

Employment growth and firms' mobility: Metropolitan Luxembourg in the making (1994-2005)

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Abstract

This article deals with the role played by sectoral and regional factors in employment growth in Luxembourg between 1994 and 2005. By considering the country's twelve main sectors of economic activity and by dividing the national territory into five functional units, it shows that this growth was highly heterogeneous in sectoral and geographical terms. A first analysis details the centripetal or centrifugal orientation of job transfers affecting the spatial units. Building on a model of regional employment growth, a second analysis, balancing between-firm transfers, results in an estimate of the share of employment growth due to regional or structural effects. Computing virtual economies finally leads to distinguishing regional effects specific to a given region, and then highlights the contribution of each sector to these regional effects. Results underpin the emergence of an integrating metropolitan area structured by the Luxembourg agglomeration.

Résumé

Cet article traite de l'importance des facteurs sectoriels et régionaux dans la croissance de l'emploi au Luxembourg de 1994 à 2005. Pour ce faire, 12 secteurs économiques représentatifs des principales activités du pays et 5 unités géographiques fonctionnelles correspondant à un découpage concentrique de l'espace national sont considérés. Une première analyse détaille l'orientation centripète ou centrifuge des transferts d'emplois résultants des mouvements d'entreprises entre unités géographiques. En s'appuyant sur une modélisation de la croissance régionale de l'emploi, une seconde analyse, corrigée des transferts d'entreprises, estime la part de la croissance de l'emploi due à des effets régionaux ou sectoriels. Le calcul d'économies virtuelles permet finalement de distinguer les effets régionaux spécifiques à chaque unité géographique, puis de mettre en évidence la contribution de chaque secteur à ces effets régionaux. Les résultats illustrent l'émergence d'un ensemble métropolitain en voie d'intégration organisé autour de l'agglomération de Luxembourg.

Key-words

Employment growth; firms' mobility; metropolisation; virtual economy; Luxembourg

Mots-clés

Croissance de l'emploi ; mobilité des entreprises ; métropolisation ; économie virtuelle ; Luxembourg

JEL Classification

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Introduction

From 1995 to 2005, Luxembourg went through a spectacular growth of internal employment, which evolved from 215.500 to 307.300 units (+42.6%), while its population grew from 406.350 to 461.230 inhabitants (+13.5%). The development of newly created employments contributed to the increase in the number of cross-border commuters from France, Belgium and Germany, which went from 47.300 to 109.500 throughout the same period (+131.5%) (STATEC 2006). The first economic activities that benefited from this growth were those that were specifically related to metropolisation. The national territory's small size in addition to the spatial consequences of agglomeration have led to a profile marked by a high degree of specialization, notably in financial knowledge intensive services and in business services. As a matter of fact, on the scale of Europe, Luxembourg is known as the country with the most important degree of specialization (Fontagné 2004). Aware of the risks that such a level of specialization may provoke in case of a slowdown in the financial activities, the government has been concerned with diversifying the national economy through the use of several development tools. However, studies that were carried out according to specific indexes (Bertinelli and Strobl 2007, Bourgain, Guarda and Pieretti 2000), demonstrated that the Luxembourg economy has a heavy tendency towards specialization.

Even though effects related to heterogeneousness of space are far from being irrelevant in terms of consequences on employment, the spatial dimension of the Luxembourg economy's specialization and growth movements is still quite unknown. In that respect, what part did regional and sectoral aspects play in Luxembourg's employment growth from 1994 to 2005? Was this growth beneficial to all economic sectors or did it concentrate exclusively on the sectors characterized by a high degree of knowledge and skills? Was it equally distributed to all parts of the national territory or was it mostly profitable to central areas at the expense of others? From an economic point of view combined with a geographical one, the main hypothesis is to consider that the spatial organization of Luxembourg economic activities is close to that which characterizes the European *urbanization regime*, that is to say "all territorialisation modes conditioning the renewal of urban centralities as well as the reproduction and functioning of cities and urban areas as economic, social and physical zones" (Da Cunha and Both 2004: 7). Today, this urbanization regime is mostly characterized by a metropolisation process, considered as a growing concentration of highly specialized activities and wealth in the major urban centres, a polarisation and development of inter-cities flows and the formation of a world city network (Taylor 2004) and the establishment of large, functional and discontinuous urban areas.

The first part will be dedicated to literature relating to the localization choice of economic activities in metropolitan areas. The second one will deal with methodological elements defining the sectoral, spatial and temporal framework of the analysis, by reminding, among other aspects, the national specificities which justify the chosen structure. The third part will concentrate on the study of employment evolution in Luxembourg from 1994 to 2005. The sectoral, temporal and spatial aspects of employment growth, the economic profile of spatial units as well as a concentration and specialization index for employment will be introduced. Considering the significant flows affecting geographical units, an empirical analysis will be conducted in a fourth part, dealing with employment movements, in order to show the benefits and losses of each unit in the national territory. A model of regional employment growth, presented in a fifth part, will determine which part of employment growth is due to regional or structural causes. A calculation of virtual economies will then make it possible to identify the regional causes that are specific to each geographical unit, and then to determine the part of contribution played by the different sectors in the regional effect analysed.

1. Metropolisation and the location of economic activities

Metropolisation offers an adapted framework to firms that are established in global networks and benefiting from urban areas' external economies that are specific to the metropolitan environment, some of which urbanization and localization economies have been particularly studied (Audretsch and Feldman 1996, Glaeser *et al.* 1992, Krugman 1991). The metropolitan environment's advantages lead to a high concentration of activities that are most specific to urban areas and this even if some technologies are now allowing an optimal control of distances. This paradox implies the development of two simultaneous phenomena: the dispersion of economic activities which are the most sensitive to flexibility and costs, such as low technologies or back-office services, and the concentration of high positions that are sensitive to proximity, and that allow to control the dispersion of economic activities on a global scale (Harvey 1990, Sassen 2001).

Thus, metropolitan centres can be described as both the cores of a relational cohesion and the opposite poles of a territorial unit (Veltz 1996). In the latter, localization of economic activities within the city has been traditionally interpreted, according to the concentric model of land rent (Alonso 1964) which attributes an arbitration role to surface availability as well as to real estate and transport costs, and according to the minimum differentiation model which allows one to explain the concentration of complementary firms (Brown 1992). Then, the suburbanization and periurbanization processes have partially called the monocentric organization of economic activities into question by decentralizing populations and employment (Boiteux-Orain and Huriot 2002).

Thus, location is not only interpreted according to transport costs but also to transaction costs that are linked to relations between the firms and their suppliers, to services the formers have to seek and to their qualified workforce supply (Catin 1995). Then the resulting urban economy takes the shape of a competition for metropolitan space, which implies the intervention of arbitration between concentration factors (agglomeration economies) and dispersion factors (wage costs, land rent, availability of activity areas, congestion, pollution).

Non-codifiable activities founded on skills and/or knowledge exchange such as higher services (notably financial), culture or new technologies will tend towards a central localization as long as this knowledge is transmitted throughout interactions between groups of individuals sharing the same codes. However, activities that are essentially founded on codifiable information exchange, requiring no physical proximity with customers will be able to adopt a more out-lying location (Storper and Venables 2004). Such is the case with some less qualified metropolitan activities such as transport, logistics or wholesale trade that are highly space-consuming, and tend towards specific centralities, which is a sign of a greater specialization of infra-metropolitan zones. More particularly, the presence of manufacturing industries on the close periphery is explained by the fact that such localization multiplies their advantages, and allows them at the same time to "imitate" urban economies that are specific to centres (Polèse and Shearmur 2007). The metropolis' great periphery is on the contrary occupied by industries that are less sensitive to agglomeration economies, and active in the transformation process, using a small degree of knowledge.

2. Methodology

Sectoral and spatial differentials linked to employment growth in Luxembourg are approached by considering the country's main economic sectors as well as relevant geographical units. For that purpose, individual data coming from the Luxembourg General Inspection of Social Security (IGSS) allow to know the state of all active persons who worked in Luxembourg in 1994, 1996, 1999, 2002 and 2005, whatever their country of residence.

2.1. Sectoral variables

Jobs are organized in twelve categories based on three-digit NACE code positions that characterize them (see Annex 1). The purpose of the analytical grid used to form categories is to identify high-technology manufacturing and intensive-knowledge services sectors. Those sectors choices are all the more appropriate for they bring favourable prospects, at least in some geographical units, in terms of growth. The identification of knowledge intensive industries and services has been based on classifications established by OECD and Eurostat (2006). The identification of Luxembourg metropolitan sectors has been based on the works of Sohn and Walther (2008b).

A reclassification was necessary in order to reduce the number of economic sectors with a small number of employees. Economic activities considered to be similar have been grouped together. Following Decrop (2003) in Belgium, five categories were removed from the analysis because of their low contribution in the national economy: Agriculture, hunting and related service activities (NACE 01), Forestry, logging and related service activities (02), Mining of coal and lignite; extraction of peat (10), Mining of metal ores (13), as well as Extra-territorial organizations and bodies (99), exclusively concentrated in Luxembourg-City.

2.2. Geographical variables

On a European scale, Luxembourg distinguishes itself by its national territory's extremely reduced size and by its internal employment as well as by the presence of a dominant urban, i.e Luxembourg-City. Therefore it is impossible to do a study of regional and sectoral factors on employment growth on a similar basis to that of comparative works carried out on the scale of bigger national city systems (see Feldman and Audretsch 1999, Wenjuan 2006).

Luxembourg lacking an operational definition of major urban areas and urban regions unlike other European States, the geographical division which was applied has been based on a radioconcentric vision of the national State organized around Luxembourg-City. The concept of a unique centrality around which a metropolitan unity is organized, which is often mentioned in urban economic literature, is justified by costs increase linked to distance in economic organization. In addition to that, one can mention the great weight carried out by the Luxembourg Urban Area in terms of absolute employment (59.5% in 2005) and employment related to the resident population (1.24) compared to other urban areas of the country, as well as a heavy polarization of commuting movements towards the capital (Sohn and Walther 2008a).

A spatial division made on the basis of urban units' morphological characteristics and functional specificities that are usually adopted in Europe allows to bring out five infra-metropolitan units (Map 1).

1. Luxembourg-City (83.820 inhabitants in 2007).

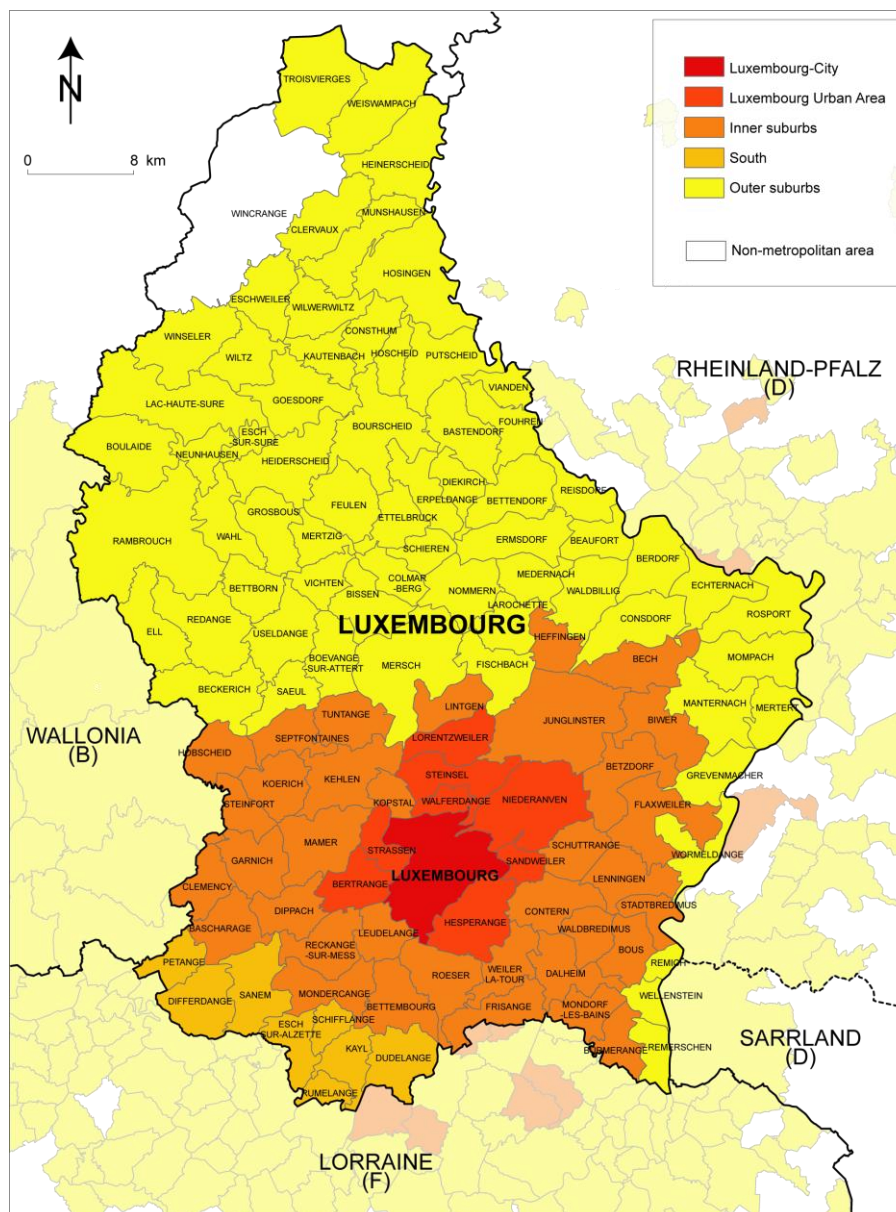
2. Luxembourg Urban Area: suburban area in which a certain redistribution of population and jobs has taken place from the mid-XXth century (Sohn 2006) (47.833 inhabitants). This area is continuously built from the city-centre of Luxembourg-City.

3. Inner suburbs: municipalities in which the proportion of commuters working in the Luxembourg Urban Area is higher than 40% of the active population in 2002 (104.787 inhabitants). These suburban areas are built discontinuously from the city-centre and are characterized by a low density of buildings, population and employment. Their development was made possible by the improvement of road accessibility and private real estate.

4. South: municipalities in which the proportion of commuters working in the Luxembourg Urban Area is lower than 40% of the active population in 2002 and located in the old southern industrial basin of the country (116.718 inhabitants). The South is a very populous area, however marked by a low density of jobs and increased dependency in the direction of Luxembourg-City. This area has benefited from several state initiatives in order to foster the industrial redevelopment (University in Esch-sur-Alzette), as well as some financial back-office activities.

5. Outer suburbs: municipalities in which the proportion of commuters working in the Luxembourg Urban Area is between 8.3 and 39.9% of the active population in 2002 (116.814 inhabitants). Although functionally linked to the Agglomeration, these suburbs have a low density of population and jobs, with the exception of a few atypical locations (Colmar-Berg).

Map 1. Infra-metropolitan units in Luxembourg



Data: Bundesanstalt für Arbeit 2001; INS 2001; INSEE 1999; Administration des Contributions Directes du Luxembourg 2002; Recensement de la Population 2001, STATEC.

Note: The availability of data does not allow to analyze the evolution of employment outside of the Grand Duchy of Luxembourg.

Cartography: Walther 2008.

2.3. Taking into consideration the job mobility

Scholars studying firm's movements across space have highlighted that the structure of those relocations is essentially intraregional (Delisle and Lainé 1998). Considering the reduced dimensions of Luxembourg's national territory, it then seems necessary to take those relocations – which may have been neglected on the scale of large metropolitan areas or larger States – into account (see Mager 2006, Toulemonde 2001). Indeed, a compared study of employment growth measures – including or excluding those relocations – allows to show the significant role they play in employment evolution. Relocations in particular represented nearly half of the Urban Area's employment growth from 1996 to 1999 (Table 1).

Table 1. Employment growth including or not regional job transfers

Geographical units	1994-1996		1996-1999		1999-2002		2002-2005	
	transfers included	transfers excluded	transfers included	transfers excluded	transfers included	transfers excluded	transfers included	transfers excluded
Luxembourg-City	0.036	0.033	0.107	0.108	0.150	0.161	0.021	0.024
Lux. Urban Area	0.058	0.066	0.346	0.187	0.185	0.195	0.103	0.139
Inner suburbs	0.141	0.106	0.162	0.178	0.274	0.216	0.127	0.119
South	-0.012	-0.017	0.196	0.168	0.237	0.184	0.098	0.099
Outer suburbs	0.053	0.043	0.122	0.122	0.122	0.128	0.100	0.115

Source: IGSS; authors' calculation

In this study, relocations have two origins: the transfer from one geographical unit to another or the merger of one or several firms located in different geographical units.

3. Employment growth in Luxembourg between 1994 and 2005

In the studied period, Luxembourg went through an employment growth which was on the whole superior to that of European Union states. The following elements will serve to show how much such a growth was influenced by sectoral, cyclic and geographical differentials.

Employment growth appears to be quite varied depending on the different economic sectors considered (Table 2).

Table 2. Employment growth by economic sectors, 1994-2005

Economic sectors	Employment 1994	Employment 2005	Growth 1994-2005
High-tech and medium-high-tech industries	5713	6572	0.15
High-tech knowledge intensive services	2024	8991	3.44
Market knowledge intensive services	11536	32243	1.79
Financial knowledge intensive services	20979	34081	0.62
Higher education, human health, cultural and sporting activities	1237	2055	0.66
Medium-low and low-tech industries	28997	27664	-0.05
Construction	22050	30955	0.40
Sale, wholesale, retail trade	28161	37381	0.33
Land transport, post	11401	16711	0.47
Other business services	4210	8405	1.00
Hotels and restaurants	8423	12140	0.44
Other service activities	3204	6351	0.98
All sectors	147935	223549	0.51

Source: IGSS; authors' calculation

From 1994 to 2005, high-tech and market knowledge intensive services (+344%, +179%) as well as other business services (+100%) went through a considerably high growth, whereas medium-low and low-tech industries went through a negative growth (-5%). Besides it is interesting to notice that the sectors that mostly increased were those that hired the smallest number of employees, except for business services and financial knowledge intensive services (+62%).

Employment growth also appears to have been cyclic: it was indeed not as high in the first and last years (1994-1996 and 2002-2005) than it was in the intermediate years of the observed periods (1996-1999 and 1999-2002) (Table 3). This trend is the result of the sharp decline in jobs in the banking sector and manufacturing industry between 2002 and 2003 because of the difficult economic context and the reorganization of the activities on a global scale.

Table 3. Employment growth by periods, 1994-2005

Periods	Number of jobs at the beginning of the period	Number of jobs at the end of the period	Average annual employment growth
1994 - 1996	147935	155121	0.024
1996 - 1999	155121	178463	0.047
1999 - 2002	178463	209778	0.055
2002 - 2005	209778	223549	0.021

Source: IGSS; authors' calculation

From a geographical point of view, employment growth was twice as high in the inner suburbs (+91%) and in the Luxembourg Urban Area (+86%) as it was in Luxembourg-City (35%) from 1994 to 2005 (Table 4). The South (+60%) and the outer suburbs (+45%) went through a moderate growth, which explains why the rate of employment which is located in the inner suburbs and in the Urban Area – as opposed to the whole national territory – increased considerably, going from 11.9 to 15.1% and from 10.8 to 13.3% respectively. As for the City of Luxembourg, it went through an important decline in terms of employment compared to the whole national territory in the studied period, whereas the South and the outer suburbs remained relatively stable.

Table 4. Employment growth by geographical units, 1994-2005

Geographical units	Employment 1994	Employment 2005	Growth 1994-2005
Luxembourg-City	76714	103283	0.35
Luxembourg Urban Area	15983	29768	0.86
Inner suburbs	17672	33746	0.91
South	15104	24162	0.60
Outer suburbs	22462	32590	0.45
Country	147935	223549	0.51

Source: IGSS; authors' calculation

3.2. Regional growth and economic profiles

Regional growth is obviously not unrelated to geographical units' economic profiles nor to the latter's temporal evolutions. Indeed, one part of the growth differential is due to the local productive systems' heterogeneousness, which in this case is comprehended throughout sectoral specializations. For a given year, a selected specialization index measures the relation between each sector's employment proportion in each geographical unit and each sector's proportion in the rest of the country's total employment record:

$$S_{si} = \frac{X_{si}}{Y_{si}} \quad \text{where } X_{si} = \frac{E_{si}}{E_i} \text{ and } Y_{si} = \frac{\sum_{i=1}^{k-1} E_{si}}{\sum_{i=1}^{k-1} E_i}$$

E is the employment, s is the economic sector, i is the geographical unit and k is the number of geographical units

This specialization index is different from that which is usually used on metropolitan scales (see Feldman and Audretsch 1999) in so far as Luxembourg-City's predominant weight has a considerable influence over the results which are calculated on a national scale. When the index equals 1, regional employment's diversity in the studied sector will be perfectly identical to the rest of the country; a value that is inferior to 1 will indicate a low representation of regional employment in the studied sector, whereas a value which is superior to 1 will indicate an over-representation.

The specialization index evolution allows one to identify distinct profiles according to geographical units (Table 5 and 6). In 1994, the City of Luxembourg was characterized by a considerably high degree of specialization in financial knowledge intensive services – which were 15 times as much represented as in the rest of the country –, in other services, mostly those provided to companies, as well as higher education, health, culture and sports. However, other non metropolitan jobs were much less represented than in other parts of the country, in particular in the construction, sale, wholesale, retail trade and low or medium-low industries. As for the South, it is characterized by an almost opposite profile, distinguished by a high degree of specialization in non metropolitan industries as well as in other services, in the construction industry and in transport services.

Table 5. Sectoral specialization by geographical units, 1994

Economic sectors	Luxembourg -City		Luxembourg Urban Area		Inner suburbs		South		Outer suburbs	
	Emp (%)	I_spe	Emp (%)	I_spe	Emp (%)	Emp (%)	I_spe	Emp (%)	I_spe	Emp (%)
High-tech and medium-high-tech industries	0.02	0.28	0.07	1.79	0.11	3.69	0.03	0.69	0.05	1.32
High-tech knowledge intensive services	0.01	1.00	0.02	1.71	0.03	2.53	0.01	0.35	0.00	0.15
Market knowledge intensive services	0.10	2.31	0.07	0.95	0.03	0.40	0.06	0.73	0.03	0.34
Financial knowledge intensive services	0.26	15.58	0.06	0.40	0.01	0.04	0.00	0.01	0.01	0.03
Higher education, human health, cultural and sporting activities	0.01	2.25	0.01	0.94	0.01	0.95	0.00	0.18	0.00	0.36
Medium-low and low-tech industries	0.17	0.79	0.04	0.20	0.17	0.85	0.24	1.28	0.36	2.13
Construction	0.08	0.36	0.21	1.53	0.27	2.08	0.22	1.59	0.18	1.33
Sale, wholesale, retail trade	0.13	0.49	0.39	2.23	0.22	1.17	0.27	1.42	0.22	1.14
Land transport, post	0.10	1.70	0.04	0.51	0.07	0.85	0.07	0.96	0.05	0.56
Other business services	0.04	11.37	0.00	0.21	0.00	0.09	0.00	0.16	0.00	0.12
Hotels and restaurants	0.05	0.84	0.06	0.99	0.05	0.86	0.06	0.99	0.08	1.49
Other service activities	0.02	0.67	0.02	0.91	0.03	1.21	0.04	2.07	0.02	0.98

Source: IGSS; authors' calculation

Note: I_spe is the specialisation index; Emp (%) is the employment distribution by sector

By comparing the specialization degree of metropolitan units with sectoral employment growth, it appears that the City of Luxembourg is rather specialized in highly job-creating sectors, which hired 51% of City employees in 1994. However, other geographical units

seem rather specialized in sectors that are not much job-creating. There is an exception related to such a distribution. Indeed high-tech knowledge intensive services, which are highly job-creating, seem to be highly represented in the Urban Area and the Inner suburbs. Nevertheless, this sector's size is very limited (8991 jobs in 2005). At first sight, such an observation about a rather positive effect on Luxembourg-City seems to be in contradiction with the city's moderate employment growth. The coexistence of these two phenomena is in fact suggesting a relatively negative consequence linked to the City of Luxembourg.

Specialization indexes' temporal evolutions show that the metropolitan territories' structure tends to retain the general characteristics inherited from 1994 to 2005. However, some evolutions are worth noticing. (1). While Luxembourg-City went through a decrease in specialization in high and middle-high technology industries, the South went through a growth of specialization in the same industries. (2). While the Inner suburbs went through a decrease of specialization in high technology industries, the Outer suburbs experienced a growth of specialization in the same industries. (3). While specialization in financial knowledge intensive services and in business services went down in Luxembourg-City – at the same time as the rest of the country, especially in urban areas – the latter increased in the South and in the second periphery.

Table 6. Sectoral specialization by geographical units, 2005

Economic sectors	Luxembourg -City		Luxembourg Urban Area		Inner suburbs		South		Outer suburbs	
	Emp (%)	I_spe	Emp (%)	I_spe	Emp (%)	I_spe	Emp (%)	I_spe	Emp (%)	I_spe
High-tech and medium-high-tech industries	0.00	0.09	0.04	1.84	0.06	3.20	0.05	2.17	0.06	1.18
High-tech knowledge intensive services	0.03	0.60	0.06	1.75	0.04	1.08	0.02	0.41	0.07	1.90
Market knowledge intensive services	0.19	1.73	0.12	0.95	0.08	0.54	0.15	0.94	0.08	0.53
Financial knowledge intensive services	0.30	12.08	0.09	0.48	0.01	0.06	0.01	0.03	0.01	0.05
Higher education, human health, cultural and sporting activities	0.01	1.47	0.01	0.89	0.01	1.35	0.00	0.35	0.01	0.56
Medium-low and low-tech industries	0.10	0.74	0.02	0.16	0.14	1.20	0.24	1.78	0.19	1.68
Construction	0.07	0.32	0.14	1.13	0.23	1.90	0.20	1.55	0.22	1.80
Sale, wholesale, retail trade	0.11	0.50	0.30	2.08	0.18	1.05	0.18	1.17	0.21	1.38
Land transport, post	0.07	0.96	0.05	0.66	0.11	1.65	0.07	1.03	0.07	0.79
Other business services	0.05	3.64	0.09	1.38	0.02	0.08	0.01	0.34	0.00	0.13
Hotels and restaurants	0.05	0.84	0.05	0.97	0.08	1.22	0.04	0.89	0.06	1.26
Other service activities	0.02	0.48	0.03	1.15	0.04	1.66	0.04	1.60	0.03	1.24

Source: IGSS; authors' calculation

Note: I_spe is the specialisation index; Emp (%) is the employment distribution by sector

3.2. Geographical concentration and sectoral specialisation

The range of regional economic profiles is reflected in the study of geographical concentration and in sectoral specialization. While the former indicates the way each sector's workforce is geographically distributed, the latter describes how each spatial unit's workforce is spread out in the different sectors. Thus, the observation of concentration and specialization offers an opportunity to summarize the information previously presented. For

that purpose, two indexes ought to be considered: The Gini index for geographical concentration and the Herfindhal index for sectoral specialization (Houdebine 1997).

The Gini index is calculated as follows:

$$G = 1 - \sum_{i=1}^{k-1} (Y_{i+1} + Y_i)(X_{i+1} - X_i)$$

where k is the number of geographical units, X_i is the proportion of employment localized in the area i , Y_i is the proportion of a given type of employment in the area i ; geographical units should be sorted by Y_i/X_i .

The Gini index measures disparity in employments' spatial distribution in a given sector and therefore indicates a sector's geographical concentration in relation to different geographical units. In that capacity, it showed how financial knowledge intensive services (0.81), which were essentially located in Luxembourg-City, formed the most concentrated economic sector in 2005 as it did in 1994, whereas other business services were highly geographically concentrated as well (≥ 0.6) (Table 7). However, high and middle-high technology industries, construction, sale, wholesale and retail trade were more equally distributed among spatial units.

Tableau 7. Gini index, 1994 and 2005

Economic sectors	Gini (1994)	Gini (2005)
High-tech and medium-high-tech industries	0.36	0.35
High-tech knowledge intensive services	0.48	0.41
Market knowledge intensive services	0.62	0.53
Financial knowledge intensive services	0.81	0.79
Higher education, human health, cultural and sporting activities	0.57	0.47
Medium-low and low-tech industries	0.52	0.42
Construction	0.27	0.26
Sale, wholesale, retail trade	0.33	0.31
Land transport, post	0.56	0.46
Other business services	0.73	0.66
Hotels and restaurants	0.45	0.42
Other service activities	0.40	0.30

Source: IGSS; authors' calculation

All the sectors went through a decentralization process from 1994 to 2005. By comparing Gini index results with sectoral employment growth results, one observes that the most concentrated sectors had a tendency to go through a high employment growth, with the exception of land transports and post that did not grow faster than the national economy as well as low and middle technology industries which went through a negative growth.

Using the Herfindahl index to report sectoral specialization makes it possible to measure which proportion of employments was represented by each sector in total employments records from 1994 to 2005 according to different geographical sectors. This index is calculated as follows:

$$H_i = \sum_{i=1}^k \left(\frac{E_{si}}{\sum_{i=1}^n E_{si}} \right)^2$$

where E is the employment, s is the economic sector, i is the geographical unit, k is the number of geographical units and n is the number of economic sectors.

A geographical unit will be considered as perfectly diversified if the index equals 0 and perfectly specialized if the latter equals 1. The relative growth of Luxembourg-City's specialization contrasts with the diversification process which was in progress in other spatial units, notably the Luxembourg Urban Area and the Outer suburbs (Table 8). Such an evolution is a direct consequence of the decentralization of a great number of services.

Table 8. Herfindahl index, 1994 and 2005

Geographical units	1994	2005
Luxembourg-City	0.14	0.16
Luxembourg Urban Area	0.21	0.15
Inner suburbs	0.17	0.14
South	0.19	0.16
Outer suburbs	0.22	0.15
All units	0.14	0.12

Source: IGSS; authors' calculation

These preliminary results allow to introduce employment growth, and to contextualize the factors that were likely to have an influence on it. In order to go further, two directions of analysis are examined: employment relocations and the revised employment growth record in relation to employment relocations.

4. Employment relocations

Employment relocations represent a first direction of analysis for the understanding of geographical effects on employment evolution. Some territories appear sometimes to be attractive, provoking a relocation of companies towards them. Other territories rather appear to be repulsive. Movements from one spatial unit to another depend strongly on the sectors that are considered. A synthesis of employment movements allows one to highlight the existence of three main orientations:

(1). Centrifugal relocations that are specific to suburbanization or periurbanization from the City of Luxembourg. On all sectors' scale, from 1994 to 2005, the number of recorded departures (out) from the central city was superior to that of entries (in), all economic sectors considered (Table 9).

Table 9. Employment relocations by sectors, 1994-2005

Economic sectors	Luxembourg-City			Lux. Urban Area			Inner suburbs			South			Outer suburbs		
	In	Out	In/Out	In	Out	In/Out	In	Out	In/Out	In	Out	In/Out	In	Out	In/Out
High-tech and medium-high-tech industries	0	58	0,0	161	0	0,0	19	0	0,0	0	0	0,0	0	122	0,0
High-tech knowledge intensive services	428	747	0,6	748	362	2,1	200	250	0,8	81	43	1,9	52	107	0,5
Market knowledge intensive services	3772	2127	1,8	2639	2427	1,1	1294	2060	0,6	869	722	1,2	254	1492	0,2
Financial knowledge intensive services	518	1051	0,5	935	501	1,9	90	23	3,9	20	6	3,3	35	17	2,1
Higher education, human health, cultural and sporting activities	86	134	0,6	69	51	1,4	90	51	1,8	22	18	1,2	23	36	0,6
Medium-low and low-tech industries	296	904	0,3	292	253	1,2	538	1045	0,5	1619	327	5,0	444	660	0,7
Construction	675	2158	0,3	1189	1982	0,6	3075	895	3,4	774	700	1,1	566	544	1,0
Sale, wholesale, retail trade, hotels and restaurants	1704	3424	0,5	4059	2267	1,8	3051	2139	1,4	1335	1519	0,9	1242	2042	0,6
Land transport, post	285	921	0,3	587	327	1,8	1545	733	2,1	319	502	0,6	320	573	0,6
Other business services	1201	1828	0,7	1469	1126	1,3	359	80	4,5	22	9	2,4	0	8	0,0
Other service activities	80	212	0,4	115	61	1,9	190	38	5,0	59	93	0,6	17	57	0,3
Total	9045	13564	0,7	12263	9357	1,3	10451	7314	1,4	5120	3939	0,8	2953	5658	0,5

Source: IGSS; authors' calculation

An analysis of employment relocations' origins and directions makes it possible to show that this debit balance benefited essentially to the Luxembourg Urban Area (Table 10). This illustrates the current economic integration process affecting the city-centre and its close periphery as well as their complementarities in terms of economic activities. The progressive exurbanization of some economic activities is beneficial in the first place to financial and high-tech services as well as the construction industry in the Urban Area or the Inner suburbs (Table 11).

Table 10. Balance of employment relocations by economic periods and geographical units, 1994-2005

Geographical units	1994-1996	1996-1999	1999-2002	2002-2005
Luxembourg-City	-1251	-2346	-1270	-732
Luxembourg Urban Area	608	329	1373	-54
Inner suburbs	614	1133	-214	916
South	591	905	311	44
Outer suburbs	-562	-21	-200	-174
Total	0	0	0	0

Source: IGSS; authors' calculation

Table 11. Origin and destination of employment relocations by economic periods and geographical units, 1994-2005

		2005					
2002	Luxembourg-City	Lux. Urban Area	Inner suburbs	South	Outer suburbs	Total	
Luxembourg-City	0	2205	1057	506	473	4241	
Lux. Urban Area	2263	0	1222	308	132	3925	
Inner suburbs	320	1004	0	635	214	2173	
South	231	266	397	0	38	932	
Outer suburbs	176	1058	111	74	0	1419	
Total	2990	4533	2787	1523	857	12690	

		2002					
1999	Luxembourg-City	Lux. Urban Area	Inner suburbs	South	Outer suburbs	Total	
Luxembourg-City	0	1446	1320	239	522	3527	
Lux. Urban Area	532	0	860	108	96	1596	
Inner suburbs	453	377	0	824	207	1861	
South	122	18	606	0	12	758	
Outer suburbs	74	84	208	492	0	858	
Total	1181	1925	2994	1663	837	8600	

		1999					
1996	Luxembourg-City	Lux. Urban Area	Inner suburbs	South	Outer suburbs	Total	
Luxembourg-City	0	2062	320	316	74	2772	
Lux. Urban Area	925	0	148	30	35	1138	
Inner suburbs	383	231	0	310	87	1011	
South	102	122	126	0	10	360	
Outer suburbs	92	96	203	15	0	406	
Total	1502	2511	797	671	206	5687	

		1996					
1994	Luxembourg-City	Lux. Urban Area	Inner suburbs	South	Outer suburbs	Total	
Luxembourg-City	0	1261	459	244	37	2001	
Lux. Urban Area	1137	0	139	55	198	1529	
Inner suburbs	56	34	0	61	15	166	
South	32	28	273	0	16	349	
Outer suburbs	44	152	211	33	0	440	
Total	1269	1475	1082	393	266	4485	

Source: IGSS; authors' calculation

A more detailed analysis highlights the existence of specialized movements, notably in the cleaning and road transport sectors. Thus, from the years 1996 to 1999, the number of employments in the cleaning sector of the Urban Area was up by 316.7%, whereas the same sector's employments which were localized in the City were down by 21.2%. In the periurban environment, those companies – which are more sensitive to cost constraints than to customer proximity needs – find the favourable conditions for a development of activities (land availability, lower costs of shop spaces, motorways proximity). Road transport companies went through a similar evolution: the sector's employment growth from 1999 to 2002 (+21.8%) was essentially beneficial for the Urban Area (+48.1%) and the Inner suburbs (+43.4%) whereas Luxembourg-City kept relatively stable (+7.3%). Transport companies' exurbanization is explained by the needs of large handling and storage spaces that are well connected to the motorway network, and it takes advantage of Luxembourg-Findel airport logistic platform's development. Thus, the first periphery becomes the privileged place for space consuming activities such as extended shop spaces and transport companies.

(2). Centripetal relocations from out-of-town territories towards the Urban Area and the City of Luxembourg. The City of Luxembourg benefits from the highly positive relocation of services companies, which are leaving the two peripheries for more central localizations (+1645 jobs). Far from being deprived of employments, the central city and the built-up area are becoming attractive in some very specific areas, which are also highly job creating.

(3). In addition to centrifugal and centripetal relocations, internal movements inside the periphery can be observed in the industrial field, as well as a complex movement from the city-centre and the outer suburbs affecting the sale, wholesale, retail trade, hotels and restaurant activities.

These observations have been illustrating the more and more complex nature of the urban organization outline and the emergence of a metropolitan unity which is more and more integrated.

5. Structural and geographical effects

Thanks to the shift-share analysis, employment growth can be observed from the points of view of structural and geographical effects. The formers are related to the sectoral structure of employment, i.e the weight carried out by each sector making up the geographical territories' economy, whereas the latter are related to local specificities causing growth differentials between geographical units (Buisson and Mignot 2005). Most of the time, in European industry and services, the further we get from urban agglomerations' centres the less sectoral effects are important, whereas geographical effects tend to be more present when one gets closer to the periphery (Gaigné, Pigué and Schmitt 2005). This means that the structure of employment is generally more advantageous to companies that are close to urban centres than to those that are near the periphery, while local specificities in the centre do not tend to attract employments from other industrial sectors as they do in the periphery.

The classic structural-geographical approach suffers from many flaws. First of all, it is a static approach, the last year being compared to the first year, with no consideration of fluctuation in the studied period (Barff and Knight 2001). Secondly, the geographical effect is referring to the residuals and therefore does not allow to directly compare the productive structure influence to other local elements influences. Thirdly, this approach is mainly descriptive and does not leave any room for statistically valid tests. Those flaws taken into account, it was considered preferable to replace the classical approach by the econometric model introduced by Marimon and Zilibotti (1998).

5.1. Employment growth turns out to be associated to economic cycles

The econometric model by Marimon and Zilibotti is defined as follows:

$$e_{i,n,t} = h_i + m_{i,n} + b_t + f_{i,t} + g_{n,t} + \varepsilon_{i,n,t}$$

$$i=1,\dots,I; \quad n=1,\dots,N; \quad t=1,\dots,T,$$

where:

$e_{i,n,t}$ is the growth rate of total employment in industry i in region n at time t

h_i is a time invariant sectoral trend component that is shared by all regions

$m_{i,n}$ is a time invariant effect that is specific to industry i and region n

b_t is a pure time effect

$f_{i,t}$ is the interaction between a fixed industry and a time effect

$g_{n,t}$ is the interaction between a fixed region effect and a time effect

$\varepsilon_{i,n,t}$ is an idiosyncratic disturbance that is orthogonal to all other effects.

An estimation of this model leads to justify 40% of employment growth in the 1994-2005 period. Employment growth factors might then seem more homogeneous in Luxembourg than in Belgium (Toulemonde 2000, $R^2=0.19$). However, such a difference may be due to finer geographical and sectoral division used for Belgium (11 provinces and 25 sectors), which implies that many shocks became specific and were then recorded in $\varepsilon_{i,n,t}$. By analyzing Switzerland's division in five metropolitan centres and seven sectors, Mager (2006) managed to obtain a model of growth observation which had a greater explanatory power than that which is presented here ($R^2=0.89$).

Among the model's different known variables, only those which imply a temporal dimension appear to have a significant influence on employment growth. Therefore employment growth turns out to be associated to economic cycles. In addition to the global temporal effect $b(t)$, variables that have an influence on employment growth are in fact those representing the temporal effects that are specific to each sector of activity $f(i,t)$ and to each geographical unit $g(n,t)$ (Table 12).

Table 12. Estimation based on Marimon-Zilibotti's econometric model (1998)

Variables	Coefficients	Robust Standard Errors
h_i	-0.027	0.026
$m_{i,n}$	0.024	0.027
b_t	1.032***	0.154
$f_{i,t}$	1.084***	0.182
$g_{n,t}$	0.823***	0.312
Number of observations	240	
R^2	0.40	

Source: IGSS ; authors' calculations

Note: *** $p < 0,01$, ** $p < 0,05$, * $p < 0,1$

Such results can be improved by the calculation of average employment growth ($\bar{e}_{i,n}$), then by the division of its variance into strictly sectoral effects (h_i) and regional deviations from this sectoral growth ($m_{i,n}$). The purpose of such a calculation is to estimate which part of contribution was played by sectoral and geographical factors in employment growth during the whole period studied. Results highlight the primacy of geographical effects, on the condition that Luxembourg-City is not included. Indeed, the City's inclusion or non-inclusion leads to divergent results. A first estimation, including all geographical territories, shows that 65% of average employment growth's variance is due to regional deviations from sectoral

growth. A second estimation, excluding Luxembourg-City, lead to results which highlight the small advantage of sectoral factors (55%) over geographical ones (45%) (Table 13).

Table 13. Variance decomposition of mean employment growth, 1994-2005

	Luxembourg-City included	Luxembourg-City excluded
$\bar{e}_{i,n}$	1.00	1.00
h_i	0.35	0.55
$m_{i,n}$	0.65	0.45

Source: IGSS; authors' calculations

Those two different results suggest that a significant part of growth gaps is due to the growth differential between Luxembourg-City and its periphery.

5.2. Breaking down employment growth

On the basis of Marimon and Zilibotti's models' estimators, more breakdown are computed.

A first breakdown emphasizes average sectoral evolution and regional deviations from the sectoral growth (Table 14). It highlights the fast-growing development of high-tech knowledge intensive services, business services and services activities, which growth rates were superior to that of financial knowledge intensive services. As for industrial sectors they went through a stagnation regarding middle-low and low-tech industries. From 1994 to 2005, Luxembourg-City went through the lowest employment growth in every sector. Growth rates were also particularly low in the Luxembourg Urban Area as far as construction activities and medium-low and low-tech industries were concerned.

Table 14. Decomposing employment growth rates into sectoral and regional changes

Economic sectors	Average sectoral growth	Deviations by regional unit				
		Luxembourg- City	Luxembourg Urban Area	Inner suburbs	South	Outer suburbs
High-tech and medium-high-tech industries	0.000	-0.011	0.003	0.001	0.029	-0.002
High-tech knowledge intensive services	0.370	-0.023	0.013	-0.030	0.015	0.655
Market knowledge intensive services	0.187	-0.006	0.008	0.030	0.013	0.021
Financial knowledge intensive services	0.065	-0.001	0.010	0.020	0.040	0.013
Higher education, human health, cultural and sporting activities	0.069	-0.005	0.003	0.018	0.028	0.013
Medium-low and low-tech industries	-0.004	-0.002	-0.002	0.010	0.005	-0.003
Construction	0.043	-0.004	-0.003	0.002	0.000	0.005
Sale, wholesale, retail trade	0.027	-0.002	0.002	0.002	-0.003	0.003
Land transport, post	0.047	-0.007	0.012	0.027	0.002	0.008
Other business services	0.074	-0.005	0.161	0.004	0.032	0.001
Hotels and restaurants	0.037	-0.002	0.003	0.014	-0.002	-0.003
Other service activities	0.104	-0.009	0.014	0.018	-0.006	0.006

Source: IGSS; authors' calculations

A second breakdown emphasizes the global economic cycle and sectoral and regional deviations from this cycle. Once again the cyclic nature of employment growth is highlighted, with the most dynamic periods going from 1996 to 1999 and from 1999 to 2002 (Table 15).

Table 15. Decomposing employment growth rates into economic cycles and sectoral and regional changes

	1994-1996	1996-1999	1999-2002	2002-2005
Economic cycles	0.041	0.136	0.166	0.066
Deviations by economic sectors				
High-tech and medium-high-tech industries	-0.027	-0.093	-0.242	-0.047
High-tech knowledge intensive services	0.424	0.401	0.735	-0.004
Market knowledge intensive services	0.106	0.310	0.206	0.161
Financial knowledge intensive services	0.045	0.022	0.104	-0.052
Higher education, human health, cultural and sporting activities	-0.003	0.099	-0.108	0.158
Medium-low and low-tech industries	-0.046	-0.131	-0.203	-0.072
Construction	0.005	-0.075	-0.018	0.036
Sale, wholesale, retail trade	-0.017	-0.030	-0.093	-0.038
Land transport, post	-0.028	0.007	0.050	-0.037
Other business services	0.015	-0.257	0.446	0.072
Hotels and restaurants	0.055	-0.100	-0.066	0.016
Other service activities	-0.393	1.304	-0.036	0.045
Deviations by geographical units				
Luxembourg-City	-0.008	-0.029	-0.006	-0.043
Luxembourg Urban Area	0.025	0.052	0.012	0.075
Inner suburbs	0.067	0.040	0.050	0.057
South	-0.061	0.032	0.017	0.034
Outer suburbs	0.000	-0.016	-0.040	0.017

Source: IGSS; authors' calculations

Besides, it shows that industrial sectors, all technologies included, and the commerce industry went through a minor growth during each observation period. The sectors that were subject to the most significant cyclic evolutions were technology and business services.

Finally, observations of geographical territories show that employment went through a minor growth during each observation period, in the South from 1994 to 1996 and in the Outer suburbs from 1996 to 2002. Those results also reveal that employment growth was relatively stable in the Inner suburbs.

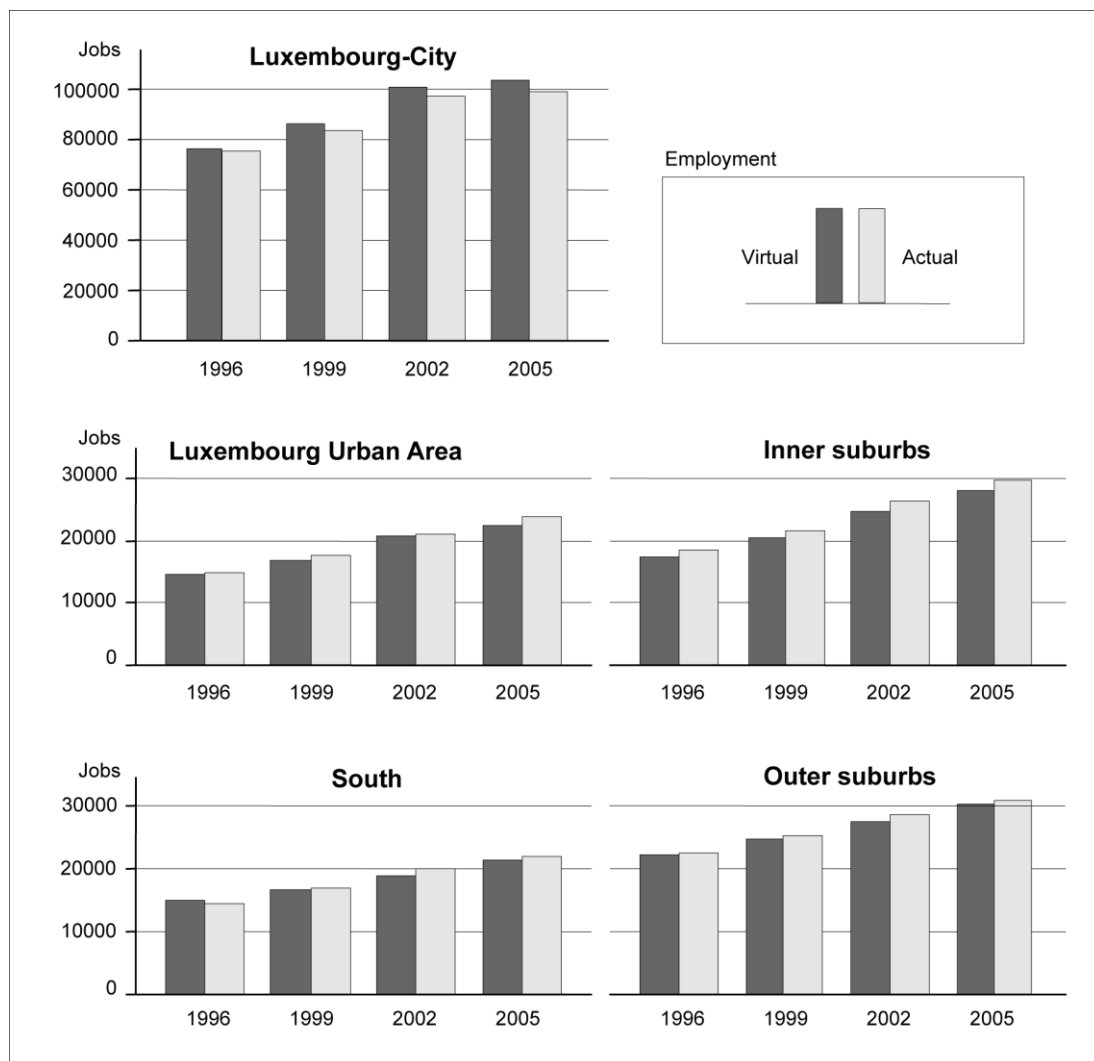
5.3. Building virtual economies

In order to obtain a more direct representation of regional effects on employment growth, five virtual economies have been estimated. The purpose of each one of them is to estimate the rate of employment which each geographical unit would have reached if there had not been any regional effect [$m_{i,n} = g_{n,t} = 0$]. Thus, the estimation is calculated on the basis of the three following components of employment growth: sectoral growth (h_i), global growth (b_t), and sectoral growth in t ($f_{i,t}$):

$$E_{virt_{i,t}} = h_i + b_t + f_{i,t}$$

The virtual employment level is obtained by choosing the employment rates of one sector and one geographical territory and by applying on them the following sequence which indicates employment growth without any regional effect (Figure 1).

Figure 1. Actual and virtual employment by geographical units, 1994-2005

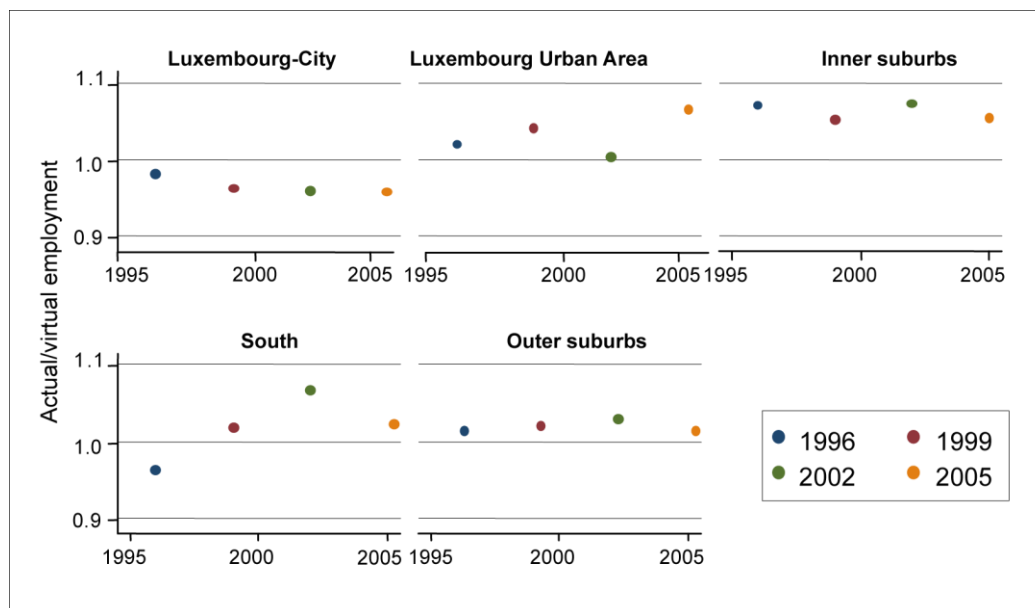


Source: IGSS; authors' calculations

Results are then grouped together in geographical units. Thus, on the basis of those geographical units, it is made possible to compare actual employment levels with virtual ones. An indicator is built up by relating real employment to virtual employment. The purpose of this indicator is to comprehend each geographical unit's economic performance in terms of employment. Such a construction has the advantage of measuring the effects of local elements on employment evolution. In practice, an index which is superior to 1 will indicate that employment growth was superior to what might have been expected in relation to structural, regional and national factors (Figure 2).

On this basis, the particularities of the Urban Area and the Inner suburbs lie in the fact that real employment was significantly superior to virtual employment. As for the South, it went through a negative process from 1994 to 1996, then through a positive one with a climax that lasted from 1999 to 2002. The second periphery's evolution, which was always positive, was more continuous. As a matter of fact, Luxembourg-City was the only place where actual employment growth was inferior to virtual growth, which makes one think that local factors globally work against employment growth in the inner city and therefore that the central position seems to offer less advantages than drawbacks.

Figure 2. Actual/Virtual employment by geographical units



Source: IGSS; authors' calculations

Notably, such a result should not be only interpreted as a shortage of availability in spaces reserved to economic activities. It is true that availabilities in land and business premises in the municipalities of Strassen, Howald and Sandweiler offer companies the opportunity to establish themselves, and therefore participate in employment growth in the periphery. However it is important to emphasize the fact that Luxembourg-City has still the best potential of the country for building land availabilities (Observatoire de l'Habitat 2006), which shows by a spectacular development of office spaces, not only in pericentral areas, but also closely around the Central Business District (Clausen, Gare-Nord, Boulevard Royal). In the light of this last remark, Luxembourg City's low employment growth seems to be due to local factors that are not necessarily linked to land availability.

5.3.2. Decomposing employment performance within each geographical unit

In order to pursue this analysis, the indicator has been recalculated for each sector in a given geographical unit from 1994 to 2005. Results have highlighted spaces which would be more favourable (respectively less favourable) than others for sectoral employment growth. A global index, including all sectors of a given geographical unit, has also been established. The latter's purpose is to represent the global regional effect throughout the whole observation period. On the basis of such measurements, it has become possible to estimate a particular sector's contribution (positive or negative) in each regional effect (the global regional effect in this case) (Table 16).

It is useful to add that the importance of a given sector's contributions to the global regional effect is subject to two parameters: the value of the sector's performance indicator and the proportion of employment occupied by the sector in the geographical unit. With regard to the second parameter, the country's main economic sectors, or those containing at least one specialized spatial unit, are those that are likely to be distinguished.

Results do not contradict this assumption. Indeed, activities dealing with business services, trade, land transports and postal services are those that play the greatest part in regional effects. Business services contribute to them in a negative way in Luxembourg-City and in a positive way in each of the other spatial units.

Table 16. Decomposing employment growth within each geographical unit

Economic sectors	Luxembourg-City		Luxembourg Urban Area		Inner suburbs		South		Outer suburbs	
	I_perf	% Div	I_perf	% Div	I_perf	% Div	I_perf	% Div	I_perf	% Div
High-tech and medium-high-tech industries	0.79	-0.06	1.04	0.05	1.01	0.01	1.27	0.47	0.96	-0.03
High-tech knowledge intensive services	0.90	-0.08	1.01	0.02	0.85	-0.10	1.01	0.01	1.62	0.68
Market knowledge intensive services	0.96	-0.18	1.05	0.15	1.14	0.13	1.07	0.26	1.12	0.17
Financial knowledge intensive services	0.99	-0.06	1.08	0.16	1.12	0.02	1.30	0.04	1.13	0.02
Higher education, human health, cultural and sporting activities	0.95	-0.02	1.06	0.01	1.08	0.01	1.07	0.01	1.17	0.02
Medium-low and low-tech industries	0.96	-0.14	0.98	-0.02	1.12	0.28	1.08	0.56	0.95	-0.34
Construction	0.95	-0.10	0.97	-0.12	1.02	0.09	1.00	0.01	1.05	0.26
Sale, wholesale, retail trade	0.98	-0.08	1.02	0.17	1.03	0.08	0.96	-0.31	1.03	0.17
Land transport, post	0.92	-0.19	1.09	0.12	1.21	0.30	1.03	0.09	1.06	0.09
Other business services	0.95	-0.05	1.69	0.32	1.03	0.00	1.12	0.03	0.95	-0.01
Hotels and restaurants	0.98	-0.03	1.04	0.05	1.14	0.12	0.98	-0.04	0.96	-0.07
Other service activities	0.93	-0.04	1.14	0.10	1.11	0.07	0.92	-0.13	1.04	0.03
All sectors	0.97		1.04		1.07		1.03		1.04	

Source : IGSS ; authors' calculations

Notes : I_perf is the performance index ; % Div the contribution to the global regional effect.

An examination of each spatial unit allows one to obtain more accurate results. Thus, one observes that all sectors contribute to the negative effect of Luxembourg-City, each one of them developing slower than it would in other territories. However, the fact remains that the negative effect coming from the financial knowledge intensive services sector is still very limited (I_perf=0,99). In the Luxembourg Urban Area, financial and business services contribute more positively to the regional positive effect, which can be regarded as a gain related to the exurbanisation, while construction contributes negatively. In the inner suburbs, middle and low-tech industries as well as hotels and restaurants contribute the most to the regional effect, contrary to the high-tech services. In the South, the industrial sectors contribute positively to the regional effect, while other personal services and activities oppose the most. Finally, in the outer suburbs, high-tech services and construction contribute positively and low or medium-tech industries contribute negatively.

Those results support what was observed before, concerning employment relocations, notably as far as the inner city and its periphery are concerned. Indeed while Luxembourg-City's employment growth is slower than that of other geographical units, current jobs are relocated in the latter. This exurbanization phenomenon is all the more significant as there is only one exception to it: business services. In the Urban Area, the sectors that are highly contributing to geographical effects are also those in which the number of entries is superior to the number of departures, such as in the financial services, sale and hotels-restaurants activities. Results are more contrasted in other geographical units, in particular in the business services (Inner suburbs) or in the trade and sale sector (South). Such differences can be explained by the unexpected movements of a few big companies whose employment relocations are due to particular circumstances. Such differences confirm the coherence in the choice of analyzing employment growth and employment relocations in a separate way. Indeed, the importance and significance of relocations have a tendency to confuse estimations on employment growth.

Conclusion

From 1994 to 2005, employment growth turned out to be very heterogeneous according to the different economic sectors, periods and geographical territories considered. That growth was particularly beneficial to the Luxembourg Urban Area and to its Inner suburbs. Even though Luxembourg-City was specialized in more or less job creating sectors, this geographical unit went through the lowest employment growth. Such an evolution seems to be the result of the metropolitan nature of many jobs in the City. Indeed, while metropolitan employments are founded on non-codifiable knowledge and skills, they are also highly sensitive to transaction costs. However, not all sectors shared the same evolution. As a matter of fact, financial knowledge intensive services and business services managed to get out while the going was good.

Luxembourg-City still represents the centre of metropolitan employment, even if one can observe a balance restoration process between the inner city and the urban area. In such a context, employment relocations ought to be considered, for they play an important part in regional growth. The direction of employment movements varies considerably from the different sectors considered: while construction, transports and industry have been going through decentralization towards the first and the second periphery, business and financial services have rather had a tendency to concentrate around the Luxembourg Urban Area.

Results found on employment growth differentials allow to draw the conclusion that economic activity is being (relatively) redistributed between Luxembourg-City and its urban area. The two central territories' interdependence and complementarities are reinforced through many significant employment exchanges, in favour of advanced producer service activities. As a matter of fact, the whole geographical unit is drawing the outlines of a metropolitan area which is in the process of being functionally integrated: a core which is going through a specialization process, a urban area which benefits from a relocation of activities that are less sensitive to distance and transaction pressures and a periphery which is getting diversified, notably in the South where traditional industrial activities are being replaced by low-skilled or back-office service activities.

By subtracting employment movements, an estimation of the econometric model allows one to explain 40% of employment growth. The significant character of the model's parameters indicates that employment growth is mainly associated to economic cycles. Besides, an estimation of sectoral and geographical factors' contributions highlights the primacy of geographical effects over sectoral effects on the condition that Luxembourg-City is included in the analysis. Finally, the construction of virtual economies confirms the inner city's global inferiority in performance compared to its urban area and close periphery.

Those elements allow us to compare the Luxembourg's evolution with that which characterizes other European metropolitan centres, in which one can observe a decentralization of activities inside the urban area (Gaschet and Lacour 2002). Such an evolution suggests several prospects for the study of economic geography. The first one would consist in identifying the origin and nature of one given sector's residual effects in each geographical unit of the Luxembourg metropolitan area. A second prospect would be to pursue the analysis on the scale of neighbouring French, Belgian and German municipalities, so as to include the whole employment growth and mobility process operating in the Luxembourg cross-border metropolitan area.

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Annex 1. Economic sectors and NACE codes

N° Economic activities	NACE
1 High-tech and middle-high-tech industries	
Manufacture of aircraft and spacecraft*	35.3
Manufacture of office machinery and computers*	30
Manufacture of radio, television and communication equipment and apparatus*	32
Manufacture of pharmaceuticals, medicinal chemicals and botanical products*	24.4
Manufacture of medical, precision and optical instruments*	33
Manufacture of motor vehicles, trailers and semi-trailers*	34
Manufacture of electrical machinery and apparatus n.e.c.*	31
Manufacture of chemicals and chemical products excluding 24.4-24.7*	24.1-3
Manufacture of other transport equipment excluding 35.1 and 35.3*	35.2, 35.4, 35.5
Manufacture of machinery and equipment n.e.c.*	29
2 High-tech knowledge intensive services	
Telecommunications*	64.2
Computer and related activities*	72
Research and development*	73
3 Market knowledge intensive services	
Water transport*	61
Air transport*	62
Other supporting transport activities*	63.2
Activities of other transport agencies*	63.4
Real estate activities*	70
Renting of machinery and equipment without operator and of personal and household goods*	71
Other business activities excluding 74.2, 74.6-74.8*	74.1-74.5
4 Financial knowledge intensive services	
Financial intermediation, except insurance and pension funding*	65
Insurance and pension funding, except compulsory social security*	66
Activities auxiliary to financial intermediation*	67
5 Higher education, human health, cultural and sporting activities	
Higher education*	80.3
Human health activities*	85.1
Recreational, cultural and sporting activities*	92
6 Medium-low and low-tech industries	15-23, 25-28, 35.1, 36-37
7 Construction	45
8 Sale, wholesale, retail trade	50-52
9 Land transport and post	60, 63.1, 63.3, 64.1
10 Other business services	74.6-74.8
11 Hotels and restaurants	55
12 Other service activities	93, 95, 96, 97

Source: OECD.

Note: Metropolitan activities are asterisked (*) according to Sohn and Walther 2008b.