the recycling obligation imposed from the early 90s, companies have developed processes and recycled products that have generated additional income. By defining acceptable pollution thresholds and sufficient time spans to achieve them, regulation reduces uncertainty at the same time that it increases the competitive pressure. Both effects are positive incentives to invest and innovate (Arundel and Kemp 2009).

[4] Quoted by Belin, Horbach and Oltra (2011).

Measuring the impact of eco-innovation

Identifying the corporate behaviour in terms of eco-innovation and measuring its impact on growth has become an issue of public policy, whose intervention can be justified theoretically. A first insight into this behaviour is provided by the responses to a set of specific questions contained in the Community Innovation Survey (CIS) conducted in 2008 in Luxembourg. The environmental economic accounts established by STATEC provide measurements of greenhouse gas emissions which are detailed in the classification of economic activities adapted to environmental approaches (NAMEA). These data sources are mobilized for this study which aims at exploring the causality between latent variables or components that could show the variation of the exogenous variables and of the dependent variables. The partial least squares (PLS) method deployed for this purpose is a method of "soft modelling" based on a variance analysis which requires no assumption of variable multi-normality. This is an econometric technique used to build predictive models when the explanatory variables are many and highly correlated compared to the number of observations. It is especially popular in the social sciences to analyse complex interactions, especially since it can be deployed on observations of very small samples[5]. It is particularly suited to testing hypotheses and concepts of eco-innovation based on the database built for Luxembourg.

8.6.2 The tested hypotheses

It is therefore a matter of capturing the multidimensional and complex process that leads companies to innovate and then to eco-innovate and linking these decisions to their expected outcomes in terms of economic and environmental impacts. We saw in the introduction that the concept of eco-innovation applies to a subset of products, processes or organizations that are new to the company or to the market and that significantly reduce the impact of production on the environment.

[5] It is sometimes recommended to have a minimum sample size of between 30 and 100 observations or other more sophisticated rules that still remain very empirical (Chin & Newsted 1999).

8.6.2.1 The factors of innovation

As has already been said, we usually distinguish technological innovation (new products and processes) and non-technological innovation (organizational changes, or method of marketing changes). Both types of innovations are often complementary and could also be stimulated by the initial objective of the innovation that is primarily aimed at improving the competitive position of the company (by entering new markets, increasing its market share or reducing its production unit costs) or rather at developing its products and services by renewing them, extending their range or improving their quality.

H1: Companies are all the more innovative as they seek to improve their competitive position.

H1a: Companies are all the more prone to develop technological innovations as they seek to improve their competitive position.

H1b: Companies are all the more prone to deploy organizational changes as they seek to improve their competitive position.

H2: Companies are all the more prone to develop technological innovations as they seek to improve their products and services.

8.6.2.2 Determinants of eco-innovation

Many recent studies (Mazzanti and Zoboli (2006), Rehfeld et al. (2007), Wagner (2007), Belin et al. (2011), Nguyen Groff (2012)) focus on identifying the determinants of eco-innovation. The main determinants are related to environmental regulations, to the information sources mobilized in the innovation process and to the types of innovation already deployed.

Regulations

Based on the landmark Porter and Van der Linde (1995) study, several empirical studies seek to test the so-called Porter hypothesis, stating that regulation plays a specific and decisive role in the eco-innovator's decision. Jaffe and Palmer (1997) propose three more or less strong expressions of the Porter hypothesis: the weakest one states that environmental regulation stimulates eco-innovation and the strongest one states that strict regulation generates gains which outweigh the costs it creates for the company. Ambec et al. (2008) validate the weak hypothesis on a database of 7 OECD countries, but the results are more mixed for the two strong formulations of the hypothesis. In addition, Kammerer (2009) emphasizes that the impact of environmental regulation also depends on the objective of the eco-innovation in question.

In particular, we distinguish between "clean technology" and "end-of-pipe" eco-innovations. The first ones are process eco-innovations that reduce environmental costs through process innovation or organizational change in order to limit the negative externalities during the production process. The second ones consider the entire product life cycle and aims at reducing the environmental impact of products during their consumption and transformation into waste. Here it is about transforming products and services, for example to enhance recyclability or to reduce packaging or harmfulness of waste at the end of product life cycle.

H3: When a company must comply with an environmental regulation or must pay environmental taxes, it develops eco-innovations more frequently.

H3a: When a company must comply with an environmental regulation or must pay environmental taxes, it is more likely to develop clean technologies.

H3b: When a company must comply with an environmental regulation or must pay environmental taxes, it is more likely to develop "end-of-pipe" eco-innovations.

Mobilized sources of information for innovation

As in literature on innovation[6], knowledge acquisition plays an important role in studies on determinants of eco-innovation. According to Mazzanti et al. (2010) knowledge is a key factor in facilitating the adoption of environmental innovations. However, it appears that the impact depends on the sources of information considered, but the direction of the effect and its significance are not clearly established in empirical studies. Borghesi et al. (2012) measure so the impact of mobilized information sources on the environmental innovation capabilities of Italian companies (ECI 2008). In their estimates, the impact is significant only when information sources are internal or are transmitted through suppliers but Groff and Nguyen (2012) obtained very different results from the data of the survey conducted in Luxembourg. Thus, according to the model, the impact is significant and positive when firms rely on internal resources or information transmitted through their customers for eco-innovation in products or processes and the sign is reversed when they are based on internal information to develop clean technologies.

[6] This hypothesis has already been tested for example by Pavitt and Malerba (2004).

H4: Companies are all the more prone to eco-innovate as they make intensive use of the sources of information in order to innovate.

H4a: Companies are all the more prone to develop clean technologies as they make intensive use of their markets (customers, suppliers, competitors) as sources of information in order to innovate.

H4b: Companies are all the more prone to develop clean technologies as they make intensive use of public institutions (universities, government, research centres) as sources of information in order to innovate.

H4c: Companies are all the more prone to develop "end-of-pipe" eco-innovations as they make intensive use of their markets (customers, suppliers, competitors) intensively, as sources of information in order to innovate.

H4d: Companies are all the more prone to develop "end-of-pipe" eco-innovations as they make intensive use of public institutions (universities, government, research centres) as sources of information in order to innovate.

Types of innovation

For Belin et al. (2011) the different types of eco-innovation are closely linked to the types of innovation developed within the company. To show this, these authors measure the impact of all possible combinations between innovation in products, processes, organizational change and marketing on the development of clean technologies and "end-of-pipe" eco-innovations. They get mixed results: the impact is significant for France but not for Germany. Zoboli & Mazzanti (2006) and Wagner (2007) get a strong correlation between organizational innovation and the eco-innovation of process and product.

H5: Companies are all the more likely to develop eco-innovations as they have already innovated.

H5a: Companies are all the more likely to develop clean technologies as they have already made organizational changes.

H5b: Companies are all the more likely to develop clean technologies as they have already developed technological innovations.

H5c: Companies are all the more likely to develop "end-of-pipe" eco-innovations as they have already made organizational changes.

H5d: Companies are all the more likely to develop "end-of-pipe" eco-innovations as they have already developed technological innovations.

8.6.2.3 The impact of eco-innovation on economic and environmental performances

The concepts related to eco-innovation have been developed recently and so far few studies seek to quantify the impacts of eco-innovation. On a theoretical level, however, environmental innovations should have impacts through improved performance of two types: environmental performance and economic performance.

Environmental performance is the ultimate purpose of environmental innovations (e.g. reduction of emissions, lower energy consumption, recycling...) but the effects are, as we have seen, positive externalities that spread across a country, a region or a population. Potential beneficiaries do not directly control the decision, while the eco-innovating company or branch fails to take full advantage of it and it must bear the cost of a negative externality if it does nothing. As a result, the extent of the effect is a two-fold problem. A first difficulty is the time lag between the development of the eco-innovation and the dissemination of benefits for the environment. The second arises from the obligation to change the level of analysis to observe the phenomenon, which also implies having access to multiple sources of information.

Economic performance is a priori easier to measure at least for the part that is directly readable by the company through costs, turnover or changes in the number of employees (Horbach 2011). Indeed, following the Porter hypothesis, costs should decrease over the long term through a better use of inputs. Improved revenue can come from the creation of new markets or from the sale of products for which a larger (profit) margin is acceptable to consumers whose willingness to pay is higher for "organic" products for instance (Kammerer, 2009). However, the time lag and the difficulty of acquiring additional data make the measurement of the performance as delicate as the previous one.

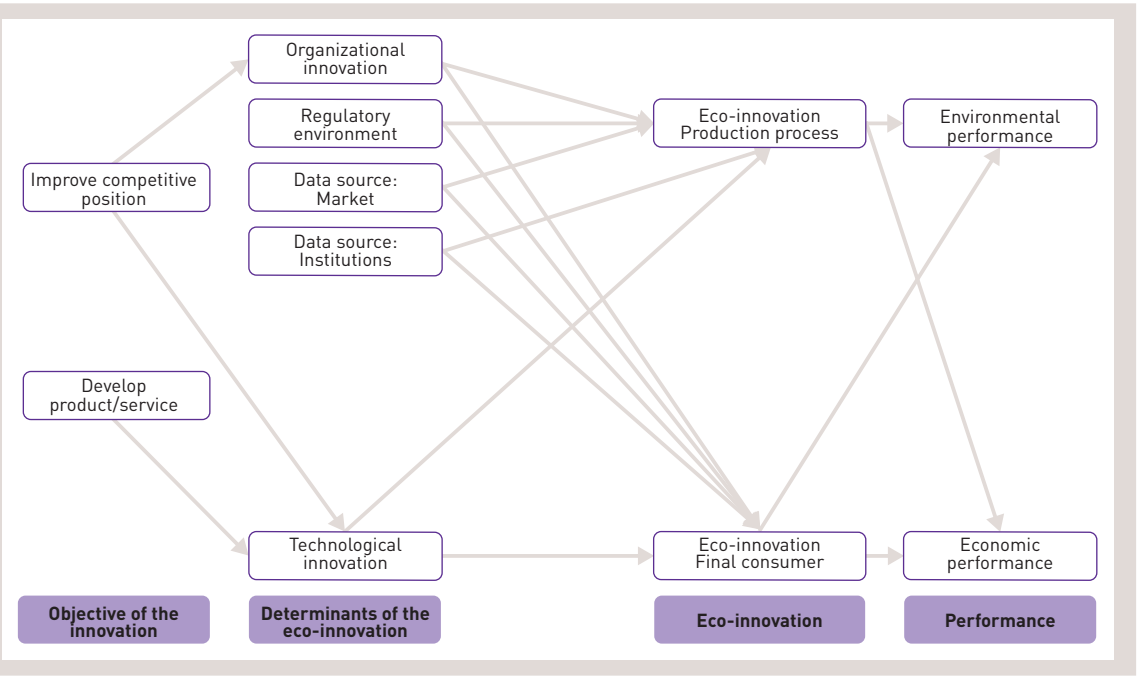
Therefore, the positive scope of environmental innovations has been the subject of a few case studies and Mazzanti and Zoboli (2009), who study the determinants of eco-innovation, admit that they are unable to use their model to test the impact of eco-innovation on performance.

H6: Companies that eco-innovate improve their performance and that of their sector of activity.

- H6a: Companies that develop clean technologies improve their economic performance.
- H6b: Companies that develop clean technologies improve the environmental performance of their sector of activity.
- H6c: Companies that develop "end-of-pipe" eco-innovations improve their economic performance.
- H6d: Companies that develop "end-of-pipe" eco-innovations improve the environmental performance of their sector of activity.

All hypotheses presented will therefore be tested in an exploratory search model of causality between latent variables: objectives of innovation, innovation, eco-innovation and performance explained by sets of explanatory criteria. The objectives of the innovation should have a significant impact on the type of innovation deployed by innovative companies; in turn the type of innovation and the regulatory environment contribute in a differentiated way to eco-innovation, which we hope will partly determine the economic and environmental performances.

Chart 1
Tested causal links



Source: Diagram by the authors

8.6.3 Databases

Several databases have been mobilized to carry out this analysis.

The Community Innovation Survey (CIS) is a mandatory European survey which provides information on the corporate behaviour in terms of innovation. In Luxembourg, only the 2008 issue, covering the period 2006 to 2008, includes a specific module dedicated to the environment.

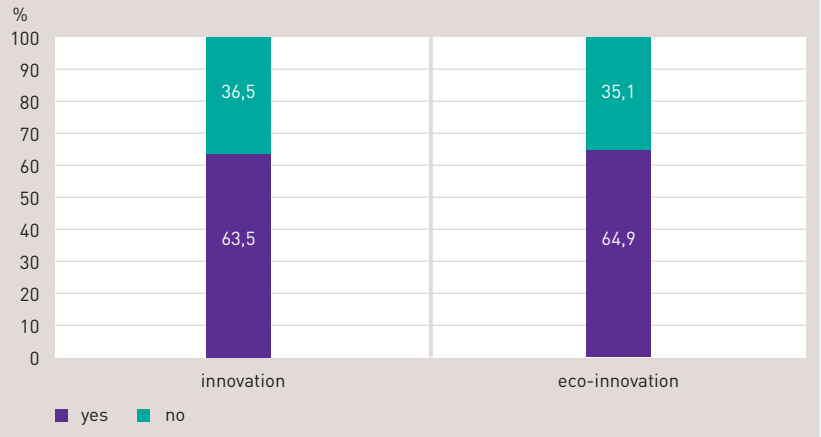
In order to measure environmental performance, data from satellite accounts of the national accounts are merged with data from the CIS 2008. NAMEA accounts data are only available at an aggregate level and for the years ranging between 2000 and 2010. The finest aggregation level available (called level 3) was used. Categories that compose it are described in the appendix (NAMEA account).

Finally, the economic performance of companies is measured by changes in the employment and turnover of the company, calculated from the data of the directory of companies.

8.6.3.1 Eco-innovation in the CIS survey 2008

While 63.5% of companies[7] innovate, 41.2% "eco-innovate". In fact, regardless of the type of eco-innovation considered, 64.9% of innovative companies are eco-innovative.

Chart 2
Proportion of eco-innovating companies



Source: STATEC, Community Innovation Survey 2006-2008

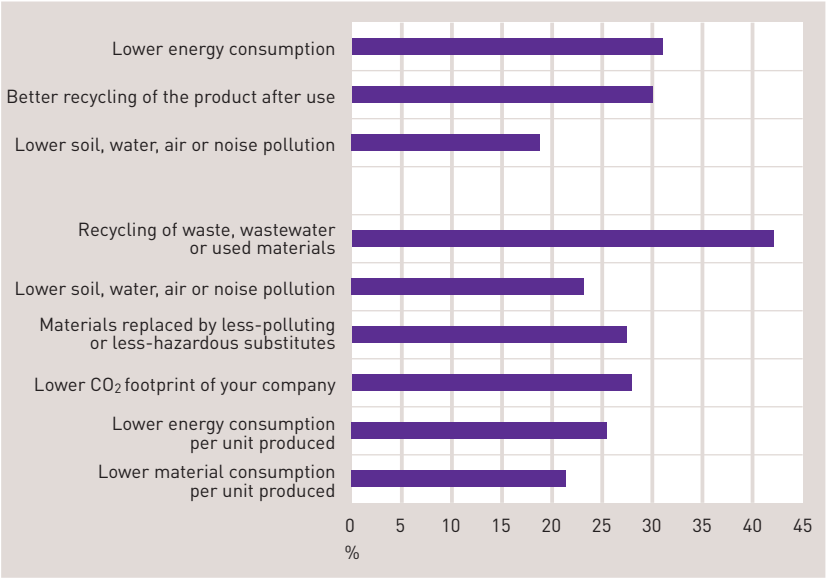
[7] Representative sample of companies with more than 10 employees established in Luxembourg. Companies are considered innovative regardless of the type of innovation considered (innovation of products, processes, organizational changes or marketing innovation).

In the survey, the objectives of innovation are described using 8 criteria allowing identifying the types of eco-innovation. Several objectives can be pursued through the development of the same eco-innovation. Most of the proposals listed in the question are referring to the development of eco-innovations within the production process. The commonly pursued objective is the recycling of waste and materials used in the process (42%). The objectives which are strictly aimed at lower emissions such as the substitution with less polluting materials (27%) and the lowering of the carbon footprint (28%) are, along with recycling, also areas where regulation is particularly present. The objectives of rationalizing costs on the long term such as reducing energy or material consumption per unit produced (25.5% and 21.4% respectively) were less frequently cited.

The objective of eco-innovations

Regarding "end-of-pipe" technology aimed at reducing the negative effects on the environment during and after the consumption of goods and services by the final consumers, a lower energy consumption (31%) and better recycling of the product after use (30%) were the most frequently quoted objective.

Chart 3
The objective of developed eco-innovations

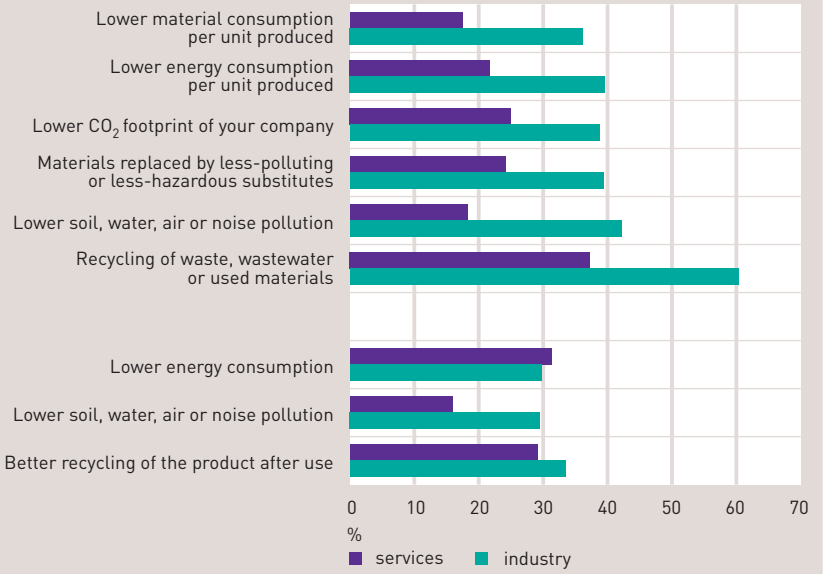


Source: STATEC, Community Innovation Survey 2006-2008

However, the objectives which are primarily pursued by industrial and service companies are very different as far as eco-innovation process goes, and are subtler for innovations regarding environmental impacts occurring after the sale of the product or service. If, for "end-of-pipe" eco-innovations, lower energy consumption remains a shared and important goal, along with after use recycling, by contrast, lower soil, air and water pollution is only mentioned by 16% of service companies, against 29% of industrial enterprises.

Regarding the development of eco-innovations within the production process, waste recycling is a goal pursued by 60% of industrial eco-innovative companies (against less than 40% of service companies) and the other pollution and consumption reduction objectives are mentioned by 39% to 40% of industrial companies (against 22% to 25% of service companies).

Chart 4
Eco-innovation in industry and services

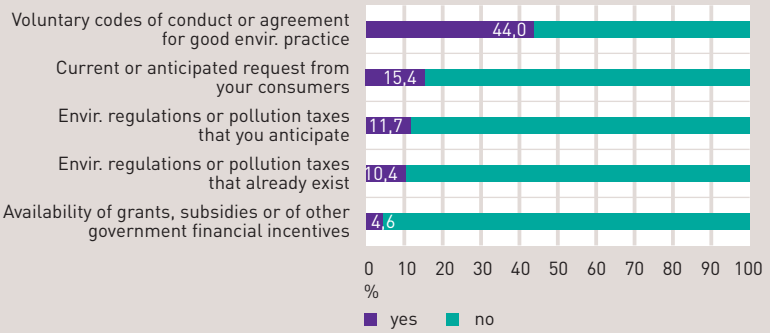


Source: STATEC, Community Innovation Survey 2006-2008

Origin of the eco-innovative approach

According to the respondents, the main motivation that led them to eco-innovate is the voluntary adoption of a code of conduct or of agreements for good environmental practices (44%). The constraints imposed by current or expected environmental regulations and pollution taxes only influence 10% and 12% respectively of eco-innovative companies. This equates to a less pressing motivation than the current or anticipated demand from customers (15%).

Chart 5
Eco-innovation incentives



Source: STATEC, Community Innovation Survey 2006-2008

Information from the CIS 2008 database was finally completed by indicating the environmental results from the NAMEA national accounts aggregated at level 3 of the nomenclature for the industry to which the considered company belongs. The distribution of companies by branch in the final database is shown in the following table.

Table 1
Distribution of companies according to NAMEA activity in the final database

Sectors	Number of companies in %
Non-energy mining and quarrying products	1.18
Agricultural and food industries products	3.89
Textile and clothing industry products	1.01
Paper and cardboard; published products	3.55
Chemicals	1.52
Rubber or plastic products	1.86
Other non-metallic mineral products	1.69
Metal products and metal working products	6.42
Machinery and equipment	2.70
Electrical and electronic equipment	3.21
Transport equipment	1.52
Other manufactured products	2.36
Production and distribution of electricity, gas and heat	1.18
Collection, purification and distribution of water	0.68
Construction	0.34
Wholesale trade and commission trade	13.68
Transport and communications	17.74
Financial intermediation	7.43
Insurance	1.18
Auxiliaries to finance and insurance	5.41
IT activities	10.14
Services provided principally to firms, R&D	8.45
Sewage and refuse disposal, sanitation and waste management	2.53
Associative activities	0.17
Recreational, cultural and sporting activities	0.17
Total	**100**

Source: STATEC, Community Innovation Survey 2006-2008 and NAMEA
Calculations by the authors

8.6.4 The construction of the model

Therefore the proposed model seeks to identify three sets of causal links between the four sets of process variables.

1. In a first series of links, it is to test the impact of the different objectives assigned to the innovation on the development of technological or non-technological innovations. Remember that eco-innovation is at first an innovation; hence, its determinants are also those for innovation. It is important to represent the determinants of innovation in the model and to choose the suitable variables for this representation[8] so as to analyse their direct impact on the types of innovation but also their indirect impact on eco-innovation, as the partial least squares (PLS) method allows. Belin et al. (2011) note that innovation is mainly driven by two factors: market conditions on the one hand and on the other hand the technological capabilities of the company. Market conditions result in the willingness of the company to innovate in order to improve its competitive position. The technological capabilities of the company are captured through its development objectives and the improvement of its products and services.

2. The second stage of research of causalities focuses on the determinants of eco-innovation in the production process and of eco-innovation aiming at making products and services less harmful to the environment during their use and disposal.

3. Finally, the last set of links is intended to highlight possible causalities between these eco-innovations and the economic and environmental performance as measured in the database.

The PLS method is based on the construction of latent variables representing the non-observable underlying phenomenon which we want to model. A set of indicators is mobilized to describe this latent variable using a construct that represents the common cause shared by all indicators. This method has several advantages over multiple regressions or methods of analysis of variance:

- It can simultaneously test the existence of causal relationships between several explanatory latent variables and several explained latent variables;

- It also allows to test the validity of the latent constructs, developed from the combination of several items;

- Finally, the sample size needed for the estimation may be very small.

The application of PLS regression to the treatment of simultaneous equation model was carried out with the software SmartPLS (Ringle et al., 2006).

[8] Spending on R&D is often used to represent one of the main determinants of innovation. However, the available data do not distinguish R&D dedicated to innovation from R&D dedicated to eco-innovation.

Frame 1
Definition of constructs

Stage 1:
describing the objectives of innovation

The company aims to improve its competitive position...

- by entering new markets
- by increasing its market share
- creating new export opportunities
- by lowering unit costs

The company aims first to develop its products and services offer...

- by expanding its range of goods or services
- by improving the quality of the goods or services
- replacing obsolete products or processes

Stage 2:
identifying the determinants of eco-innovation

The regulatory environment, that is to say:

- environmental regulations and existing pollution taxes
- environmental regulations or pollution taxes that the company anticipates

Sources of information mobilized for new innovation projects:

Sources from the market, that is to say:

- The company uses its suppliers of equipment, material, components or software to gain information
- The company uses its customers to gain information
- The company uses its competitors or other companies in its sector to gain information
- The company uses consultants, commercial or private labs or R&D institutions to gain information

Information from institutions, that is to say:

- The company uses universities or higher education institutions to gain information
- The company uses public research institutions to gain information

Organizational innovations already implemented in the company, such as:

- New practices in work organization or new procedures (e.g., supply chain management, business re-engineering, knowledge management, lean production, quality management, training systems, etc.)
- New methods of work organization to share responsibilities and decision-making (e.g. first implementation of a new system of employee empowerment, teamwork, decentralization, integration or separation of departments, training systems, etc.)
- New methods of organizing external relationships with other companies or public institutions (e.g., first signature of an alliance, of a partnership, subcontracting, etc.)

Technological innovations deployed in the company in the past:

- New or significantly improved products (excluding the simple resale of new products purchased from other enterprises and purely aesthetic changes)
- New services or significantly improved services
- New or significantly improved manufacturing or production processes of products or services

Frame 1
Continued

- New or significantly improved methods of logistics, supply or distribution of raw materials, products or services
- New or significantly improved supporting activities for processes, such as maintenance systems or operations for purchasing, accounting...

Stage 3:
constructing the latent variable "eco-innovation"

Eco-innovation that changes the impact of the production process

- Lower consumption of materials per unit produced
- Lower energy consumption per unit produced
- Lower CO_2 footprint (total CO_2) of your company
- Materials replaced by less polluting or less hazardous substitutes
- Less soil, water, air or noise pollution
- Recycling of waste, wastewater or used materials

Eco-innovation that changes the impact of products and services in their use and disposal phase

- Less soil, water, air or noise pollution resulting from the use by the final consumer
- Better product recycling after use resulting from the use by the final consumer

Stage 4:
measuring the impact on the economic and environmental performance

Environmental performance

- Growth rate of methane emissions (CH_4) in the sector, 3 years after the decision by the company to eco-innovate (in classes)
- Growth rate of emissions of carbon dioxide ($C0_2$) in the sector, 3 years after the decision by the company to eco-innovate (in classes)
- Growth rate of emissions of nitrous oxide (N_2O) in the sector, 3 years after the decision by the company to eco-innovate

Economic performance

- Growth rate of employment in the company, 3 years after the decision by the company to eco-innovate (in classes)
- Growth rate of turnover in the business, 3 years after the decision by the company to eco-innovate (in classes)

8.6.5 Results

The first part of the model was to highlight a possible link between the variables representing the determinants of innovation and different types of innovation.

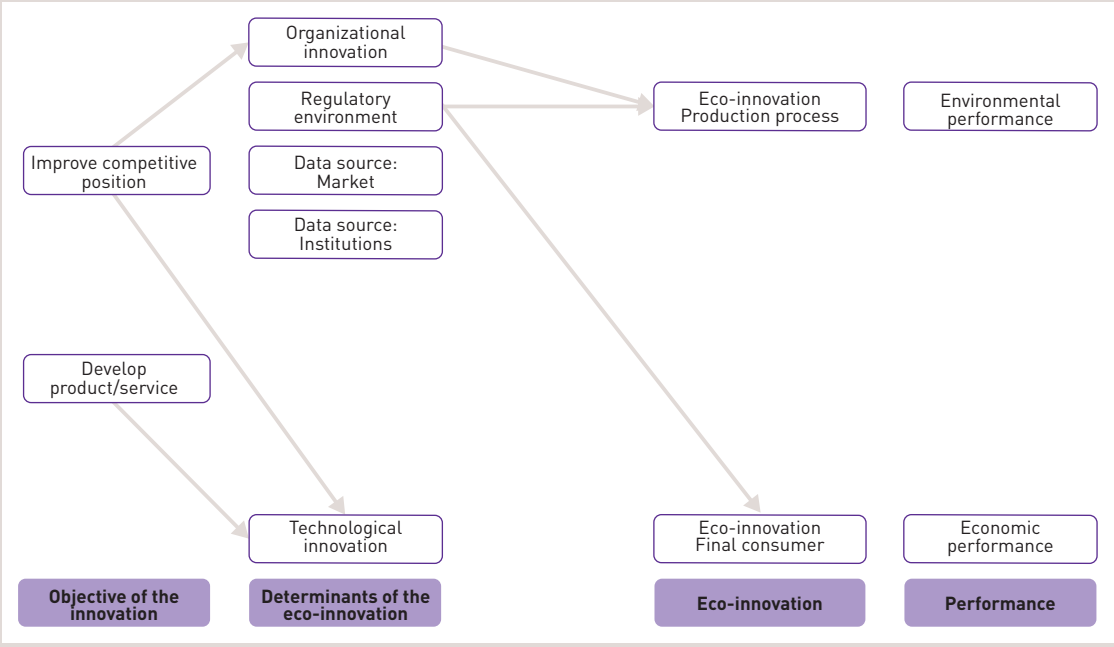
Hypotheses 1 and 2 are validated. Indeed, the deployment of an innovation process by the company seeks first to improve its competitive position regardless of the type of innovation considered (technological or organizational) and to develop new products or to improve its current products or the quality of its services. This second objective increases the likelihood of developing technological innovations. For instance, the opportunity to export and thus enter new markets is a determinant of innovation as suggested by Mazzanti et al. (2010) and, more generally, market conditions are major determinants of innovation, which confirms the results of Belin et al. (2011).

The second part of the model was intended to clarify the determinants of eco-innovation. The importance of the regulatory environment is restated as a result of numerous empirical studies: Belin et al. (2011), et al. Ambec. (2008), and Jeff Palmer (1997), Frondel et al. (2007), Del Rio and Gonzalez (2005), Kesidou & Demirel (2012) who argue that the regulatory context is the determining factor of corporate "green innovator" behaviour. Thus, hypothesis 3, underpinned by the Porter hypothesis, is confirmed and the regulatory framework strongly influences the eco-innovative behaviour of companies, whether in the production process or when the environmental benefit is intended for the final consumer as for France and Germany (Belin et al., 2011) and as suggested by the econometric estimates conducted on data from Luxembourg by Groff and Nguyen (2012). However, this result contradicts Kammerer (2009), for whom the impact of regulation varies depending on the purpose of eco-innovation. And the model does not retain any source of information as playing a convincing role in the eco-innovative behaviour of companies.

Finally, some types of accumulated innovation experiences make companies more favourable to the development of clean technologies. According to the results of Zoboli & Mazzanti (2006), organizational innovation is strongly correlated with technological eco-innovation. Hypotheses 5a and 5c are therefore validated, however, technological innovation has no impact on the practice of eco-innovation regardless of the type considered. This reinforces the complementary role attributed to organizational innovation which ensures the reaping of the full benefits of the implementation of any other type of innovation including eco-innovation. In addition, Mazzanti and Zoboli (2009) and Cainelli et al. (2010) show that the more decentralized a company is, the easier the process of eco-innovation is.

The last part of the proposed model aims to highlight the direct impact of eco-innovation on the sector's environmental performance or economic performance of the company. However, the model does not allow supporting hypotheses 6a to 6c. Several reasons can be put forward to explain this relative lack of success. On the one hand, as shown by Horbach et al. (2011), in most cases, companies which have eco-innovated do not observe changes in terms of cost reduction, turnover or employment and anyway, these are not the objectives first assigned to this process. On the other hand, and as a corollary, Ambec et al. (2008) have shown that eco-innovation is required first by regulation and then results in a decrease in performance. Finally, as has already been pointed out, the diluting of the impacts across time as well as their dissemination through beneficiaries other than the eco-innovator make it difficult to enter the phenomenon in a model constructed on the basis of individual observations.

Chart 6
The validated hypotheses



Source: Diagram by the authors

Table 2
Summary of results for tested hypotheses - Coefficients and significance of trajectories

Hypo-thesis	Path	Coefficient	T-student	Validated or not
H1				
a	Improve the competitive situation → Technological innovation	0.37	4.01	Validated
b	Improve the competitive situation → Organizational innovation	0.37	2.05	Validated
H2				
	Develop product/service → Technological innovation	0.45	2.61	Validated
H3				
a	Regulatory environment → Eco-innovation: Production Process	0.43	3.95	Validated
b	Regulatory environment → Eco- innovation: Final consumer	0.41	3.06	Validated
H4				
a	Data source: Market → Eco-innovation: Production Process	0.14	0.87	Not
b	Data source: Market → Eco-innovation: Final consumer	0.10	0.52	Not
c	Data source: Institutions → Eco-innovation: Production Process	0.01	0.01	Not
d	Data source: Institutions → Eco-innovation: Final consumer	-0.01	0.07	Not
H5				
a	Organizational innovation → Eco-innovation: Production Process	0.19	1.85	Validated[9]
b	Organizational innovation → Eco-innovation: Final consumer	0.13	1.23	Not
c	Technological innovation → Eco-innovation: Production Process	0.14	0.84	Not
d	Technological innovation → Eco-innovation: Final consumer	0.03	0.19	Not
H6				
a	Eco-innovation: Production Process → Economic performance	0.01	0.05	Not
b	Eco-innovation: Production Process → Environmental performance	0.01	0.03	Not
c	Eco-innovation: Final consumer → Economic performance	-0.08	0.49	Not
d	Eco-innovation: Final consumer → Environmental performance	0.09	0.64	Not

[9] At the 10% threshold.

8.6.6 Limitations and conclusion

Eco-innovation is a recent concept and the still scarce literature grew especially after C. Fussler and P. James (1996), whose book is the first to address this issue.

The estimation uses data collected in a single wave of the Community Innovation Surveys conducted in Luxembourg, the one conducted in 2010 on innovation activities deployed in companies between 2006 and 2008. Thus, it is not possible to study the evolution of a growing phenomenon. A second limitation is the lack of certain variables whose role is probably essential. For example, the input measures of eco-innovation are limited. It is possible to know the companies spending on R&D, but it is not possible to distinguish among them those for innovation and for eco-innovation, or even those incurred so as to reduce emissions, to improve the process and to reduce costs or to create new "eco-friendly" products as defined by Grubb and Ulph (2002). Similarly, the outcome measurements of eco-innovation, for example through eco-innovative patents, or measures to reduce damages to the environment, are not available in this survey. Despite these limitations, the purely exploratory approach based on partial least squares estimation techniques helped to develop and test a set of causalities in the context of developing innovative activities in terms of environment within companies.

The results confirm the significant and differentiated impact of the market conditions revealed through the initial objectives assigned to technological and non-technological innovations. An important aspect of eco-innovation is the specific role of the regulatory environment and of policy incentives. The model confirms their positive impact and their role as a key factor in the development of eco-innovations. However, the model fails to demonstrate any causal link between innovation and economic and environmental performance. On the one hand, the attempt to incorporate at least one time lag is not enough to correct the imperfection of the measures used. On the other hand, one must admit that the proposed specification is unsatisfactory.

Indeed, it tends to find an overall effect, the "environmental performance", from individual characteristics and behaviours. In addition, since the effects on the environment are negative externalities, internalizing them could generate costs that outweigh the benefits recoverable by the producer, like most innovations. Above all, as shown by Rennings (2000), if the willingness of the consumers to pay for environmental improvement is too low, which explains the absence of positive impact on the economic performance of companies. This misspecification can also come from a real lack of causality or, if one follows Zoboli and Mazzanti (2009), from a reverse causality in which it is rather the performance of the company that would have an impact on the innovation behaviour (in this case the causality which is tested in the model does not exist).

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8.6.8 Appendix

Appendix 1
NAMEA nomenclature

level_3	nace_REV1_1	level
1	01 ; 02 ; 05	Agriculture, hunting and forestry, fishing and aquaculture (A+B)
2	10 ; 11 ; 12	Energy mining and quarrying products (CA)
3	13 ; 14	Non-energy mining and quarrying products (CB)
4	15 ; 16	Agricultural and food industries products (DA)
5	17 ; 18	Textile and clothing industry products (DB)
6	19	Leather, luggage, shoes (DC)
7	21 ; 22	Paper and cardboard; published, printed or reproduced products (DE)
8	23	Products of coking, refined petroleum and nuclear fuel (DF)
9	24	Chemicals (DG)
10	25	Rubber or plastic products (DH)
11	26	Other non-metallic mineral products (DI)
12	27 ; 28	Metal products and metal working products (DJ)
13	29	Machinery and equipment (DK)
14	30 ; 31 ; 32 ; 33	Electrical and electronic equipment (DL)
15	34 ; 35	Transport equipment (DM)
16	20 ; 36 ; 37	Other manufactured goods (20+36+37) *included 20 = DD
17	40	Production and distribution of electricity, gas and heat (40)
18	41	Collection, purification and distribution of water (41)
19	45	Construction (F)
20	50	Trade and repair of motor vehicles (50)
21	51	Wholesale trade and commission trade (51)
22	52	Retail trade and repair of household goods (52)
23	55	Hotel and catering services (H)
24	60 ; 61 ; 62 ; 63 ; 64	Transport and communications (I)
25	65	Financial intermediation (65)
26	66	Insurance (66)
27	67	Auxiliaries to finance and insurance (67)
28	70	Real estate activities (70)
29	71	Renting without operators (71)
30	72	IT activities (72)
31	73 ; 74	Services provided principally to firms, R&D (73+74)
32	75	Public administration services (L)
33	80	Education (M)
34	85	Health and social services (N)
35	90	Sewage and refuse disposal, sanitation and waste management (90)
36	91	Associative activities (91)
37	92	Recreational, cultural and sporting activities (92)
38	93	Personal service (93)
39	95	Domestic service (P)

8.7 Environmental performance and productivity measurement[1]

8.7.1 Introduction

Faced with the need to take into account the effects of production on the environment and more generally the urgency to find the paths to a sustainable development[2], many attempts are made to establish measures of productivity growth that include the negative effect of pollution[3]. The approach which is proposed[4] in this paper uses, for the purposes of calculation, the strengths of the R language and some programs available to deal with linear programming and directional distance functions. Thus, programs[5] have been developed and adapted to extend the measurement of total factor productivity and its components – technical progress and technical efficiency – to the consideration of environmental performance by minimizing the unfeasibility problems encountered in usual approaches that use the Malmquist index – a pioneering productivity index used in non-parametric approaches to measuring productivity growth.

The main advantage of these approaches is that they do not require data on prices of inputs and outputs (desirables and undesirables) nor a functional form to describe the overall production. However, based on a radial distance measure, the Malmquist index results from a distance ratio calculated by an optimization program that only considers a maximum increase in quantities (positive) of produced outputs (i.e. along a radial axis), while maintaining the quantity of inputs constant. Yet, in considering undesirable productions, we would like the modelling allow increasing "good" productions while reducing "bad" productions. In this spirit, the Malmquist index was modified by Chambers, Chung and Färe (1996) from the work of Luenberger (1992), to measure productivity growth by taking into account the environmental performance and giving rise so to the Malmquist-Luenberger index, based on a directional distance function. These are reference contributions in the literature and are widely quoted in subsequent work that use tem: Chung et al. (1997), Färe et al. (2001), Weber and Domazlicky (2001), Pasurka (2006), and Managi Nakano (2008), Yoruk and Zaim (2005) and Kumar (2006) for example.

This new index has been extended to respond to the old objection made by Tulkens and Eeckaut (1995). Indeed these authors were the first ones to challenge the technological decline that, under the standard DEA model, becomes possible. Sequential index construction is designed to prevent this technological regress.

1 Contact: Michel Prombo (michel.prombo@statec.etat.lu) and Anne Dubrocard (anne.dubrocard@statec.etat.lu) – STATEC – EPR2. This is an excerpt from a wider analysis conducted at branch level and to be published as a Working Paper in Économie et Statistiques Series of STATEC.

2 The environmental regulations "Rio de Janeiro (1992), Kyoto (1997), Johannesburg (2002), The Bali roadmap (2007), etc."

3 Such as the main greenhouse gases - water vapour (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3) - measured by the GHG (Green House Gas).

4 The study results presented here are derived from an approach whose original purpose was the deployment and use of data envelopment techniques and linear programming with R (programming language and statistical environment) to verify the feasibility of transferring tools supporting the analysis conducted after the project LuxKlems.

5 Developed in R language by Michel Prombo and using the following "packages" of software R:
lpSolve (Interface to Lp_solve v. 5.5 to solve linear/integer programs)
nonparaeff (Non-parametric Methods for Measuring Efficiency and Productivity).

The results and their underlain theoretical assumptions are presented succinctly but show the possibilities and flexibility offered by the R language in addressing optimization problems. The focus is on the evolution of the Malmquist index when considering the undesirable outputs and it also seeks to compare the results with and without considering environmental performance in a theoretical and empirical exercise for 15 European countries and the United States.

In particular, the choice of an index has a significant impact on the measurements of productivity and on the comparison of the resulting performance. So, for Luxembourg, the average annual growth of TFP measured over the period 1995-2010 is flat if it does not include any measurement of environmental performance but becomes negative when the emission of greenhouse gases are considered and Luxembourg loses 4 positions in the ranking of countries. In addition, Luxembourg has experienced a loss of technical efficiency, reflecting a suboptimal use of production factors when using a sequential index that considers all the possibilities of production observed during the time period. In this latter case, innovation and technological progress are no longer the only sources for improving total factor productivity and the average growth rate of total factor productivity is positive according to the new sequential index.

8.7.2 Methodological tools

8.7.2.1 Production technology

In general, production technology is defined as a process transforming a vector of factors of production (inputs):
$\mathbf{x}= (\boldsymbol{x_1}, \dots, \boldsymbol{x_n}) \supset \mathbb{R}_+^{\boldsymbol{n}}$, into a vector of produced factors (outputs):
$\boldsymbol{y} = (\boldsymbol{y_1}, \dots, \boldsymbol{y_m}) \supset \mathbb{R}_+^{\boldsymbol{m}}$.[6]
The nature and state of knowledge at any given time, i.e. technology, determine the limits of this set.

The entire production can be represented in three different ways depending on the purpose of the proposed analysis:

1. Input correspondence gives the input levels required to achieve a specified level of outputs. This is the approach used when searching for substitution possibilities between inputs;

2. Output correspondence measures the quantities of outputs attainable with a given combination of inputs. This is the perspective of the work presented here. At a given quantity of inputs, we contemplate the several combinations of desirable and harmful outputs it is possible to obtain given available technology;

3. Finally, the diagram (often called "overall production" here) is the usual graphical presentation of the production functions.

[6] Formally *T = {(x, y): x can produce y}.*

So, in exploring the possibilities of substitution between outputs, outputs correspondence defines the set of outputs that can be produced for a given level of inputs.

$$P(x) = \{y \in \mathbb{R}_{+}^{m} : y \; is \; produced \; by \; x\}$$

To ensure that this set is a good representation of a production technology, a number of axioms should be checked. They are detailed in the appendix. The production possibility frontier is defined as all technically efficient production plans, that is to say such that it is not possible to increase the quantity of outputs produced without increasing the used quantity of at least one of the inputs. For a given production unit[7], we observe combinations of inputs and outputs that are either inside or on the frontier, since it must be within the set of possible productions. Inside the frontier, the unit is considered inefficient since it is possible to increase the quantity produced for the same level of inputs in the process. The relative position of the unit in relation to the efficiency frontier is a determinant of its productivity.

8.7.2.2 The measurement of productivity through the Malmquist productivity index

Indeed, productivity is the ratio between production (output) and the factors of production (inputs) that contribute to it. We speak of apparent partial productivity when production is related to a single one of these inputs and of total factor productivity (TFP) when measuring the production obtained related to all factors of production, meaning labour, capital and intermediate consumption.

Measuring the productivity of a production unit against a production frontier assumes having a distance measure. Moreover, in a competitive environment, the most important is to compare performance in terms of productivity and temporal variations. In other words, the aim is to analyse not only the position in relation to the efficiency frontier at time t, but also the movements of the production unit and of the efficiency frontier and their relative positioning. Inspired by the quantity index of Sten Malmquist (1953) based on distance functions of radial type, and following Caves, Christensen and Diewert (1982), Färe et al. (1989) define the Malmquist productivity index output-oriented in period t+1 as the product of two ratios: the first refers to the distance of the production unit between t and t+1 relative to the technology of period t; in the second ratio distances are measured relative to the frontier at time t +1. The Malmquist index is given by the geometric mean of both ratios:

$$M_t^{t+1} = \left[\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \times \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^t, y^t)}\right]^{1/2}$$

[7] The observed units or decision centres (DMU - Decision Making Unit) can be companies, branches of economic activity, countries or any other economic entities.

Färe et al. (1994) show afterwards that this index can be decomposed in order to distinguish the main sources of productivity growth namely the technical efficiency change (EFFCH) that measures the variation in the distance of the considered unit compared to the frontier and the technological change (TECH) which results in the shift of the efficiency frontier:

$$M_t^{t+1} = \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \left[\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})} \times \frac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)} \right]^{1/2}$$

$$M_t^{t+1} = EFFCH_t^{t+1} \times TECH_t^{t+1}$$

EFFCH and TECH are calculated by the Data Envelopment Analysis method (DEA, itself based on linear programming).

As Briec and Peypoch (2010) recalled, "productivity, technical progress and more recently the deviations from best practice techniques, known as inefficiency" generate growth; which should draw attention, for example "to the relationship between the change in efficiency and technical progress for research and development and human capital".

The direct calculation of the Malmquist index and the construction of a non-parametric frontier have many advantages but also significant limitations.

The advantages:

- Unlike traditional indices, consistency with economic theory is ensured even without assuming maximizing behaviour from producers, since it is not necessary to approximate the marginal productivities by prices as in the traditional Divisia indices (Jorgenson and Griliches 1967);
- Data on prices and costs of using of fixed factors are not necessary;
- No econometric estimation is required, but only an approximation of the production envelope, very simple to implement.

Thus, the hypotheses in this approach are less restrictive than in alternative measurements of TFP. However, the use of the Malmquist index encounters two major limitations. On the one hand, when we want to take environmental impacts into account, the implementation of a measure of radial distance cannot easily handle negative productions or undesirable outputs. On the other hand, the construction of a distinct frontier with the observations (DMU) available each year can lead to shifts of the frontier corresponding to the "technological regress" difficult to justify from an economic point of view. Several approaches have been explored in an attempt at overcoming these limitations. The Malmquist index once transformed into Malmquist-Luenberger index (ML) allow to consider as efficient DMU which are able to increase the production of desirable outputs while reducing the undesirable outputs. The introduction of a sequentiality in the construction of production frontiers through the sequential Malmquist-Luenberger index (SML) is used to prevent any technical regress. These two approaches are now detailed in the following paragraphs.

8.7.2.3 Pollutants in production technology

Pollutants are considered as negative externalities, that is to say as undesired productions which are attached to the production of those goods and services commonly taken into account in the measurement of productivity. As mentioned above, taking unwanted production or undesirable outputs into account, makes the functions of radial distance inappropriate. Indeed, while the increase in production of undesirable products is not desirable or is simply not possible if an environmental regulation is imposed on the DMU, the radial distance tends to maximize outputs.

One way to do this is to make changes in variables so as to assimilate pollutants to a negative production. These changes are intended to modify the undesirable outputs using a monotonic decreasing function (Seiford and Zhu 2002). By doing so, the transformed undesirable outputs can be integrated into the model alongside the desirable outputs and be maximized like them. Thus, the original values of the undesirable outputs are indeed minimized. Finally, Zhou et al. (2008) introduce the axiom of undesirable outputs' weak disposition for the exposed models (all of which are based on measurements of radial distance). One of the non-linear forms of the program[8] (Pure Environment Index) based on the assumption of variable returns to scale (VRS) is used for example in Peroni C. (2012).

Another approach is to use directional distance functions as developed by Chambers, Chung and Färe (1996) from the work of Luenberger (1992). These metrics allow an asymmetric treatment of desirable and undesirable outputs. Formally, for the DMU that produce a desirable output vector y and an undesirable output vector b from an input vector x, the directional distance functions are defined as follows:

$$\vec{D}_o(x, y, b, g) = max\{\delta : (x, y, b) + (\delta g_x, \delta g_y, \delta g_b) \in P(x)\}$$

where $g = (g_x, g_y, g_b)$ is a vector that determines the considered direction. Different directions can be considered, for example the one proposed by Chung, Färe and Grosskopf (1997). According to this direction $g = (g_y, g_b) = (y, -b)$, directional distance functions $\vec{D}_o(x, y, b, g)$ measure the maximum increase in desirable outputs which is simultaneous to a proportional decrease in the production of undesirable outputs, given a fixed quantity of inputs. Formally, this type of directional distance is defined by:

$$\vec{D}_o(x, y, b; y, -b) = max\{\delta : (x, y, b) + (\delta y, -\delta b) \in P(x)\}$$

[8] The linear equivalent of the program is used for the purposes of calculations.

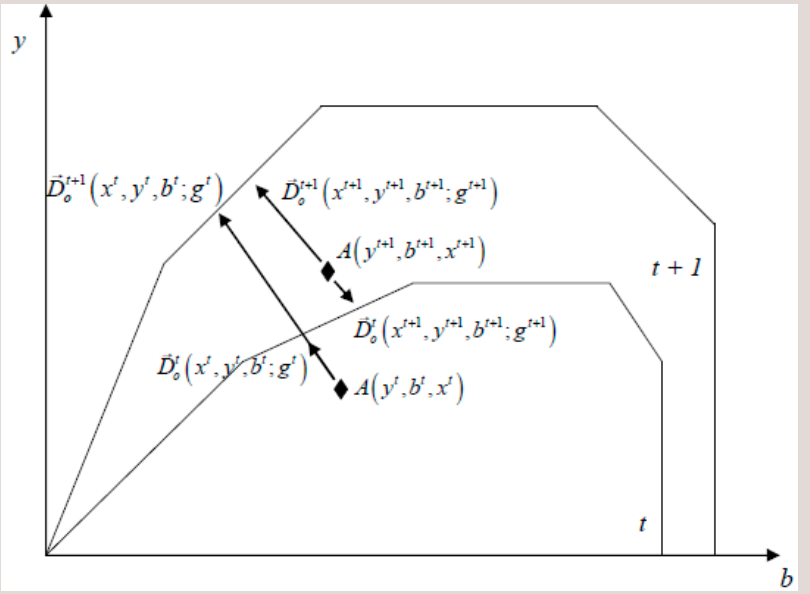
The distance δ calculated so is a value between 0 and 1. In addition, directional distance functions appear to be more general than the radial distance functions that they include as a special case. From directional distance functions, Chung, Färe and Grosskopf (1997) develop the Malmquist-Luenberger index (ML) defined by:

$$ML_t^{t+1} = \left[\left(\frac{\left(1+\vec{D}_o^t(x^t,y^t,b^t,g^t)\right)}{\left(1+\vec{D}_o^t(x^{t+1},y^{t+1},b^{t+1},g^{t+1})\right)}\right)\left(\frac{\left(1+\vec{D}_o^{t+1}(x^t,y^t,b^t,g^t)\right)}{\left(1+\vec{D}_o^{t+1}(x^{t+1},y^{t+1},b^{t+1},g^{t+1})\right)}\right)\right]^{1/2}$$

The first term in brackets measures the "shift" of the DMU analysed between t and t+1 relative to the technology of period t, while the second term measures the shift of the DMU relative to the technology of period t+1. As before, the index is the result of the calculation of a geometric mean and its interpretation is the same as for the Malmquist index. In addition, it can also be broken down to show the main sources of productivity change.

The chart below (Simon Vallières, 2006) illustrates the calculation of the Malmquist-Luenberger total factor productivity index from the point of view of a DMU A in its movement between t and t+1, producing a desired output y and an undesirable output b from an input quantity which is fixed in the time.

Chart 1
Illustration of the ML calculation



Source: Chart taken from Simon Vallières (2006)

Despite its widespread use, the Malmquist-Luenberger index has certain weaknesses:

- The Malmquist-Luenberger productivity index uses a geometric mean of two contemporary Malmquist-Luenberger indices; therefore, it is faced with a potential problem of unfeasibility cases in solving linear programming problems due to the use of cross periods of time in the directional distance functions. In addition, the geometric mean of the two contemporary ML indices is not circular. It is therefore obvious that the productivity growth measured using two adjacent ML indices should be interpreted with caution;

- The ML index (Malmquist-Luenberger) tolerates technological decline; indeed, from a theoretical point of view, even if it seems less likely, a deterioration of technical progress cannot be excluded. An improvement of the ML index consists in choosing the sequential approach which eliminates the possibility of measuring technological decline.

These shortcomings of the conventional ML index, which might provide biased measurements of productivity growth, led to the introduction of an alternative methodology that can use both desirable and undesirable outputs, and inputs to measure the environmental performance in order to overcome the drawbacks of the conventional ML index.

8.7.2.4 The problem of technological regress

Tulkens and Eeckaut (1995) were the first to question the technological decline in the standard DEA model. Forstner and Isaksson (2002) noted "one of the disadvantages of the standard DEA model is that this method allows the DMUs to ignore all previous technologies (no memory process)." Although such a situation is theoretically possible - it may be the case of economies of countries at war - it does not reflect the more general situation. Not taking into account the past is not plausible and gives an inaccurate measurement of technical efficiency change and of technological change (technical progress). To remedy this situation, an alternative approach that eliminates the possibility of measuring a technological decline has been proposed. The solution is to consider that at each of the periods analysed, all previous technologies are also possible (Tulkens and Vanden Eeckaut, Shestalova 1995 and 2003). Thus, the frontier of period t "envelopes" all the data observed so far, which eliminates, by definition, the possibility of obtaining a decline in technology. It is called a sequential approach by Shestalova (2003).

The sequential Malmquist-Luenberger index developed in this way is based on the definition of two production technologies for the calculation of the distance function: a contemporary production technology (relative to a given period) and a sequential production technology relative to all prior periods. Contemporary production technology in period t is defined by:

$$P^t(x^t) = \left\{(y^t, b^t) : x^t \; can \; produce \; (y^t, b^t)\right\} with \; t = 1 \ldots T.$$

The sequential Malmquist-Luenberger index is defined based on the following directional distance functions:

$$D_0^s(x, y, b; y, -b) = max\{\delta: (x, y, b) + (\delta y, -\delta b) \in P^s(x)\}, s = t, t+1$$

They are defined for each sequential set of production technology. It is defined by a geometric mean of Malmquist-Luenberger productivity indices over two periods:

$$SML_t^{t+1} = \left[\left(\frac{\left(1+\vec{D}_o^t(x^t, y^t, b^t, g^t)\right)}{\left(1+\vec{D}_0^t(x^{t+1}, y^{t+1}, b^{t+1}, g^{t+1})\right)}\right)\left(\frac{\left(1+\vec{D}_o^{t+1}(x^t, y^t, b^t, g^t)\right)}{\left(1+\vec{D}_o^{t+1}(x^{t+1}, y^{t+1}, b^{t+1}, g^{t+1})\right)}\right)\right]^{1/2}$$

The first term in brackets measures the "shift" of the DMU analysed between t and t+1 relative to the technology of period t, while the second term measures the shift of the DMU relative to the technology of period t+1. Again, the interpretation of the results is the same as for the Malmquist index and the geometric shape of the SML index can be broken down to show the main sources of productivity change, which can be expressed simply by:

$$SML_t^{t+1} = SMLEC_t^{t+1} \times SMLTC_t^{t+1}$$

where $SMLEC_t^{t+1}$, the factor of technical efficiency increase, compares the distances on the frontier of best practices[9] and measures the growth of technical efficiency between periods t and t+1, $SMLTC_t^{t+1}$ which is a geometric mean, each term of which measures the advance of the frontier. This index shows the production frontier shifts, independently of the reference DMU_0.

If there is no change in the inputs and outputs between the two periods t and t+1, then $SML_t^{t+1} = 1$.

If there is an increase (decrease) in productivity, then $SML_t^{t+1} > (<)1$. It should be noted that the above assumes a stable relationship between the two types of outputs.

Moreover, if $SMLTC_t^{t+1} > 1$, then there was a catching-up or convergence movement towards the frontier in period t+1. It is interpreted as an improvement in technical efficiency.

Finally, if $SMLTC_t^{t+1} < 1$, then the DMU is far (divergent) from the frontier in t+1 than in t, and has therefore become less efficient.

The index of technological change in the SML index is always greater than one since $\vec{D}_o^{t+1}(x^s, y^s, b^s) \geq \vec{D}_o^t(x^s, y^s, b^s)$. If technical change allows a greater production of desirable outputs and less production of undesirable outputs, then $SMLTC_t^{t+1} > 1$, otherwise $SMLTC_t^{t+1} = 1$.

[9] For S. Perelman (1996), the border is a sort of envelope, which often coincides with all points identified as representative of best practice in the field of production, to which the performance of each company can be compared.

8.7.3 Results

8.7.3.1 Data description

Data comes from the statistical tables constructed from information provided by EUROSTAT, EUKLEMS the UNFCC (United Nations Framework Convention on Climate Change) and the National Accounts Division of STATEC.

For the purposes of calculation, we use four sets of variables for the period 1995 to 2010, and for a total of 15 EU[10] countries and the United States (U.S.).

1. GDP: the series are converted using PPP (purchasing power parity), to ensure the comparability of aggregates between countries.

2. L (Labour/employment): the employment chosen refers to a concept of domestic employment which includes both resident and non-resident workers. It is measured by the number of jobs that is provided by Eurostat.

3. K (Capital stock): the capital stock estimates are constructed from capital stock data of the EUKLEMS[11] database and from the series on investment obtained from Eurostat, except for Luxembourg for which data is from STATEC.

4. GHG (Greenhouse Gas): data on pollution and GHG in particular come from the database of the United Nations Framework Convention on Climate Change (UNFCC) updated in June 2012.

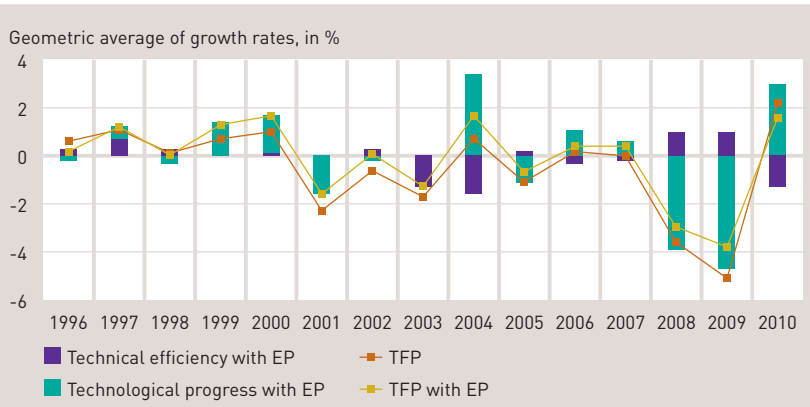
The data is used to calculate the Malmquist-Luenberger indices (ML) which are suitable for taking the undesirable outputs into consideration (here the greenhouse gas emissions - GHG), then to calculate the sequential indices (SML) which minimize cases of unfeasibility and prohibit technological regress.

In the chart below, the results obtained with the ML index incorporating a measurement of environmental performance are compared with more usual results in which GDP is the only output measurement taken into account.

[10] AT-Austria; BE-Belgium; DE-Germany; DK-Denmark; ES-Spain; FI-Finland; FR-France; GR-Greece; IE-Ireland; IT-Italy; LU-Luxembourg; NL-Netherlands; PT-Portugal; SE-Sweden; UK-United Kingdom.

[11] Downloadable from the website: www.euklems.net. For details on the construction method, see A. Dubrocard et al. PPE No.14, May 2010.

Chart 2
Taking environmental performance (EP) into account in the calculation of TFP and its components according to the ML index - All countries



Source: Statec Eurostat, EUKLEMS, STATEC and UNFCC – Calculations by the authors

Considering the environmental performance as measured by greenhouse gas emissions improves the whole factor productivity. Indeed, the geometric mean calculated for all countries is higher every year, except in 1996, than the results achieved without undesirable outputs. Trends and their reversals are concurrent. The analysis can now focus on the comparison of different types of measurement that take environmental performance into account. Thus, in the following sections, TFP is calculated when greenhouse gas emissions are considered as (undesirable) outputs. Both index types (sequential and non-sequential) and their decomposition are presented first per country, then according to their temporal evolution, and finally, the light is shed on results concerning Luxembourg in particular.

8.7.3.2 Country heterogeneity

Average productivity growth, technical efficiency change and technological progress are calculated for the considered countries with the measurements of indices proposed in chapter 2, i.e. the Malmquist-Luenberger index and the sequential Malmquist-Luenberger. The measurements obtained are presented in the following two tables.

Figures correspond to the geometric mean of the changes - observed each year from 1995 to 2010 – in total factor productivity (ML and SML respectively) in the fourth columns and its components in the second and third columns, changes in technical efficiency (MLEC and SMLEC respectively) and in technical progress (MLTC and SMLTC respectively) calculated for each country (DMU listed in the first columns). This decomposition expresses for each calculated index, one of the main sources of the change in productivity: change in the efficiency level and technological progress.

Note that if the value of the geometric mean of the index is higher (lower) than one, it corresponds to a positive (negative) growth rate, i.e. to an improvement (deterioration) of technical efficiency (CE), technical progress (TC) or total factor productivity.

Table 1
Geometric mean of growth rates of the ML index per country

Countries	Technical efficiency - MLEC	Technical progress - MLTC	TFP - ML
AT	0,0 %	0,5 %	0,5 %
BE	0,0 %	0,4 %	0,4 %
DE	0,8 %	-0,1 %	0,6 %
DK	0,0 %	-0,3 %	-0,4 %
ES	-0,7 %	0,8 %	0,1 %
FI	0,9 %	0,1 %	1,0 %
FR	0,2 %	0,3 %	0,5 %
GR	-0,6 %	-0,5 %	-1,1 %
IE	0,0 %	-0,1 %	-0,1 %
IT	-0,9 %	-0,2 %	-1,2 %
LU	**0,0 %**	**-1,0 %**	**-1,0 %**
NL	0,5 %	0,2 %	0,8 %
PT	-1,2 %	-1,0 %	-2,2 %
SE	0,0 %	0,9 %	0,9 %
UK	0,1 %	-1,2 %	-1,0 %
US	0,0 %	0,0 %	0,0 %

Source: Statec Eurostat, EUKLEMS, STATEC and UNFCC – Calculations by the authors

Table 2
Geometric mean of growth rates of the sequential ML index per country

Countries	Technical efficiency - SMLEC	Technical progress - SMLTC	TFP - SML
AT	-0,4 %	0,9 %	0,6 %
BE	-0,2 %	0,6 %	0,4 %
DE	0,4 %	0,5 %	0,9 %
DK	-0,4 %	0,4 %	0,0 %
ES	-1,0 %	1,2 %	0,1 %
FI	0,8 %	0,4 %	1,1 %
FR	-0,2 %	0,8 %	0,5 %
GR	-1,2 %	0,3 %	-0,9 %
IE	0,0 %	0,5 %	0,5 %
IT	-1,3 %	0,5 %	-0,8 %
LU	**-0,5 %**	**1,5 %**	**1,0 %**
NL	0,2 %	0,5 %	0,7 %
PT	-1,5 %	0,3 %	-1,1 %
SE	-0,3 %	1,4 %	1,2 %
UK	-0,6 %	0,1 %	-0,5 %
US	-0,2 %	0,3 %	0,1 %

Source: Statec Eurostat, EUKLEMS, STATEC and UNFCC - Calculations by the authors

In addition, a test of equality has been conducted on TFP indices and its components calculated using the Malmquist-Luenberger method the or sequential method.

Frame 1
Test of equality of indices

The Wilkoxon rank-sum test was used to test the equality of the various indices and their decompositions at a 0.05 threshold. The following table summarizes the results obtained in the approach per country.

Null hypothesis	Statistics	p-value	Results
SML=ML	175.5	0.074	Ho is not rejected (>0.05)
SMLEC=MLEC	41	0.00107	Ho is rejected (<0.05)
SMLTC=MLTC	95	0.2197	Ho is not rejected (>0.05)

Source: Calculations by the authors based on model results

The following table shows the ranking of countries according to the average annual growth rate of their TFP. The rank is given for the growth rates obtained from the calculation of the Malmquist-Luenberger index with and without undesirable production (respectively ML-EP and ML (non- GHG)) and then with the sequential index that integrates environmental performance (SML-EP).

Table 3
Ranking of countries according to each index

Countries	ML-EP	ML (non-GHG)	SML-EP
FI	1	1	2
SE	2	3	1
NL	3	6	5
DE	4	4	4
FR	5	5	7
AT	6	2	6
BE	7	7	9
ES	8	10	10
US	9	8	11
IE	10	12	8
DK	11	11	12
UK	12	14	13
LU	**13**	**9**	**3**
GR	14	13	15
IT	15	15	14
PT	16	16	16

Source: Statec Eurostat, EUKLEMS, STATEC and UNFCC – Calculations by the authors

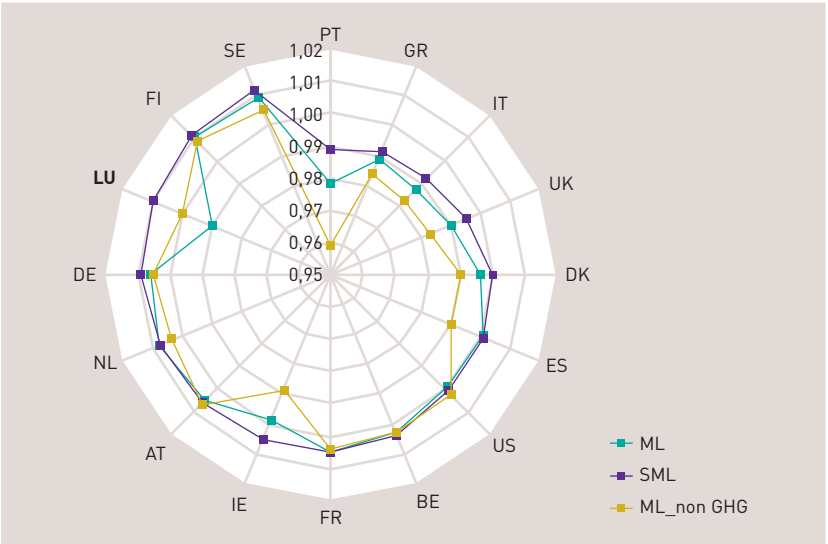
The comparison of the ranks in the first two columns shows that the order changes between the top 5. However, Finland, Sweden, Germany and France remain in this group, while Austria leaves and is replaced by the Netherlands. At the bottom of the ranking, there are also more or less the same countries with both indices: United Kingdom, Greece, Italy and Portugal, and while Ireland disappears from this group, it is replaced by Luxembourg that loses 4 positions with this new index.

Indeed, geometric means calculated over the entire period vary especially on the one hand for Portugal and Ireland, where the evolution of TFP – although negative – is improved when environmental performance is taken into account and, on the other hand, for Luxembourg, whose performance deteriorates when greenhouse gas emissions are included in the calculation of the index.

These elements are confirmed by reading the radars shown below. Thus, when comparing ML and SML indices, both of which take environmental performance into account, 7 countries have experienced a decline in the evolution of TFP measured by the geometric mean of annual changes in the ML index, and there are only 4 countries (Greece, Italy, the United Kingdom and Portugal, all of which are included in the first list) when the sequential index is used. Only Germany, Finland, Ireland and the Netherlands escape a decline in their average technical efficiency. Luxembourg and Sweden have the highest growing technical progress when technological declines are no longer allowed in the model. And in the sequential index ranking, Luxembourg is third.

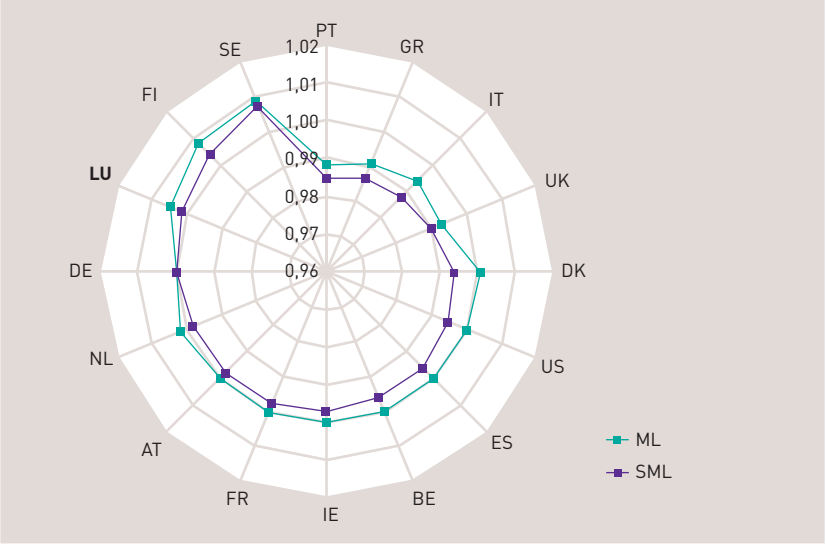
Moreover, since technical progress is always positive or zero, the average growth for this component obtained with the sequential index is always higher than or equal to the non-sequential measurement. Additionally, technical efficiency gains are often lower than the sequential measurement, except for Germany and Sweden where technical efficiency gains are almost identical in the two measurements. Finally, the implementation of the sequential index gives TFP measurements that are, on average, always higher than the other indices.

Chart 3
Growth of total factor productivity - Geometric mean per country (1996-2010)



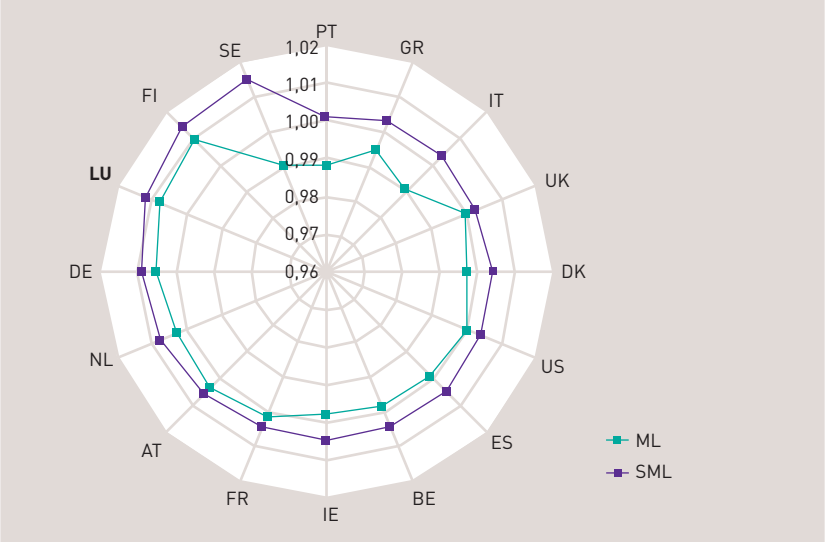
Source: Statec Eurostat, EUKLEMS, STATEC and UNFCC – Calculations by the authors

Chart 4
Technical efficiency



Source: Statec Eurostat, EUKLEMS, STATEC and UNFCC - Calculations by the authors

Chart 5
Technological progress



Source: Statec Eurostat, EUKLEMS, STATEC and UNFCC - Calculations by the authors

8.7.3.3 Annual change for all countries

Changes in SML and ML productivity indices show similar trends during the period under review. Thus, the geometric mean of growth rates of TFP for all countries experiences a sharp decline for both indices between 2000 and 2001 and between 2004 and 2005, then a dramatic drop between 2007 and 2008 which continued until 2009. The rise is also spectacular for both indices between 2009 and 2010.

By contrast, the change in the indices' decomposition is very different, while the ML index tends to attribute a portion of these declines to technological regress in 2001 and in 2008 and 2009, the sequential index attributes it more widely to a loss of efficiency gains.

Table 4
Geometric mean of growth rates of the Malmquist-Luenberger index

Year	Technical efficiency - MLEC	Technical progress - MLTC	TFP - ML
1996	0,3 %	-0,2 %	0,2 %
1997	0,7 %	0,5 %	1,2 %
1998	0,3 %	-0,3 %	0,0 %
1999	0,0 %	1,4 %	1,3 %
2000	0,1 %	1,6 %	1,7 %
2001	0,0 %	-1,6 %	-1,6 %
2002	0,3 %	-0,2 %	0,1 %
2003	-1,3 %	0,0 %	-1,3 %
2004	-1,6 %	3,4 %	1,7 %
2005	0,2 %	-0,9 %	-0,7 %
2006	-0,3 %	0,6 %	0,4 %
2007	-0,2 %	0,6 %	0,4 %
2008	1,0 %	-3,9 %	-3,0 %
2009	1,0 %	-4,7 %	-3,8 %
2010	-1,3 %	3,0 %	1,6 %

Source: Calculations by the authors

Table 5
Geometric mean of growth rates of the sequential Malmquist-Luenberger index

Year	Technical efficiency - SMLEC	Technical progress - SMLTC	TFP - SML
1996	-0,1 %	0,7 %	0,6 %
1997	0,3 %	1,1 %	1,4 %
1998	-0,3 %	0,7 %	0,4 %
1999	0,1 %	1,5 %	1,5 %
2000	0,6 %	1,3 %	1,8 %
2001	-1,5 %	0,0 %	-1,5 %
2002	0,2 %	0,0 %	0,2 %
2003	-1,2 %	0,0 %	-1,2 %
2004	-0,1 %	2,1 %	2,1 %
2005	-0,3 %	0,1 %	-0,2 %
2006	0,0 %	0,9 %	1,0 %
2007	-0,2 %	1,2 %	0,9 %
2008	-2,3 %	0,0 %	-2,3 %
2009	-2,8 %	0,0 %	-2,8 %
2010	1,7 %	0,1 %	1,8 %

Source: Calculations by the authors

Frame 2
Test of equality of indices

We observe that the SML methodology, while excluding technological regress, has a similar profile to ML, in terms of total factor productivity, with a very strong correlation (0.990).

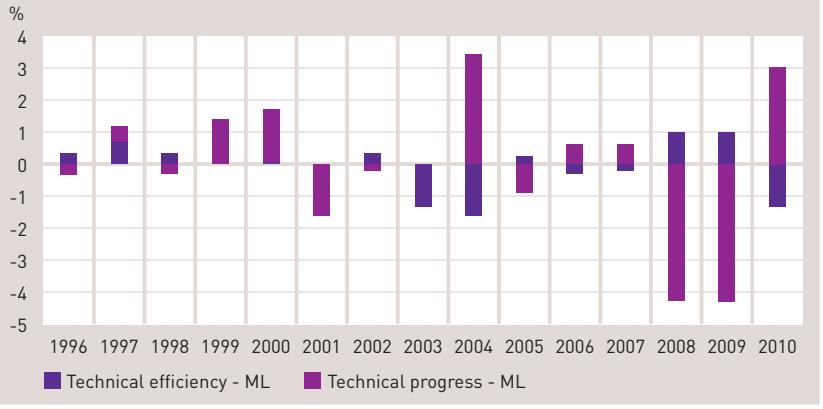
Observable deteriorations relate to the same years (2001, 2003, 2005, 2008, 2009). Equality between the different parameters could not be rejected, as shown in the table below.

Table Years

Null hypothesis	Statistics	p-value	Results
SML=ML	140	0.2615	Ho is not rejected (>0.05)
SMLEC=MLEC	80	0.1894	Ho is not rejected (>0.05)
SMLTC=MLTC	93.5	0.4425	Ho is not rejected (>0.05)

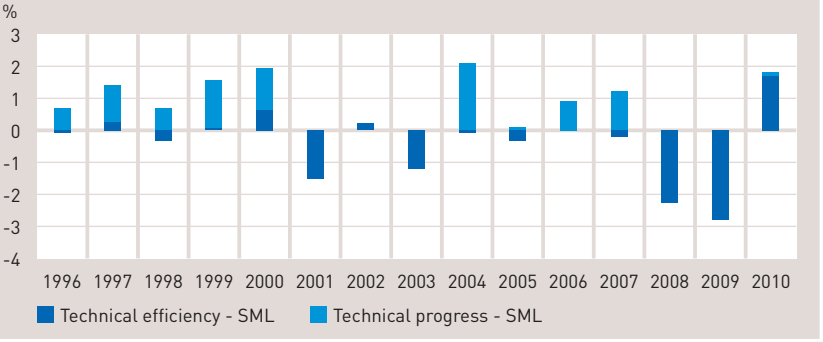
Source: Calculations by the authors
Observation: the p-value may vary if we change the sample, and generally, we cannot say that our sample is comprehensive for such a test.

Chart 6
Decomposition of TFP according to the ML index - annual growth of the geometric mean - All countries



Source: Statec Eurostat, EUKLEMS, STATEC and UNFCC – Calculations by the authors

Chart 7
Decomposition of TFP according to the SML index - annual growth of the geometric mean - All countries



Source: Statec Eurostat, EUKLEMS, STATEC and UNFCC – Calculations by the authors

8.7.3.4 Analysis of the results for Luxembourg

For Luxembourg, the measurement of TFP and its components by the ML index (Malmquist-Luenberger) and the SML index (Sequential Malmquist-Luenberger) is presented in the tables below.

For Luxembourg, the ML index detects 9 cases of deterioration (1998, 1999, 2001, 2003, 2005, 2006, 2007, 2008, 2009), which is a much higher number of cases than when considering the geometric mean of growth rates of countries, indicating that the means presented so far do cover a wide heterogeneity in the evolution of the situation in each country. In contrast, the total productivity SML index for Luxembourg is closer to the average with 5 cases of deterioration (2001, 2003, 2005, 2008 and 2009) as for all countries over the period 1995 to 2010.

Table 6
The Malmquist-Luenberger index for Luxembourg

Year	Technical efficiency - MLEC	Technical progress - MLTC	TFP - ML
1996	0,0 %	0,3 %	0,3 %
1997	0,0 %	2,4 %	2,4 %
1998	0,0 %	-0,5 %	-0,5 %
1999	0,0 %	5,9 %	5,9 %
2000	0,0 %	4,0 %	4,0 %
2001	0,0 %	-5,9 %	-5,9 %
2002	0,0 %	3,1 %	3,1 %
2003	0,0 %	-1,8 %	-1,8 %
2004	0,0 %	8,5 %	8,5 %
2005	0,0 %	-4,6 %	-4,6 %
2006	0,0 %	-4,4 %	-4,4 %
2007	0,0 %	-3,9 %	-3,9 %
2008	0,0 %	-8,5 %	-8,5 %
2009	0,0 %	-8,6 %	-8,6 %
2010	0,0 %	1,5 %	1,5 %

Source: Statec Eurostat, EUKLEMS, STATEC and UNFCC – Calculations by the authors

Table 7
The sequential ML index for Luxembourg

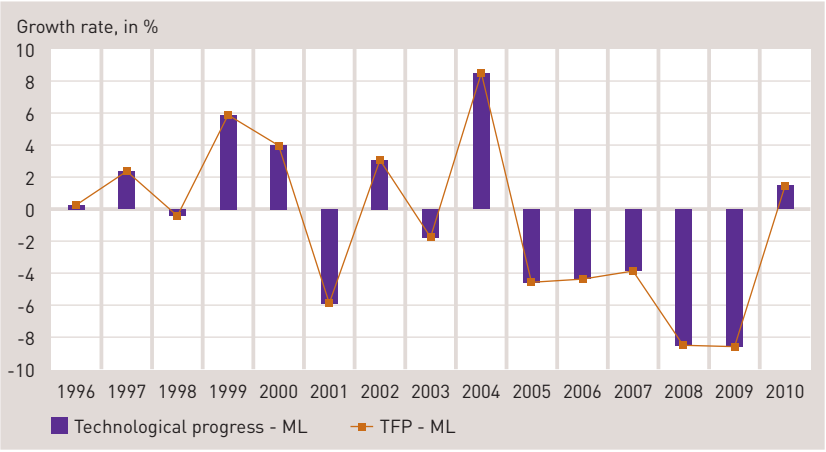
Year	Technical efficiency - SMLEC	Technical progress - SMLTC	TFP - SML
1996	0,0 %	0,3 %	0,3 %
1997	0,0 %	2,6 %	2,6 %
1998	0,0 %	3,7 %	3,7 %
1999	0,0 %	4,6 %	4,6 %
2000	0,0 %	3,2 %	3,2 %
2001	-3,0 %	0,0 %	-3,0 %
2002	0,0 %	0,0 %	0,0 %
2003	-1,6 %	0,0 %	-1,6 %
2004	4,7 %	7,7 %	12,8 %
2005	-1,7 %	0,0 %	-1,7 %
2006	1,7 %	0,1 %	1,9 %
2007	0,0 %	0,1 %	0,1 %
2008	-2,5 %	0,0 %	-2,5 %
2009	-4,3 %	0,0 %	-4,3 %
2010	0,1 %	0,0 %	0,1 %

Source: Statec Eurostat, EUKLEMS, STATEC and UNFCC – Calculations by the authors

The sequential approach is particularly interesting in the case of Luxembourg. Indeed, when technological regress is authorized, Luxembourg is always on the efficiency frontier and the changes in TFP are fully attributed to shifts of the efficiency frontier and interpreted as technological declines. If we accept that a level of production reached in the past is part of the whole production achievable in subsequent periods, then a deterioration observed in Luxembourg can also be attributable to a decrease in technical efficiency. The charts below illustrate the point clearly.

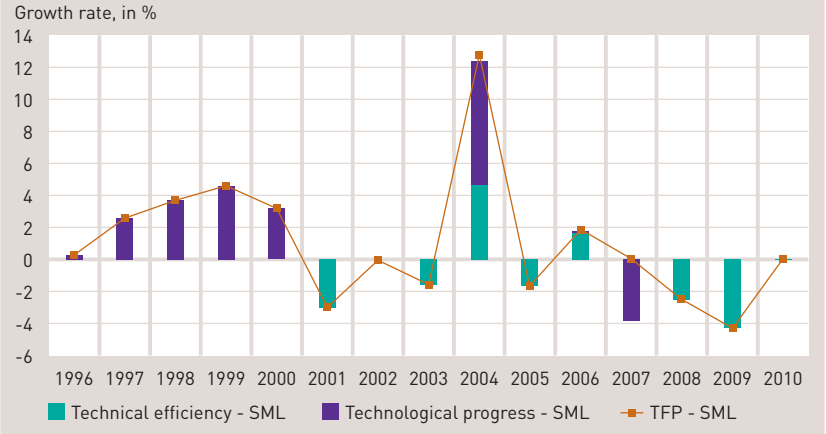
In the sequential approach, Luxembourg experiences a continuous period of TFP growth entirely due to technical progress from 1996 to 1998. Then, the evolution of TFP deteriorates in 2001 in the absence of technical progress and with a sharp decrease in technical efficiency, the same phenomenon prevails in 2003, 2005 and again in 2008 and 2009. These results seem more consistent with the hypothesis of a loss of technical efficiency due to the delay in factor adjustments following a decrease in production.

Chart 8
Environmental performance of Luxembourg - TFP and its components with the ML index



Source: Statec Eurostat, EUKLEMS, STATEC and UNFCC – Calculations by the authors

Chart 9
Environmental performance of Luxembourg - TFP and its components with the sequential ML index



Source: Statec Eurostat, EUKLEMS, STATEC and UNFCC – Calculations by the authors

8.7.4 Conclusion

The climate change concerns, which global cooperation echoes through environmental regulations such as "Rio de Janeiro (1992), Kyoto (1997), Johannesburg (2002), The Bali roadmap (2007), etc.", require better controls over negative externalities related to production. This also implies that we must take into consideration undesirable outputs linked to desirable outputs in the measurement of productivity growth. In the context of DEA models and indices constructed on distance functions to measure the total factor productivity, this leads to biased results or to unfeasibility problems when undesirable outputs are not properly integrated. Färe et al. (1989), Chung et al. (1997) and Ball et al. (2004) have adapted efficiency and productivity measurements to the introduction of negative externalities in the technology of the analysed DMUs.

In this paper, different distance functions have been used. The oldest is the radial distance function (Shephard, 1970). But it requires that the ratios between the various factors of production and products to be held constant. However, the concern in the context of taking negative externalities into consideration is to define the priorities given to the different factors. Instead, the directional distance function, proposed by Chambers, Chung and Färe (1996), allows to focus on one or more factors of production with respect to others and work simultaneously in input and output. These methodological contributions have been used to measure the evolution of total factor productivity in 15 European countries and in the United States between 1995 and 2010. The results show that taking into consideration environmental performance measured through greenhouse gas emissions improves the whole factor productivity[12]. Indeed, the geometric mean calculated for all countries is higher every year, except in 1996, than the results achieved without taking environmental performance into account. As a result, the ranking of countries according to the TFP calculated by the Malmquist-Luenberger index is not much different from that obtained without undesirable production although variations are noticeable for some countries.

In contrast, the elimination of situations of technological decline through the implementation of the sequential Malmquist-Luenberger index leads to the growth of total factor productivity, always higher on average than other indices. The analysis of temporal trends in SML and ML productivity indices for all countries reveals similar patterns of evolution during the period under review (1995-2010). However, this overall TFP trend covers very different developments of its components. While the ML index tends to attribute a portion of these declines to technological regress in 2001 and in 2008 and 2009, the sequential index attributes them more widely to a loss of efficiency gains. Similarly, a more detailed analysis of the evolution of country indices would allow assessing the disparities masked by the overall results. However, only Luxembourg has been presented in detail.

[12] Indeed, this is supported for example by the lower carbon content of GDP generally observed during the last 15 years.

Before concluding on these results, a number of hypotheses and alternatives should still be tested: especially the integration of a larger number of production factors such as intermediate consumption or more particularly the energy consumption in the production process as well as taking into account variable rather than constant returns to scale. This last hypothesis, the most frequently used in the context of this type of analysis, may seem somewhat restrictive. Indeed, Griefell-Tatjé and Lovell (1995) show that a Malmquist index can cause a bias in the measurement of productivity growth if the variable returns to scale characterize in fact the DMU technology analysed. Future contributions should also aim to deploy these measurements in the context of an international comparison of performance at the business sectors level.

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8.7.6 Appendix

The sequential Malmquist-Luenberger index

Four distance functions are necessary to measure the change in TFP for DMU_k (to be evaluated) between periods t and t+1. Therefore four different linear programming problems must be solved. Two problems use the same time period for observations and a sequential production technology; while the other two use time cross-references for observations and a sequential production technology:

$\vec{D}_o^t(x^t, y^t, b^t, g^t), \vec{D}_o^{t+1}(x^{t+1}, y^{t+1}, b^{t+1}, g^{t+1}), \quad \vec{D}_o^t(x^{t+1}, y^{t+1}, b^{t+1}, g^{t+1}),$
$\vec{D}_0^{t+1}(x^t, y^t, b^t, g^t)$

The first sequential directional distance function for the DMU_k: $\vec{D}_o^t(x^t, y^t, b^t, g^t)$ can be calculated by solving the following linear programming problem:

$$\vec{D}_o^t(x^t, y^t, b^t, g^t) = max\ \beta$$

$$Sc.$$
$$\sum_{\tau=1}^{t}\sum_{k=1}^{K} z_k^\tau y_{km}^\tau \geq (1+\beta) y_m^t\ , \quad m = 1, \dots, M$$
$$\sum_{\tau=1}^{t}\sum_{k=1}^{K} z_k^\tau b_{kj}^\tau = (1-\beta) b_j^t\ , j = 1, \dots, J$$
$$\sum_{\tau=1}^{t}\sum_{k=1}^{K} z_k^\tau x_{kn}^\tau \leq x_n^t\ , \quad n = 1, \dots, N$$
$$z_k^t \geq 0\ , \ k = 1, \dots, K \quad ,$$

The solution of the second sequential directional distance function for the DMU_k $\vec{D}_o^{t+1}(x^{t+1}, y^{t+1}, b^{t+1}, g^{t+1})$ is identical to the previous one, with the exception that the exponent t of the second member of the various constraints is replaced by t+1.

The two directional distance functions used in the construction of the SML index require time cross-periods. The first one, that is to say $\vec{D}_o^t(x^{t+1}, y^{t+1}, b^{t+1}, g^{t+1})$ is calculated for the DMU_k, by solving the following linear programming problem:

$$\vec{D}_o^t(x^{t+1}, y^{t+1}, b^{t+1}, g^{t+1}) = max\ \beta$$
$$Sc.$$
$$\sum_{\tau=1}^{t}\sum_{k=1}^{K} z_k^\tau y_{km}^\tau \geq (1+\beta) y_m^{t+1}\ , \quad m = 1, \dots, M$$
$$\sum_{\tau=1}^{t}\sum_{k=1}^{K} z_k^\tau b_{kj}^\tau = (1-\beta) b_j^{t+1}\ , j = 1, \dots, J$$
$$\sum_{\tau=1}^{t}\sum_{k=1}^{K} z_k^\tau x_{kn}^\tau \leq x_n^{t+1}\ , \quad n = 1, \dots, N$$
$$z_k^{t+1} \geq 0\ , \ k = 1, \dots, K \quad ,$$

In the above program, the reference technology which is evaluated by $(x_k^{t+1}, y_k^{t+1}, b_k^{t+1}, g_k^{t+1})$ is built with all the observations from the period 1 to period t. The last linear programming problem to be solved $\vec{D}_0^{t+1}(x^t, y^t, b^t, g^t)$ is identical to the above problem by replacing the exponent of the second member of constraints t+1 by t.

The optimal solutions of the four linear programming problems are used to calculate the sequential Malmquist-Luenberger index.

9 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[LISBON]

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 in the labour force 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-6 classification system as follows: Agriculture, Forestry and Fishing; Industry, including energy; Construction; Trade, Auto Repair, HORECA, Transportation and Communication; Financial activities, Business services, Real estate rentals and Other activities and services. 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) LISBON

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. For these reasons, the EU has set the objective of achieving 70% employment by 2010 as part of its Lisbon Strategy. The objective for female employment in 2010 is 60%.

B4 B5 B6 Employment rate of persons aged 55-64 (T, H, F) LISBON

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 LISBON

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 in the labour force 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

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

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

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 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 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 150 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 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

This indicator lists the lowest price DSL subscription available in September 2002 and compares it to the lowest cost subscription available in November 2004, in USD with tax included. Many applications in the information society depend on high speed data transfer systems. A market that is receptive to the offer of broad band connections promotes the spread of information and simultaneously allows consumers and companies, especially PME, to take advantage of increased online services.

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 (not included in the TBCO)

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 (not included in TBCO)

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 labour 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. How efficiently resources are used must be evaluated in terms of academic results and levels of education attained.

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

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 (not included in the TBCO)

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 (not included in the TBCO)

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 LISBON

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 Lisbon Strategy, the objective to be met in internal R & D expenditures is 3% by 2010.

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

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

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 LISBON

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

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 and the 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) LISBON

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 LISBON

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 renewables in gross final energy consumption (indicator to measure the share of renewable energy in the final consumption of energy, which is under development)
EU2020-5	Energy intensity of the economy (proxy indicator for Energy savings, which is under development)
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