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Thesis:

The teleworkability of the Brussels Capital Region's economy and its potential impact on urban dynamics: the case of the food and beverage service sector

Author:
Massimo Privitera

Supervisor:
Prof. Alfredo Saad-Filho

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Introduction

For decades experts have predicted that the ability to connect electronically would make face-to face interactions and the cities obsolete. The basic idea, which appeared in various forms, was that the improvements in telecommunications would entail profound societal transformations, enabling the emergence of 'telecottages' (Toffler, 1980), the rising of a 'borderless world' (Ohmae, 1995), the 'end of geography' (O'Brien, 1992) the 'death of distance' (Cairncross, 2001), and the 'death of cities' (Drucker, 1998).

The ensuing debate on the topic highlighted that the above narratives overstated the potential of the internet and other digital communication technologies to substitute for face-to-face interactions and weaken agglomeration economies to such an extent as there would be no benefit for people and businesses to agglomerate in cities (Malecki, 2002). Some have reasoned that this is due to the complementary nature of electronic and face-to-face interactions, with the former facilitating the latter, which would still take place in an urban setting (Gaspar and Glaeser, 1998). According to their model, technological improvements in telecommunications may lead to increased demand for face-to-face interactions, which will in turn increase the importance of larger cities as centres of interaction. However, a fundamental assumption of their model is that face-to-face interactions are superior to any technology-mediated interactions. Later studies have shown that certain elements of knowledge sharing can also be achieved via online interactions (Hildrum, 2009; Panahi et al., 2013). Furthermore, social media increasingly perform an infrastructural role because of their capacity to connect people and support socialization (Ananny and Gillespie, 2016; Barns, 2019).

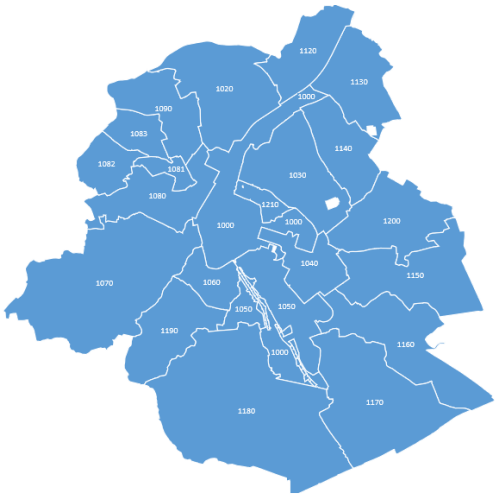
Information and communication technologies (ICT) have had a profound impact on the way work is organised, undertaken and managed by organizations and their employees, and such an impact has undoubtedly been increased during the COVID-19 pandemic. Telework, in particular, allows employees to work anywhere and anytime, and it has a potential impact on several aspects of society, such as climate and energy (Hook et al., 2020), local income (Gallardo and Whitacre, 2018), residential mobility (Qin et al., 2016) and commuting behaviours (de Vos et al., 2020). The present thesis first explores the level of teleworkability of the Brussels Capital Region (BCR)'s economy, and then assesses what is the potential impact on the food and beverage service sector of a widespread uptake of teleworking in the region.

The thesis is structured as follows. The first chapter provides an introduction to the BCR's economic geography, providing an overview of the features of the different municipalities in the region and covering the relevant literature on location choices of households within an urban setting. The second chapter approaches the topic of teleworking, exploring the factors that favour or impede the spreading of the habit of teleworking, both at company and societal level. The third chapter assesses what is the teleworkability of the BCR's economy, examining which jobs are more suitable for teleworking and how this could potentially impact the future commuting flows for the different municipalities within the region, thus returning a specific risk profile for each municipality. The fourth chapter maps the location of the food and beverage service activities within the region and introduces the theory on retail location, which is used as a basis to understand why these activities locate as they do within the region. The fifth chapter combines the insights from the previous chapters to speculate on whether an uptake of teleworking in the region could impact the food and beverage service activities and its employees, and in what form could this impact materialise. The thesis ends with a concluding section wrapping up its findings and a methodological note that explains more in details how the analysis was performed and how certain metrics were estimated.

Chapter 1: An introduction to the BCR's economic geography

Brussels-Capital Region, also simply called Brussels (henceforth BCR) is a region of Belgium comprising nineteen municipalities, including the City of Brussels (henceforth called by its French name, Bruxelles), which is the capital of Belgium. The nineteen municipalities, which constitute the geographical focus of the current research are: Anderlecht, Auderghem, Berchem-Sainte-Agathe, Bruxelles, Etterbeek, Evere, Forest, Ganshoren, Ixelles, Jette, Koekelberg, Molenbeek-Saint-Jean, Saint-Gilles, Saint-Josse-ten-Noode, Schaerbeek, Uccle, Watermael-Boitsfort, Woluwe-Saint-Lambert, Woluwe-Saint-Pierre. However, for analytical purposes, the municipality of Bruxelles will be divided into four different areas, namely the three areas in the north (Laeken, Neder-over-Heembeek and Haren) that historically constituted three different municipalities later annexed to Bruxelles, and the rest of Bruxelles, which is mainly located in the core of Brussels, with two protuberances heading south and east. This division elevates the number of geographical units of analysis to twenty-two, whose exact location within Brussels-Capital Region is shown in figure 1. Most of the data sources used for the present research treat Bruxelles as one single entity, and figures for the four different areas are, whenever possible, derived following procedures detailed in the methodological note. This entails that some of the findings that concern these four areas treated separately, although based on reasonable assumptions, must be approached with caution. Furthermore, when more granularity is needed and data is available, figures are reported by neighbourhood (a smaller unit than a municipality), but effort is made to show where these units locate within and across municipalities.

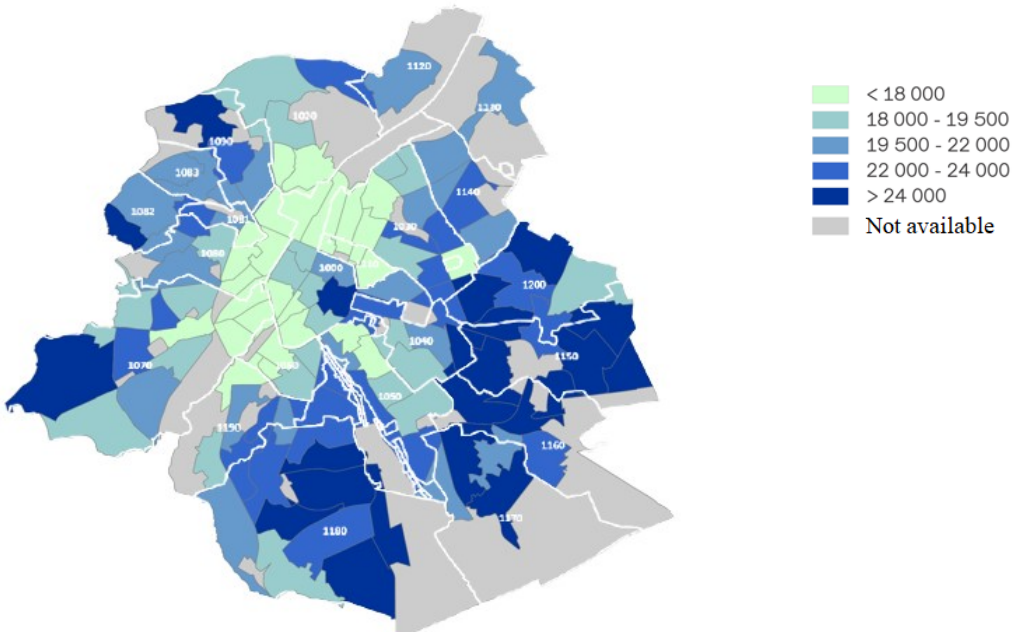
Figure 1: Location of the municipalities within Brussels-Capital Region



	Postal code
Bruxelles	1000
Laeken	1020
Schaerbeek	1030
Etterbeek	1040
Ixelles	1050
Saint-Gilles	1060
Anderlecht	1070
Molenbeek-S.-Jean	1080
Koekelberg	1081
Berchem-S.-Agathe	1082
Ganshoren	1083
Jette	1090
Haren	1120
Neder-over-Hembeek	1130
Evere	1140
Woluwe-S.-Pierre	1150
Auderghem	1160
Watermael-Boitsfort	1170
Uccle	1180
Forest	1190
Woluwe-S.-Lambert	1200
S.-Josse-ten-Noode	1210

Figure 2 shows that there is an income divide within the city, with most of the richest neighbourhoods generally concentrating in the south. However, within this divide, there also is a clear spatial sorting by income along the urban-suburban continuum, with income generally tending to increase the further a location is from the city centre. This distribution can be explained in light of the spatial sorting theories in urban economics that are going to be briefly presented in later paragraphs and, whenever possible, checked against the available data.

Figure 2: Median yearly taxable income in euros per household in each neighbourhood

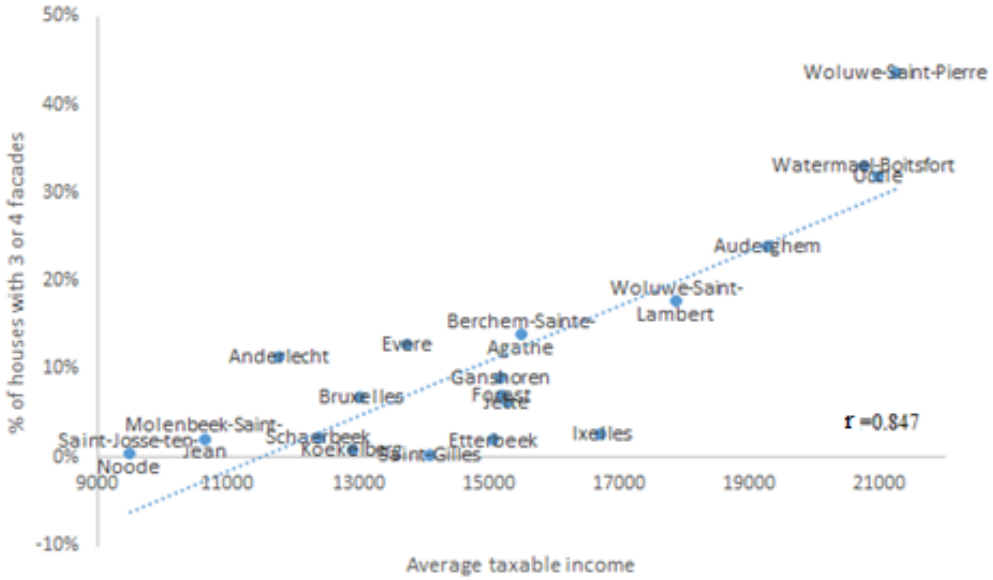


Source of the map: Monitoring des Quartiers

Several theories have been advanced in urban economics to try to explain what drives spatial sorting of households within a city. One of the earliest seminal contributions is the monocentric-city model developed by Alonso (1964), Mills (1967) and Muth (1969) (also called AMM model), which identifies two opposing forces determining location choices of households. On one hand, the high housing consumption of the rich means that they are more strongly attracted than the poor by low land prices in the suburbs, which allow for bigger houses at a lower price per square metre. On the other hand, richer households are assumed to have a higher opportunity cost of time, and thus a higher commuting cost per kilometre, and therefore they outbid poorer households for accessibility to the Central Business District (CBD). According to the AMM model, the exact location that is chosen is the resultant of these two opposing forces, with one prevailing over the other according to the specific circumstances. Figure 3 shows that the higher the average taxable income of a municipality, the higher the share of houses with three or four facades in the housing stock in that municipality. Given that,

as already shown, richer households usually reside in peripheral municipalities of the BCR (see Figure 1), this means their preference for greater housing consumption prevails on their preference for proximity to the CBD. Furthermore, as it will be explored later, access to the CBD also depends on the specific means of transport used to commute, and this can influence the maximum distance a worker is willing to commute from.

Figure 3: Correlation between percentage of detached and semi-detached houses (over the total of residential buildings) and average taxable income

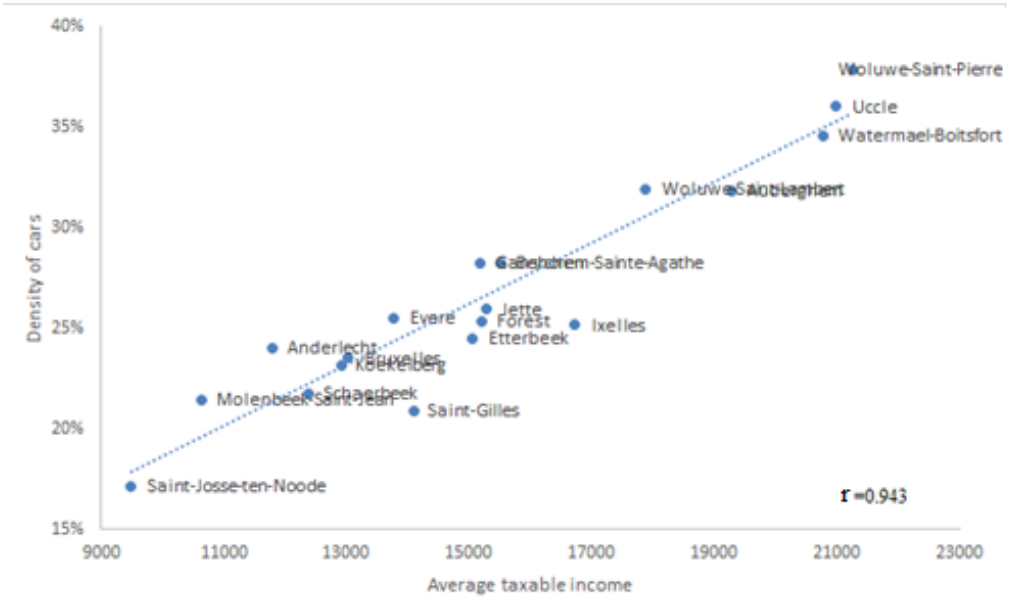


Data source: Institut Bruxellois de Statistique et d'Analyse

As it will be highlighted later, although with the nuances typical of any real-world situation, Brussels-Capital Region can generally be considered monocentric, and thus the AMM model would in theory be applicable. However, this model remains too simple to accurately describe the complex reality of cities, and more complex theories have been developed over time.

An important modification of the standard model is introduced by LeRoy and Sonstelie, (1983), who add transportation mode choice to the analysis, and assume that when rich and poor use the same transportation mode, the rich live in the centre, outbidding the poor for better accessibility to the CBD. However, if the rich switch to a faster commuting mode (i.e., auto) while the poor continue to use the slow mode (i.e., public transit), there is a location reversal, with the poor living near the CBD and the rich living in the suburbs. Figure 4 shows that car ownership is highly correlated with income in the BCR. Even though this does not show per se that car is used to access the CBD, it still highlights that richer households tend to own cars and, supposedly, to use them to move around the CBR.

Figure 4: Correlation between average taxable income and car density (n. of cars/residents)



Data source: Institut Bruxellois de Statistique et d'Analyse

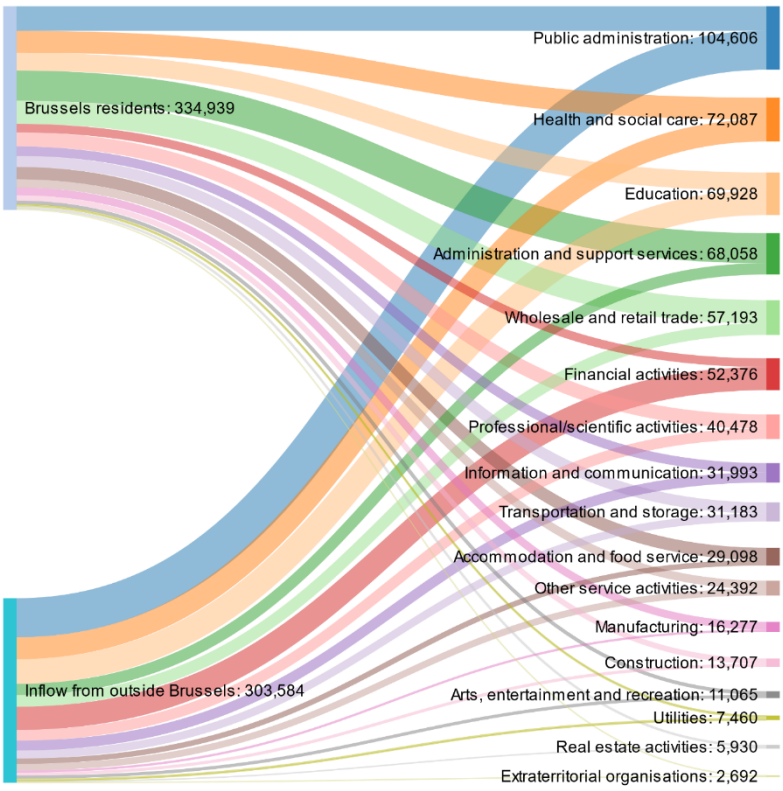
Another important development is the addition of amenities to the standard model, which is usually credited to Brueckner et al. (1999). In urban economic theory, amenities are all those factors that influence location of a household and are not captured by income or housing prices. Clearly, such factors span across a wide array of features of a city, both positive (e.g., parks) and negative (e.g., congestion), and several strands of research have devoted their attention to disentangle the contribution of each single factor to the attractiveness of specific locations. In Brueckner et al. (1999), the urban amenities under consideration can be classified into three categories: natural amenities, generated by an area's topographical features, including rivers, hills, coastline, etc; historical amenities, generated by monuments, buildings, parks, and other urban infrastructure from past eras that are aesthetically pleasing to current residents of the city; and modern amenities, which include restaurants, theatres, and modern public facilities such as swimming pools and tennis courts. Historical and natural amenities are generally considered exogenous, while modern amenities are endogenous, with their levels depending on the current economic conditions in a neighbourhood, especially the local income level.

The theory developed by Brueckner et al. (1999) posits that the relative location of different income groups depends on the spatial pattern of amenities in a city. Specifically, when the centre has a strong amenity advantage over the suburbs, the rich are likely to live at central locations. When the centre's amenity advantage is weak or negative, the rich are likely to live in the suburbs. In their opinion, this theory explains why cities in the US (epitomised by

Detroit) usually see a concentration of the rich in the suburbs and of the poor downtown, supposedly due to a lack of historical amenities, while cities in Europe (epitomised by Paris) see the opposite dynamic, supposedly due to their rich history embedded in their city centres. Thomas and Thomas and Zenou, (1997) apply this theory to Brussels, showing that location by income follows the U.S. pattern (which, as shown, still seems broadly to be the case today), and ascribe this to the fact that a substantial part of the historical centre has been demolished and replaced by office buildings. However, a more recent literature (see Couture and Handbury, 2020) seems to suggest an ongoing urban revival in larger cities that have historically followed the US pattern, driven by younger college graduates willing to reside near non-tradable services (e.g., bars, restaurants, theatres, etc.), and this could possibly also be happening in Brussels

As concerns the BCR's economy, this is largely constituted by third sector activities. Furthermore, as shown in Figure x, almost half of the workers working in Brussels-Capital Region commute from outside the BCR. This is of huge importance, as it will be discussed in later sections, when considering what is the customer base of the food and beverage service activities present on the territory.

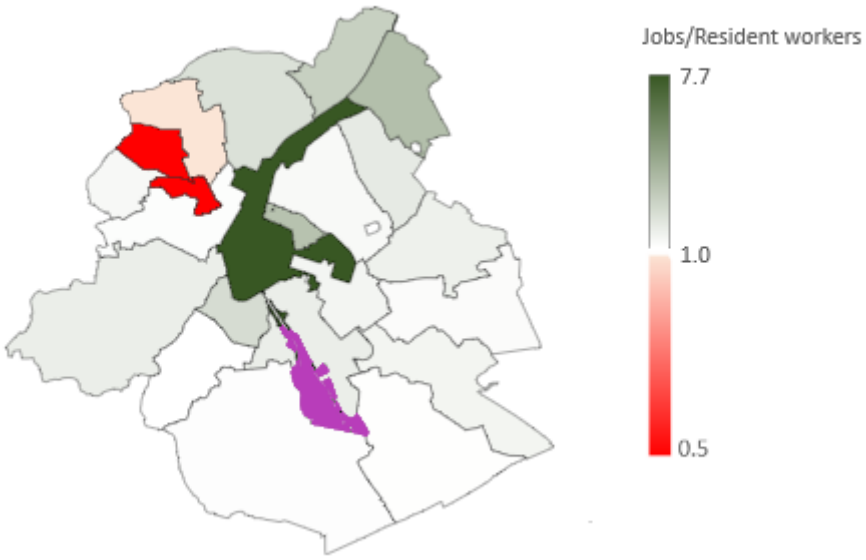
Figure 5: Place of residence of workers working in the BCR (left) and their sector of employment in Brussels (right)



Data source: Institut Bruxellois de Statistique et d'Analyse

However, even though the BCR sees overall an inflow of workers, this inflow is not equally divided among the different municipalities. Figure 6, by reporting the ratio of jobs to resident workers, broadly shows the extent of inflow (green) or outflow (red) of workers in each municipality. This metric does not actually tell us exactly what the actual extent of the inflow or the outflow is, but it tells us what its lowest limit is[1]. The ratio is much higher in the core of the BCR.

Figure 6: Ratio of jobs to resident workers in each municipality[2]



Data source: Data source: Institut Bruxellois de Statistique et d'Analyse and Monitoring des Quartiers

Note: the area in purple is part of Bruxelles (1000), but it is mainly constituted of forest (the Sonian Forest). Therefore, it has been excluded from the analysis not to give the false impression of the existence of a "high-inflow" enclave in the south.

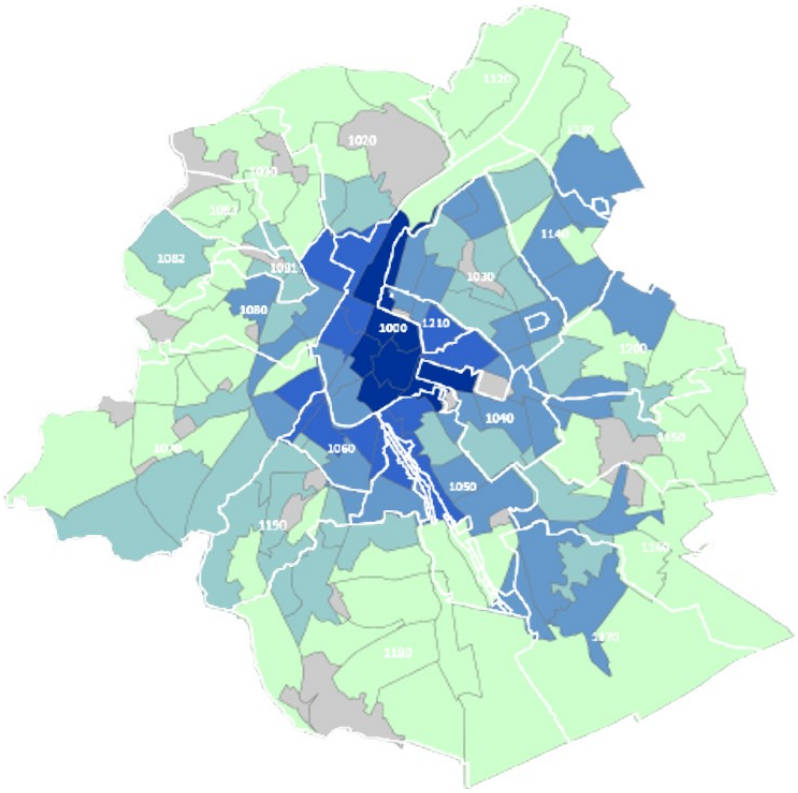
The centre of the region can indeed be considered its Central Business District (CBD). The CBD, described as the 'heart of the city' by Murphy and Vance (1954), is located in the central

[1] The following explanation will clarify the concept. There can be one extreme situation characterised by the following features: 1) all resident workers work in the municipality in which they reside (when the municipality is an "inflow" one, namely the number of jobs is higher than the number of resident workers); 2) all the jobs are held by resident workers (when the municipality is an "outflow" one, namely the number of resident workers is higher than the number of jobs). Given these two extreme cases, an "inflow" municipality will see an inflow of workers at least equal (but not lower) to the difference between the number of jobs and the number of resident workers, while an "outflow" municipality will see an outflow of workers at least equal (but not lower) to the difference between the number of resident workers and the number of jobs.

[2] Values for Bruxelles (1000), Laeken (1020), Neder-over-Heembeek (1120) and Haren (1130) are derived using a procedure highlighted in the methodological note.

part of a city, together with particular central activities, such as banks, offices, hotels, cinemas and theatres. In general, classical study in urban geography defines the CBD by mapping land zones that contained the highest concentration of central activities. Figure 7 shows that, even though there are some nuances, the neighbourhoods with the highest density of offices are in central municipalities, and this is an indication that we can assume this to be the Brussels-Capital Region's CBD.

Figure 7: density of offices in each neighbourhood[3]



Source of the map: Monitoring des Quartiers

[3] The zones in grey are either parks or industrial zones

Chapter 2: Teleworking in the BCR

Already in the 1950s, researchers on the development of information and communication technologies (ICTs) concluded that "telecommunications combined with computing technology could enable work to be relocated away from the traditional office" (Baruch, 2001). The term "teleworking" originated in the 1970s to denote remote working away from the office headquarter location (HQ), and interest both in academic and in companies rose steadily in the following decades. The different potential arrangements for teleworkers in terms of contractual arrangements, employment status, type of work and work location has impeded a universally accepted definition of telework suitable for academic research (Baruch and Smith, 2002; Sullivan, 2003; Wilks and Billsberry, 2007; Taskin and Walrave, 2010). The term "telecommuting" is widely used in the US, but according to Sullivan (2003), this terminology focusses solely on the savings in transportation costs enabled by teleworking, while neglecting the wide array of arrangements that are subsumed under the umbrella of "teleworking". For this reason, there has been in the scientific literature a mushrooming of alternative terms, such 'home working', 'working-at-a-distance', 'off-site working' or 'remote working', which all have similar meanings and are used interchangeably, but that are denoted by slightly different nuances (Baruch, 2001). Wilks and Billsberry (2007) suggested to use the term 'home anchored working' as opposed to 'office-anchored working'.

However, regardless of the different nuances, all the terms refer to some essential features: the location dimension (with emphasis on the remoteness), the time dimension and the use of ICT (Denolf et al., 2006). Various sub-types of telework can be distinguished based on the location of telework (Baruch, 2001, Walrave and De Bie, 2005; Illegems and Verbeke, 2003). Telework can be performed on company premises, called "satellite" offices, which are usually in a more convenient position for the workers than the headquarter (Helling and Mokhtarian, 2001; Walrave and De Bie, 2005). Telework can also be performed at home and this is the most common form of telework. Finally, there is the category of nomadic teleworkers, who do not have a stable workplace, and usually spend a sizable amount of their time travelling (Walrave and De Bie, 2005). For the purpose of the present research, the more general term "teleworking" will be used, and emphasis will be given to teleworking allowing workers not to commute to the headquarters of their companies/organisations, which are usually located in the CBD.

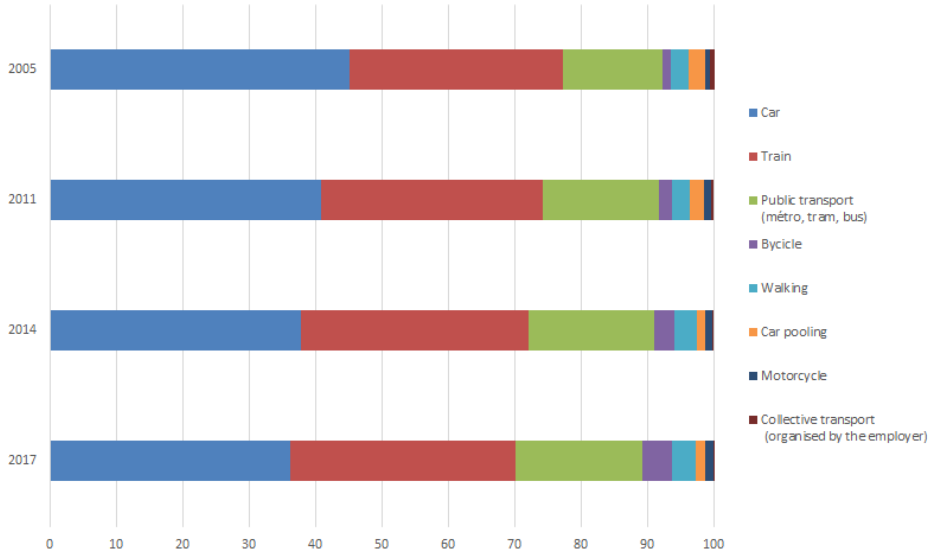
Teleworking in the BCR has been subject of research, even though the related literature is not vast and has not been updated in recent years. Below I will present the most important findings on the topic and, whenever possible, I will check them against more updated data.

Lllegems et al. (2001), starting from the observation that the large-scale implementation of teleworking had not yet occurred in the industrialised world at that time (contrary to earlier predictions), analysed the elements that influenced the implementation of teleworking through a survey conducted among firms in the BCR. They concluded that individual's decision on whether to telework was influenced by a variety of technological, institutional, and organisational elements, and they highlighted several organisational drivers of — and barriers to — the implementation of teleworking. Specifically, among the barriers that prevented the implementation of teleworking, they identified as determinant the lack of awareness of the concept of teleworking, direct supervision as the main coordination and control mechanism, the mostly sequential style of information flows, the mainly intraregional (local) character of commuting, and the preponderantly temporary nature of employment contracts. In contrast, they noted that a firm declared to be motivated to implement teleworking when (1) active in a knowledge-based sector, (2) located in a congested area, (3) characterised by a high level of electronic communication, (4) driven mainly by output-oriented coordination and control systems, (5) focused on nonroutine decision making, (6) building upon team organisation, (7) experienced in the use of flexible working hours, (8) experienced in outsourcing, (9) characterised by a high number of employees, (10) characterised by a high proportion of white collar workers and a high proportion of employees with a high education level.

Illegems et al. (2002) explored the potential of telecommuting/teleworking as an anti-congestion policy, starting from the observation that the problem of traffic congestion in Belgium and the BCR had increased substantially in the previous years. They reported that in the BCR, while in 1981 60.4 percent of travels by motorised vehicle were undertaken with a private vehicle, by 1991 this had increased to 72.9 percent, and that the increase of road congestion in urban areas had been amplified by the spatial reorganisation that took place in many Western European cities after World War II, based on the assumption that car use would increase. Furthermore, they argued that the migration from the city centres towards peripheral areas had also stimulated the use of private transport, because in these peripheral areas the public transport network had a lower density. Specifically, they reported that, between 1981 and 1991, the number of jobs had increased by 2.2 percent in the Brussels Capital Region and by 25.8 percent in the periphery, while the number of inhabitants had declined by 4.3 percent

in Brussels and had increased by 5.1 percent in the periphery. This tendency to use of cars seems to have been reversing in recent years, at least for commuting to work and from 2005 to 2017, as shown in figure 8, with public transport (metro, tram and bus) and bicycles compensating for the share lost by cars.

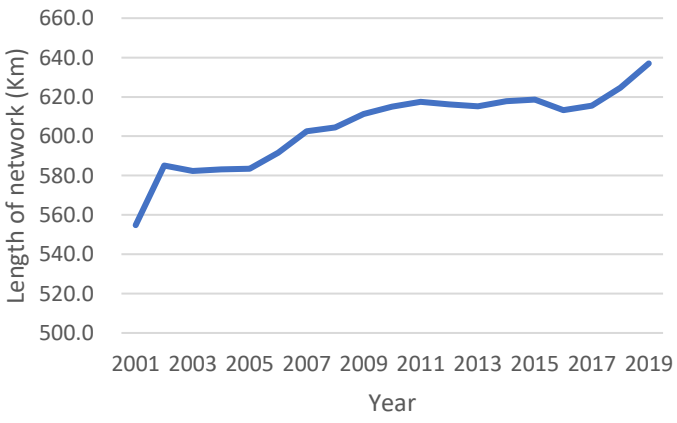
Figure 8: share of transport modes used for commuting between 2005 and 2017



Data source: Institut Bruxellois de Statistique et d'Analyse

While these last figures do not provide us with any insight about travels for leisure or other reasons, they seem to point out that a certain transition from cars to other means of transport has occurred, maybe favoured by a strengthened public transport infrastructure. On this note, it is worth noting that the length of the public transport network in the BCR increased by 14.8% between 2001 and 2019, as shown in figure 9.

Figure 9: length of the public transport network in BCR between 2001 and 2019



Data source: Institut Bruxellois de Statistique et d'Analyse

Illegems et al., (2002) claimed that the implementation of telecommuting/teleworking on a large scale could have a significant effect on road congestion, road accidents, environmental planning, and the emission of pollutants. They also claimed telecommuting/teleworking to be especially interesting for urban areas like the BCR, given its high proportion of jobs in the service sector (a feature that persists to this day, as shown in chapter one). They also classified telecommuting/teleworking according to two measures: penetration, namely the percentage of workers who telecommute/telework in the active workforce regardless of frequency; and levels of telecommuting/teleworking, namely the percentage of workers who telecommute/telework on a particular day during the workweek (Handy and Mokhtarian, 1996). They estimated a penetration level of 3.97% for Belgium and the BCR, but they lamented a lack of accurate data on the number of telecommuting/teleworking individuals. This kind of data is currently available, and I will show later that the level of penetration is much higher today, even though there still is lack of comprehensive data on the levels of teleworking.

Van Lier et al. (2012) explored if further encouragement of telework would be desirable from a sustainable mobility viewpoint in BCR, building on data coming from a survey estimating the impact of teleworking on the external costs linked to the mobility of employees, with a primary focus on external environmental transport costs (climate change, air pollution, up and downstream processes and noise) and a secondary one on external socio-economic transport costs (accidents and congestion). According to them, in 2010 telework was not yet a widespread measure in large companies (> 200 employees) in the BCR, with the Brussels Environmental Agency specifying that only 36% of the large companies formally implemented telework (BIM, 2010), though they note an increase of the number of companies including teleworking in their company transport plan in the previous years. They conclude that telework in companies located in the BCR could provide a significant external transport costs saving, since travels to the headquarter are indeed often associated with congestion, which could be avoided by teleworking, especially when this implies working from home. However, they make allowance for the possibility that the benefit derived from a reduction in the number of trips to the headquarters could be more than compensated by an increase in the number of trips for private reasons or to the satellite office, but they estimate this to be an unlikely eventuality.

Data on the penetration of teleworking in Belgium is currently being published by the Belgian statistical office (Statbel). In its last *Enquête sur les forces de travail* (Labour force survey), which reported that 45.1% of the respondents to the survey worked from home in March 2021. This is a figure for the country as a whole, but one can assume that the penetration

in the BCR is at least as high, since, as previously shown, the region is a hotspot of third sector activities, the ones that are more suitable for teleworking. Therefore, this figure will be used as a reference to calculate the teleworkability of the BCR's economy in the next chapter. It has to be noted, however, that at that time Europe was already one year into the COVID-19 pandemic, and teleworking had already begun the norm for those who could telework. It remains to be seen whether workers will revert to commuting to the headquarter of their organisation, and how often, once the pandemic will be over.

Chapter 3: The "teleworkability" of the BCR's economy

This section will explore the "teleworkability" of the BCR's economy by applying the shares of jobs that can be done at home by industry calculated by Dingel and Neiman (2020) to the BCR's economy. Even though the shares were calculated for the United States, the authors proceeded to apply them to data on employment for 26 European countries, including Belgium, and then compared the derived country-level "teleworkability" shares to the share of the Eurofound (2020) survey respondents in those same countries reporting that they started to work from home due to COVID-19. They assume that all those workers who could telework during the pandemic did so, and therefore equate the figure on the actual penetration of teleworking during the pandemic with the "teleworkability" of the whole economy.

The estimates in their study and the real country-level shares from the Eurofound survey are highly correlated, even though the estimate for Belgium (42%) lies sensibly under the share from the survey (more than 50%). However, as mentioned in chapter two, Statbel reported that the percentage of workers working from home in March 2021 was 45.1%, a figure that is remarkably close to the estimate from Dingel and Neiman (2020). Therefore, I conclude that it is warranted to use the shares of jobs that can be done at home estimated in their study for the purpose of my research

Before proceeding to applying these shares to the BCR's economy, I need to check the coincidence between the sectorial decomposition of the economy used in Dingel and Neiman (2020) and the one I use in the present research. Dingel and Neiman (2020) use the 2-digit North American Industry Classification System (NAICS) sectors for their analysis of the teleworkability of US economy, while I will be using the Level-1 sectors of the 2008 *Nomenclature statistique des Activité economique dans la Communauté Européenne* applied to Belgium (NACE-BEL 2008) used by the *Institut Bruxellois de Statistique et d'Analyse* (Brussels Institute for Statistical Analysis, IBSA) in its data on employment in the BCR. There is a close relationship between the two types of classification, even though there are some notable differences that require further explanation. Table 1 shows, in descending order, the level of teleworkability in each sector of the economy both according to the NAICS and to the NACE-BEL 2008. The two classifications are almost completely overlapping, but highlighted at the bottom of the table are the most important differences spotted while transposing the teleworkability shares from NAICS to NACEBEL 2008. The first difference is that the sectors

"Activities of extraterritorial organisations and bodies" and "Activities of households as employers; undifferentiated goods- and services- producing activities of households for own use" in NACE-BEL 2008 do not have correspondent sectors in NAICS. However, this should not pose a problem while performing the analysis of teleworkability of the BCR's economy since jobs in these sectors represent only the 0.5% of the total.

Table 1: Share of teleworkable jobs per sector

2-digit NAICS	Share	Level-1 NACEBEL 2008	Code	Share
Educational Services	0.83	Education	P	0.83
Professional, Scientific, and Technical Services	0.80	Professional, scientific and technical activities	M	0.80
Finance and Insurance	0.76	Financial and insurance activities	K	0.76
Information	0.72	Information and communication	J	0.72
Real Estate and Rental and Leasing	0.42	Real estate activities	L	0.42
Federal, State, and Local Government	0.41	Public Administration and Defence; Compulsory Social security	O	0.41
Utilities	0.37	Water supply; Sewerage; Waste Management and Remediation Activities	E	0.37
		Electricity, Gas, Steam and Air Conditioning Supply	D	0.37
Administrative and Support and Waste Management and Remediation Services	0.31	Administrative and support service activities	S	0.31
Other Services (except Public Administration)	0.31	Other service activities	N	0.31
Arts, Entertainment, and Recreation	0.3	Arts, entertainment and recreation	R	0.3
Health Care and Social Assistance	0.25	Human health and social work activities	Q	0.25
Mining, Quarrying, and Oil and Gas Extraction	0.25	Mining and quarrying	B	0.25
Manufacturing	0.22	Manufacturing	C	0.22
Construction	0.19	Construction	H	0.19
Transportation and Warehousing	0.19	Transportation and storage	F	0.19
Agriculture, Forestry, Fishing and Hunting	0.08	Agriculture, forestry and fishing	A	0.08
Accommodation and Food Services	0.04	Accommodation and food service activities	I	0.04
Wholesale Trade	0.52	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	G	0.33
Retail Trade	0.14			
		Activities of extraterritorial organisations and bodies	T	
		Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	U	

Data source: Dingel and Neiman (2020)

Slightly more problematic is the fact that "Wholesale Trade" and "Retail Trade" are treated as separate sectors in NAICS (with their sector-specific teleworkability share) and as one in NACE-BEL 2008. To overcome this snag, I assigned a single teleworkability share to the related sector in NACEBEL 2008 that is the mean of the teleworkability shares for the two

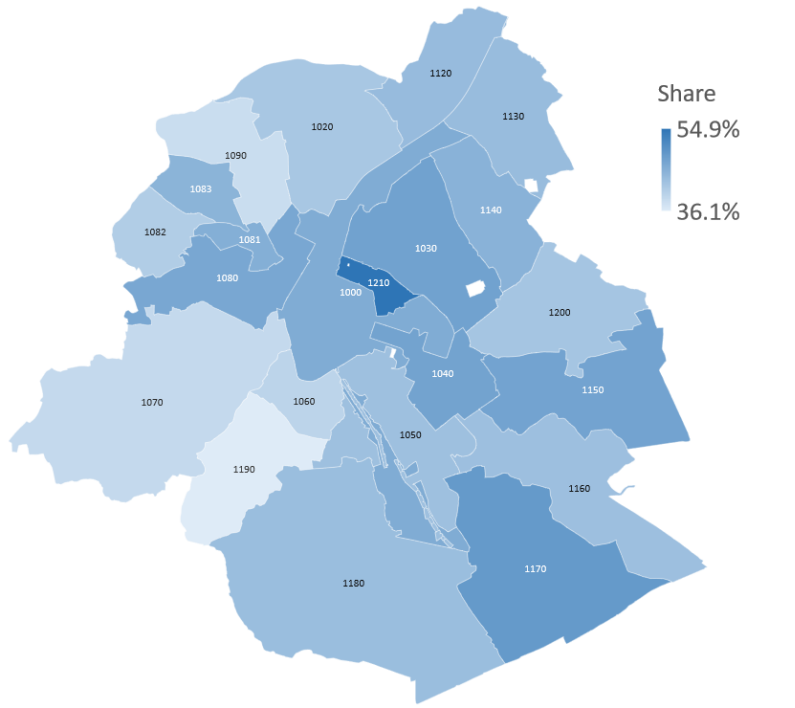
NAICS sectors. This workaround should not cause great bias in the estimation of teleworkability for the sector, since the two sub-sectors are of similar sizes[4] in the BCR.

Now that we have the Belgium-specific shares of jobs that can be done at home per sector, we can apply them to the BCR's economy to come up with an estimate of its teleworkability and understand where workers employed in teleworkable jobs work and reside within the city. However, before proceeding to the estimation, a caveat is in order. The spatial analysis that follows considers each municipality as one single location and all the different municipalities as separate (as if divided by an insurmountable wall). Reality is obviously more nuanced, given that some municipalities are big enough to include several locations relevant for the purpose of the present analysis and that those people that reside (or work) close to the borders between two municipalities, even though counted for the municipality they officially reside (or work) in, could in reality "pertain" to the contiguous municipality. This simplification, even though it imposes caution in drawing conclusions, allows to perform the analysis in absence of more granular data. Furthermore, more granular data on other metrics (e.g., office density at neighbourhood level) will later be presented, and this would help to better contextualise the findings reported below.

The overall share of teleworkable jobs in the BCR using the abovementioned methodology amounts to 44.4%. However, as shown in Figure 10, there is a certain variability when one considers the specific shares for each municipality. This is due to the fact that jobs in the different sectors of the economy are not evenly spread throughout the region, and some municipalities have a relatively higher proportion of jobs in highly "teleworkable" sectors (e.g. financial activities), while others have a relatively higher proportion of scarcely "teleworkable" sectors (e.g. manufacturing). Table 2 reports the share of jobs in each sector over total per municipality, with the sectors arranged from left to right in increasing order of teleworkability, and the share of jobs formatted in shades of blue from the lowest (light blue) to the highest (dark blue).

[4] Data source: Banque Carrefour des Entreprises

Figure 10: Share of teleworkable jobs per municipality (by location of workplace)[5]



Date source: Institut Bruxellois de Statistique et d'Analyse

Table 2: Share of jobs in each sector over total per municipality[6]

	Sector	I	A	F	H	C	B	Q	R	N	S	G	D	E	O	L	J	K	M	P	T	U
	Teleworkability	0.04	0.08	0.19	0.19	0.22	0.25	0.25	0.3	0.31	0.31	0.33	0.37	0.37	0.41	0.42	0.72	0.76	0.8	0.83	N/A	N/A
1070	Anderlecht	1.7%	0.0%	5.4%	6.6%	5.8%	0.0%	15.1%	0.8%	14.1%	2.1%	19.3%	0.2%	0.2%	7.6%	0.8%	2.3%	1.9%	2.5%	13.5%	0.0%	0.0%
1160	Auderghem	2.6%	0.0%	1.6%	9.8%	0.6%	0.6%	15.9%	3.3%	16.5%	2.5%	9.1%	0.0%	0.1%	5.3%	1.7%	3.2%	8.5%	9.6%	8.8%	0.1%	0.2%
1082	Berchem-Sainte-Agathe	1.8%	0.0%	2.4%	1.9%	3.1%	0.0%	14.9%	0.6%	25.6%	0.8%	19.4%	0.0%	0.9%	5.7%	0.5%	1.7%	2.6%	4.8%	13.2%	0.0%	0.0%
1000	Bruxelles	6.3%	0.0%	0.8%	3.2%	1.4%	0.0%	6.1%	2.0%	8.4%	5.4%	6.8%	2.0%	0.4%	22.3%	0.6%	3.2%	12.8%	9.1%	7.9%	0.0%	1.1%
1040	Etterbeek	3.7%	0.0%	0.7%	1.3%	1.1%	0.0%	9.6%	2.3%	18.0%	5.1%	6.8%	0.0%	0.0%	13.3%	1.2%	2.2%	17.6%	5.3%	11.0%	0.1%	0.7%
1140	Evere	2.0%	0.0%	1.4%	1.5%	1.9%	0.0%	6.8%	0.4%	16.9%	1.2%	13.0%	0.0%	0.1%	26.0%	0.7%	11.1%	1.3%	8.8%	6.4%	0.0%	0.3%
1190	Forest	1.5%	0.0%	6.0%	5.5%	23.3%	0.0%	11.0%	2.8%	11.6%	1.2%	8.8%	0.0%	1.6%	8.7%	0.8%	2.1%	1.2%	2.7%	11.2%	0.1%	0.1%
1083	Ganshoren	2.2%	0.0%	2.4%	3.6%	5.9%	0.0%	16.3%	1.9%	16.8%	2.6%	5.7%	0.0%	0.0%	9.9%	2.4%	1.0%	1.2%	1.6%	26.4%	0.0%	0.0%
1130	Haren	2.1%	0.0%	3.3%	10.5%	2.4%	0.0%	5.3%	1.4%	11.7%	2.3%	7.7%	1.0%	2.3%	22.3%	0.4%	2.5%	13.3%	4.8%	6.5%	0.0%	0.0%
1050	Ixelles	14.6%	0.0%	0.7%	2.8%	1.4%	0.0%	9.0%	1.4%	9.7%	5.9%	10.4%	0.0%	0.1%	9.2%	1.3%	5.1%	5.4%	7.6%	14.7%	0.3%	0.5%
1090	Jette	1.5%	0.0%	1.4%	2.3%	0.8%	0.0%	38.6%	1.7%	15.0%	1.0%	12.0%	0.0%	0.0%	5.9%	0.9%	0.2%	0.9%	1.7%	16.2%	0.0%	0.0%
1081	Koekelberg	1.2%	0.0%	2.3%	2.1%	8.8%	0.0%	19.6%	0.5%	8.2%	2.7%	6.1%	0.0%	0.0%	15.8%	0.8%	1.8%	5.6%	3.6%	20.7%	0.0%	0.0%
1020	Laeken	4.5%	0.0%	3.0%	7.8%	3.7%	0.0%	13.3%	2.6%	11.8%	3.0%	9.8%	1.1%	1.1%	10.3%	0.5%	3.0%	8.7%	6.1%	9.6%	0.1%	0.0%
1080	Molenbeek-Saint-Jean	1.2%	0.0%	1.4%	9.1%	1.2%	0.0%	11.3%	1.4%	7.1%	3.2%	10.0%	0.0%	0.0%	20.7%	1.0%	0.7%	7.5%	6.4%	17.5%	0.0%	0.0%
1120	Neder-over-Hembeek	2.6%	0.0%	2.5%	9.3%	2.0%	0.0%	11.6%	3.4%	13.4%	2.1%	6.3%	0.9%	2.3%	14.0%	0.3%	2.5%	9.3%	5.5%	11.8%	0.0%	0.1%
1060	Saint-Gilles	5.4%	0.0%	1.8%	18.8%	1.0%	0.0%	5.7%	3.7%	7.3%	3.3%	3.7%	0.0%	0.0%	26.0%	0.9%	8.3%	2.3%	6.3%	5.5%	0.0%	0.0%
1210	Saint-Josse-ten-Noode	3.0%	0.0%	0.7%	0.5%	0.3%	0.0%	7.1%	1.1%	11.7%	4.6%	1.4%	0.0%	0.2%	18.0%	0.4%	1.6%	41.1%	1.3%	7.0%	0.0%	0.0%
1030	Schaerbeek	1.6%	0.0%	2.5%	5.6%	0.6%	0.0%	8.5%	0.8%	5.0%	4.3%	5.4%	0.0%	1.7%	27.6%	0.7%	23.7%	1.1%	1.9%	8.7%	0.1%	0.1%
1180	Uccle	4.8%	0.0%	1.7%	1.1%	4.6%	0.0%	21.9%	1.3%	11.1%	2.5%	10.8%	0.0%	0.4%	6.9%	2.5%	1.6%	1.8%	6.2%	19.8%	0.7%	0.3%
1170	Watermael-Boitsfort	2.7%	0.4%	12.8%	0.0%	0.3%	0.0%	15.1%	1.3%	2.3%	3.4%	7.2%	0.0%	0.0%	8.6%	3.6%	5.0%	9.4%	13.8%	13.7%	0.2%	0.3%
1200	Woluwe-Saint-Lambert	2.5%	0.0%	5.3%	0.4%	0.6%	0.0%	33.1%	1.0%	9.7%	2.3%	10.6%	0.0%	0.0%	4.4%	1.7%	4.0%	1.2%	5.9%	17.0%	0.1%	0.2%
1150	Woluwe-Saint-Pierre	3.2%	0.0%	0.6%	1.4%	0.9%	0.0%	8.8%	1.1%	18.3%	3.8%	8.7%	0.0%	2.8%	12.7%	1.4%	5.4%	3.5%	9.8%	16.1%	0.6%	0.9%

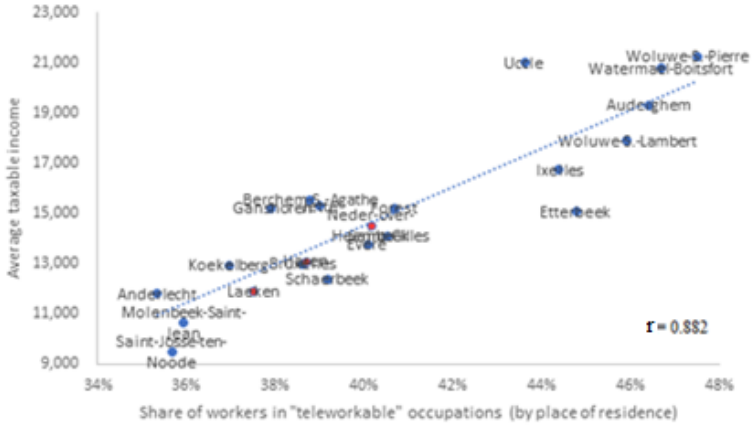
Date source: Institut Bruxellois de Statistique et d'Analyse

[5] The share for Bruxelles (1000), Laeken (1020) Neder-over-Hembeek (1120) and Haren (1130) is derived using a procedure detailed in the methodological note.

[6] The shares for Bruxelles (1000), Laeken (1020) Neder-over-Hembeek (1120) and Haren (1130) is derived using a procedure detailed in the methodological note.

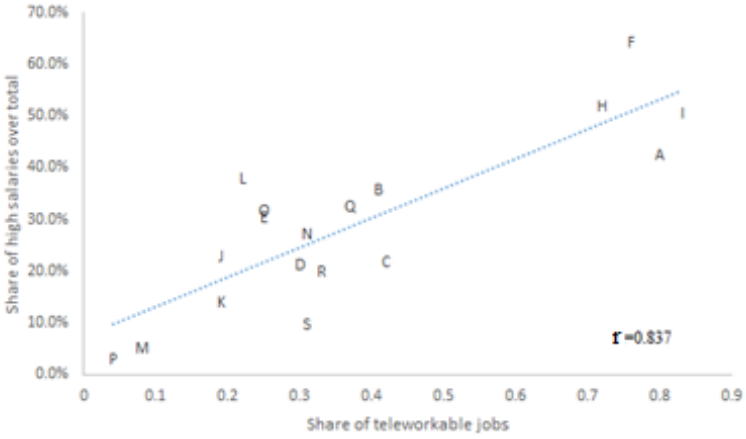
For what concerns the place of residence of people employed in teleworkable occupations, Figure 11 shows that there is a tight correlation between the average taxable income in the municipality and the share of workers employed in teleworkable jobs. This is because people employed in the sectors with higher shares of teleworkable jobs are also, in general, those that pay higher salaries. Indeed, Figure 12 shows that there is a strong correlation between the share of teleworkable jobs over total and the share of high salaries (i.e., between the 8th and the 10th decile of Belgium's salaries).

Figure 11: Correlation between share of workers in teleworkable occupations (by place of residence) and average yearly taxable income (per person)[7]



Date source: Institut Bruxellois de Statistique et d'Analyse

Figure 12: Correlation between share of teleworkable jobs and share of high salaries over total

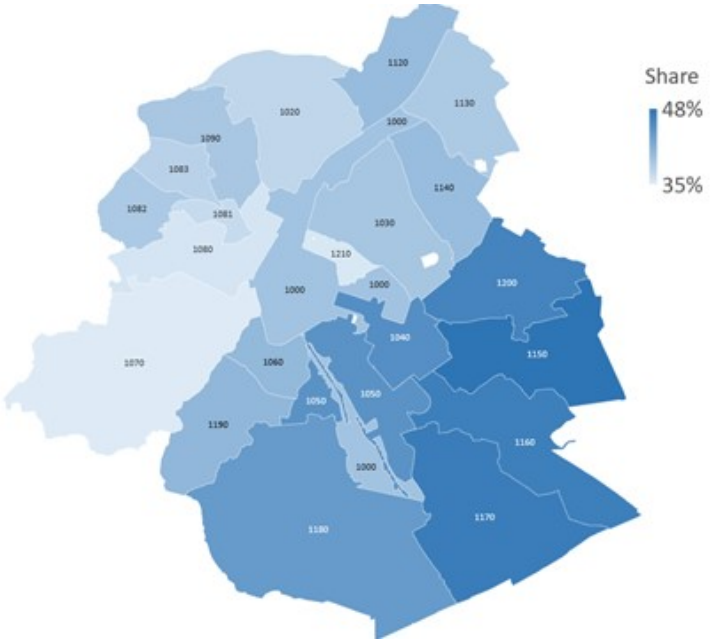


Data source: Institut Bruxellois de Statistique et d'Analyse

[7] The value for Laeken (1020), Neder-over-Heembeek (1020) and Haren (1030), shown in red in the graph, has been estimated using a procedure detailed in the methodological note.

Knowing that there is tight a correlation between average taxable income and share of resident workers employed in teleworkable occupation, one can infer in which municipalities can higher shares be found (see Chapter 1 for the theory on location choices). As shown in Figure 13, there is a clear divide between north and south in terms of residence of workers employed in teleworkable jobs. This divide resembles the one in terms of income previously highlighted (see Figure 2).

Figure 13: Share of workers employed in a teleworkable occupation over total (by place of residence)

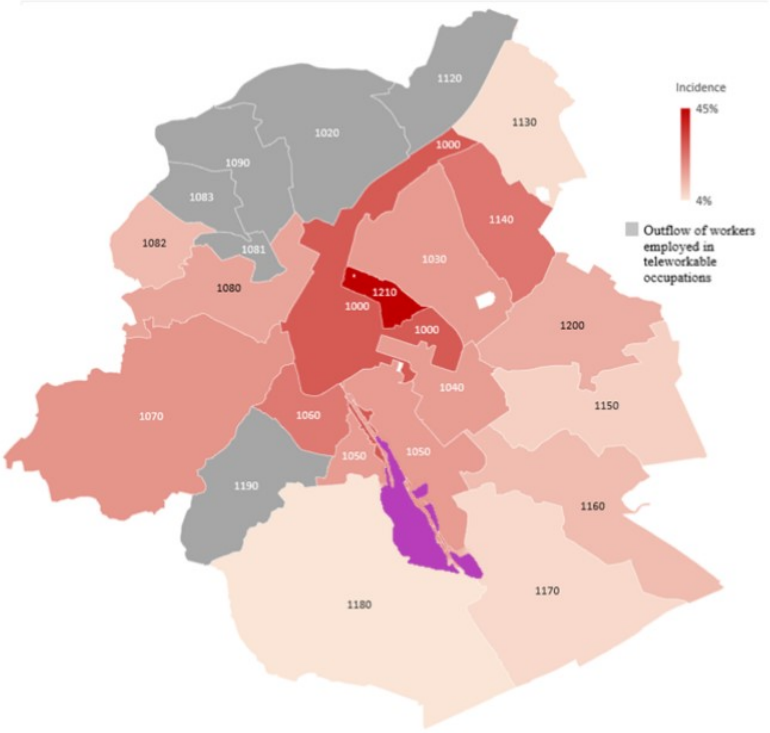


Date source: Institut Bruxellois de Statistique et d'Analyse

A comparison between the number of workers employed in teleworkable occupations (by place of residence) and the number of teleworkable jobs (by workplace) provides a picture of the commuting flow of workers employed in teleworkable occupations, and therefore an indication of the exposure of the different municipalities to an uptake or a continuation of teleworking. Figure 14 shows that some municipalities are extremely vulnerable to teleworking, with inflow of workers in teleworkable occupations amounting to as much as 45% of total of jobs for Saint-Josse-ten-Noode (1210), followed by Bruxelles (1000) at 28%, Evere (1140) at 24% and Saint-Gilles (1060) at 23%. Workers engaging in teleworking spend more time in their location of residence and less in the location of their official workplace (provided

they work from home), and this can trigger important changes in the urban dynamics of the different municipalities. In a later section, the potential impact on food and beverage service activities of the exposure to teleworking in the different municipalities will be explored.

Figure 14: Incidence of the inflow of workers employed in teleworkable occupations over total of jobs (by location of workplace)[8]



Date source: Institut Bruxellois de Statistique et d'Analyse

[8] The area in purple is the portion of Bruxelles (1000) that is covered by forests. It has been removed to avoid giving the false impression of a high inflow enclave in the south

Chapter 4: The geography of the food and beverage service activities in the BCR

As it is the case for most European capitals, food and beverage service activities (e.g. restaurants, bars, cafés and other similar activities) are an important constituent of the economy in the BCR, and according to data from the *Institut Bruxellois de Statistique et d'Analyse (IBSA),* in May 2021 the BCR counted 19,256 such businesses. The present chapter explores the geography of food and beverage service activities in the BCR and its determinants, setting the stage to better understand how and why these businesses could be impacted by an uptake in teleworking.

Location choices for food and beverage service activities can be explained in light of the main theories on retail location. Researchers have advanced several seminal theories on the topic, and *central place*, *principle of minimum differentiation* and *spatial interaction* remain the most popular (Litz and Rajaguru, 2008).

Central place theory offers an explanation of the spatial distribution of retail facilities and market centres, as well as of the pattern and extent of market areas (Craig, 1984), suggesting that they are determined by the maximum distance consumers are willing to travel to obtain a good (also called the "range") and the minimum amount of demand that must exist in an area for a store to be economically viable (Craig, 1984). Therefore, the optimal location for a store is in an area containing the population that can support the store within an acceptable travelling distance for consumers (Christaller, 1966). This could explain why restaurants concentrate in and around Central Business Districts (CBDs) (Austin et al., 2005).

However, this theory is susceptible to two main criticisms. The first one is its inability to account for differences in retail location patterns on the basis of product offering, store image, and competition levels (Craig, 1984; Litz and Rajaguru, 2008). This criticism can also be extended to restaurant settings where factors such as cuisine type, image and existing restaurant mix influence the pattern of location in addition to customer accessibility and sales maximisation. The second one is its failure to account for agglomeration effects – the clustering of retail stores in particular areas of a town or near a shopping centre that increases the attractiveness of the area for consumers (Teller and Reutterer, 2008). Over the years, the concentration of restaurants in CBD areas might exemplify the agglomeration effects in the restaurant industry (Austin et al., 2005; Smith, 1985).

Principle of minimum differentiation theory, developed from Hotelling (1929)'s law in economics, which emphasises the concept of clustering effect, and suggests that the degree of proximity to competitors in a geographic area is an indicator of attractiveness and competitiveness of that area (Chou et al., 2008)). An accompanying principle of this theory was developed by (Nelson, 1958) suggesting that "a given number of stores dealing in the same merchandise will do more business if they are located adjacent, or in proximity to each other than if they are widely scattered" (p. 58). This concept is better known as the "principle of cumulative attraction" (Litz and Rajaguru, 2008). In retailing, cumulative attraction is manifested through retail agglomerations and restaurant clusters and several explanations have been offered for their existence (Miller et al., 1999; Oppewal and Holyoake, 2004; Smith, 1995; Teller and Reutterer, 2008). Restaurants cluster together mainly because:

- it facilitates comparison of restaurants on cuisine types and ambience etc,
- it increases the attractiveness of individual restaurants and the area as a whole,
- it allows economies of scale and synergistic effects,
- it enables sharing of costs of facilities and promotion, and
- it allows for better representation of restaurateurs' shared interest with local government bodies.

Finally, *spatial interaction theory* assumes the possibility of customers making trade-offs between specific features of the products and services offered and the attractiveness of the location (Litz and Rajaguru, 2008). Better known as "law of retail gravitation", this theory is the precursor of the "gravity" type of spatial choice model commonly used today (Babin et al., 1994); Yrigoyen and Otero, 1998). This theory, even though it remains congruent with many principles of *central place theory,* such as that of a store or restaurant having a minimum level of attractiveness that must be achieved given the population of an area and that convenience of location matters (Lösch, 1954), it includes in the analysis a wider list of features, such as price, service levels, image features and "less" objective criteria of store attraction measured in terms of consumer perceptions, as determinants of store location (Teller and Reutterer, 2008). In the case of restaurants these gravity models suggest that customers make trade-offs between location and other attractiveness factors such as ambience and atmosphere (Teller and Reutterer, 2008; Tzeng et al., 2002), namely they are willing to cover longer distances to get to a restaurant they consider particularly attractive. As a consequence, certain typologies of restaurants would cluster in a specific area and customers would be willing to get there regardless of the distance (up to a certain point) if the attraction is strong enough. Furthermore,

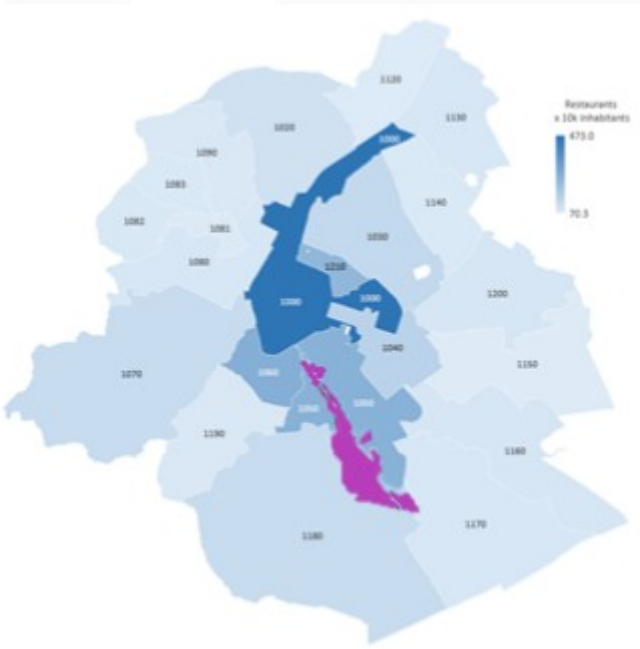
"newer" gravity models also take into account other factors, which in the restaurant industry are, among others, traffic patterns (Timor and Sipahi, 2005), parking facilities (Tzeng et al., 2002), locating near a highway (Smith, 1995), visibility of premises and the presence of other complementary businesses (Schaefer et al., 1996).

In summary, *central place theory* emphasises the relative density of a store's trading area, *principle of minimum differentiation* theory suggests that proximity to rivals enhances performance (Litz and Rajaguru, 2008), and *interaction theory* posits performance related differences emanating from the specific competitor's product and service offering. Research has shown that a combination of all three perspectives is needed to have an understanding of location decisions for restaurants (Prayag et al., 2012).

Figure 15 shows that the number of food and beverage service activities per 10k residents of each municipality in the BCR is highly heterogeneous, with a far higher number of such activities per capita in a few municipalities at the centre of the city. This is confirmed by Figure 16, which shows that, even though there is a general positive correlation between the number of residents and the number of food and drink service activities in each municipality ($r = 0.683$), some municipalities have a much higher number of these activities than one would expect by simply extrapolating based on the number of residents (e.g. Bruxelles), while other have a lower one (e.g. Molenbeek). This suggests that these numbers are only partially explained by where people reside, and additional factors must be considered.

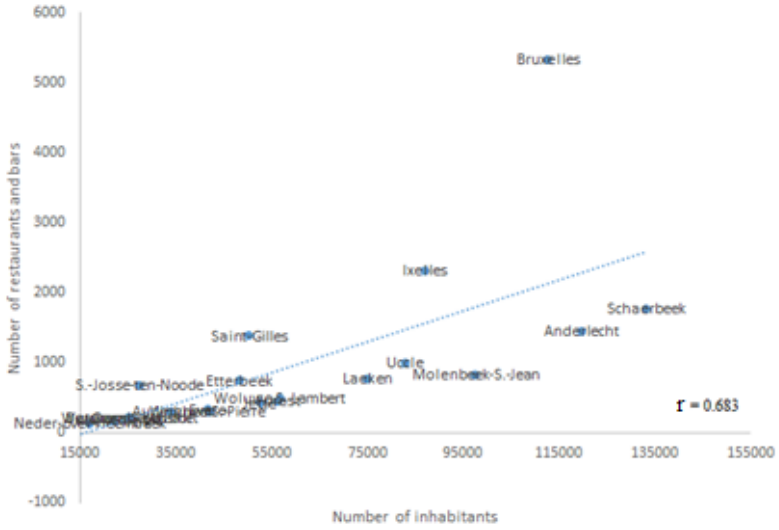
One possible explanation for the discrepancy between the number of food and beverage service activities and the number of residents in each municipality could be that these activities cater to a wider customer base than just residents (even though residents are part of the customer base), and my hypothesis is that the number of restaurants and bars correlates even more strongly with the number of workers that work in each municipality. Figure 17 confirms that the correlation is indeed much stronger ($r = 0.964$ vs $r = 0.683$), with the only outlier (Ixelles) being the municipality in which the two biggest universities in the BCR (ULB and VUB) are located, where the number of restaurants and bars is plausibly also influenced by the great number of students living in the area.

Figure 15: Number of food and beverage service activities per 10k inhabitants[9]



Date source: Banque Carrefour des Entreprises et Monitoring des Quartiers

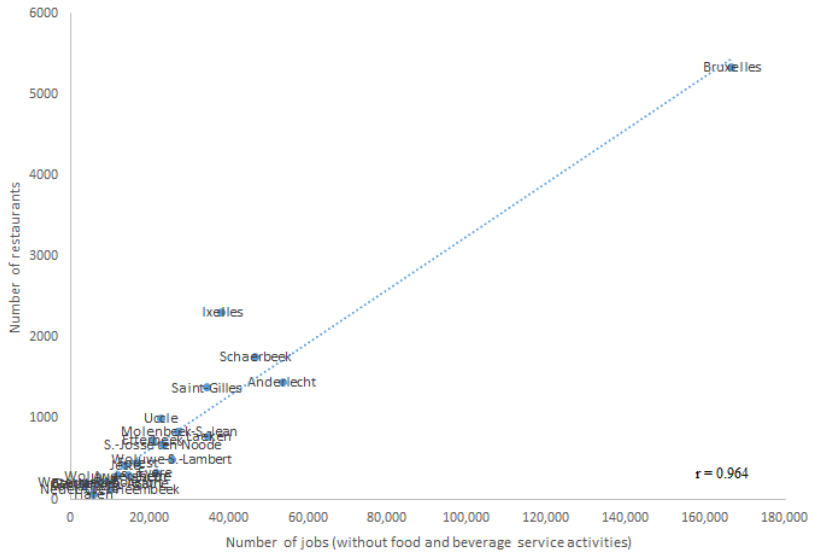
Figure 16: Correlation between the number of inhabitants and the number of food and beverage service activities



Date sources: Banque carrefour des Entreprises and Monitoring des Quartiers

[9] The area in purple is the portion of Bruxelles (1000) that is covered by forests. It has been removed to avoid giving a false impression of an inhabited area with presence of restaurants.

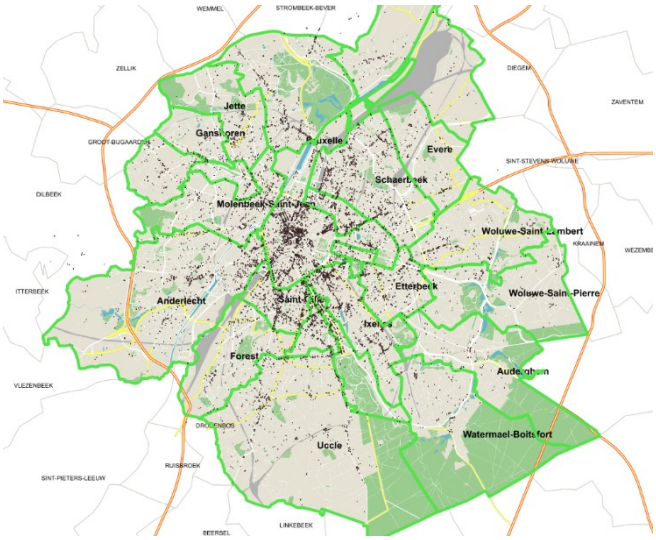
Figure 17: Correlation between the number of jobs and the number of food and beverage service activities



Date sources: Banque carrefour des Entreprises and Monitoring des Quartier

After having shown the location of food and beverage service activities in aggregate at the level of the municipality, let us now zoom in to identify their exact locations at the level of the address, so as to spot if there are clusters to be observed and where these clusters are located. Figure 18 shows that these activities tend not to evenly spread throughout the region, and that they appear highly clustered at the centre of the city, even though smaller clusters are present in the surrounding municipalities.

Figure 18: Location of food and beverage service activities in Brussels

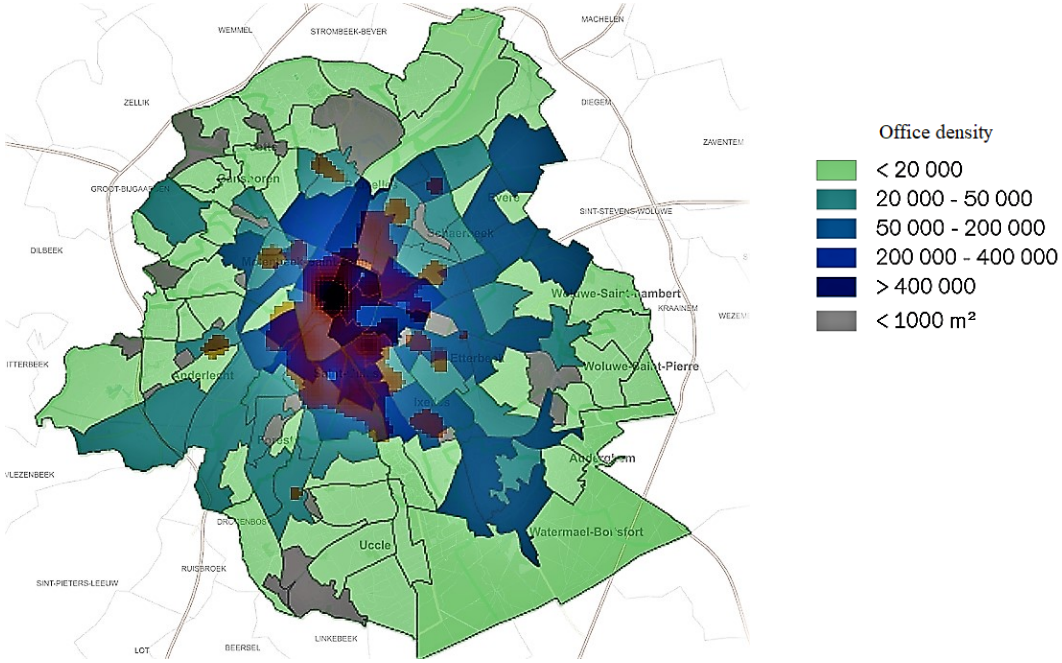


Source for the map of Brussels: Urbis.

Data source for the food and beverage service activities: Banque Carrefour des Entreprises

As predicted by *central place theory,* also in Brussels we find the highest density of food and beverage service activities in and around the CBD. Furthermore, as previously mentioned, the *principle of minimum differentiation theory* posits that the degree of proximity to competitors in a geographic area is an indicator of attractiveness and competitiveness of that area, and that retail activities (and, by extension, food and beverage service activities), usually earn more by being clustered together than by being scattered around, following the so called "principle of cumulative attraction" (Litz and Rajaguru, 2008). Among the reasons that are given in literature for the existence of such a cumulative attraction there is that competitors exploit each other's visibility in an area that is frequented by costumers. It has been shown that workers commuting to the CBD from the periphery (and beyond) represent a fundamental component of the customer base for the food and beverage service activities in the BCR, and Figure 19 shows that, at a more granular scale, these activities tend to cluster in and around areas at high density of offices, supposedly to be within a close distance of their customers.

Figure 19: Heatmap of density of food and beverage service activities[10] over office density in each neighbourhood[11]



Source for the map on office density Brussels: Monitoring des Quartiers

Data source for the food and beverage service activities: Banque Carrefour des Entreprises

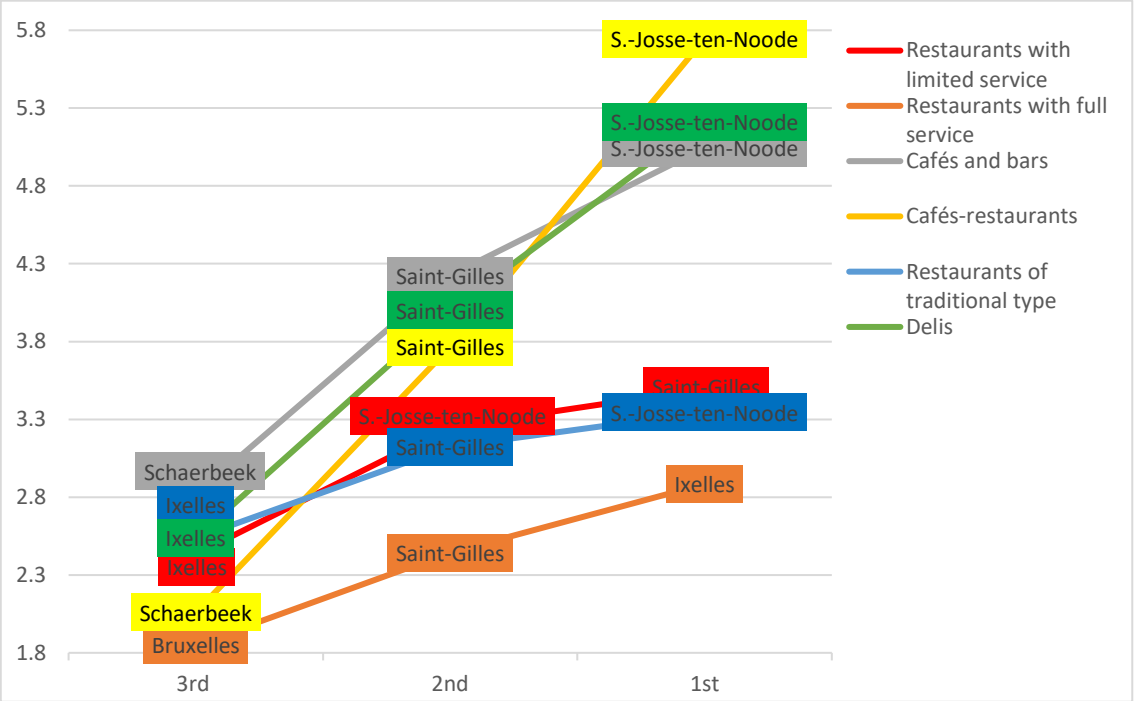
[10] The heatmap shows the density of food and beverage service activities found within a radius of 500 metres from each point. The darker the shade, the highest the density. Clusters within the lowest decile of density have been cut off to highlight the significant clusters, since a limited number of activities are found everywhere int eh BCR.

[11] Office density is shown in m^2/km^2

Finally, *spatial interaction theory* posits that the location of a store (and, by extension, a food and beverage service activity) might not only depend on the maximum distance consumers are willing to travel to obtain a good (also called the "range") and the minimum amount of demand that must exist in an area for a store to be economically viable (Craig, 1984), but also on other specific characteristics of the activity under scrutiny. This implies that food and beverage service activities with similar characteristics would often choose the same location, and a certain specialisation and characterisation of different areas emerges.

Figure 20 shows that, different typologies of food and beverage service activities are not homogeneously distributed across the BCR, and that a certain degree of geographical specialisation is indeed present.

Figure 20: Ranking of municipalities based on the density of each specific typology of food and beverage service activity[12]



In summary, food and beverage service activities show higher density in and around the BCR's CBD and tend to be clustered in neighbourhoods at high density of offices. However,

[12] The vertical axis reports how a municipality compares in terms of density of food and beverage service activities of a certain typology to the situation in which all the activities of that typology were present with the same density throughout the entire surface of the region. For instance, a density of 2 means that a municipality has double the density than one would find in the "equal density" situation.
The horizontal axis, instead, shows the ranking in terms of density for a specific typology of activity. For instance, for "*cafés and bars*" the third highest density is found in Schaerbeek, the second highest in Saint-Gilles and the first highest in Saint-Josse-ten-Noode

the specific typology of an activity also determines its exact location, and this entails a certain degree of specialisation of different areas within the CBD.

Chapter 5: The potential impact of teleworking on the food and beverage service sector

The level of exposure of the different municipalities to teleworking could have an important impact on different urban dynamics. In this section I am going to explore the potential impact of an uptake of the practice of teleworking on "non-teleworkable" industries, with a specific focus on food and beverage service activities. Indeed, even though online delivery services have allowed food and drink service activities to reach customers within a wider perimeter than in the past, still these activities remain relatively localised and dependent on where potential customers are located. Furthermore, not every food and drink service activity is suitable to take advantage of online delivery services.

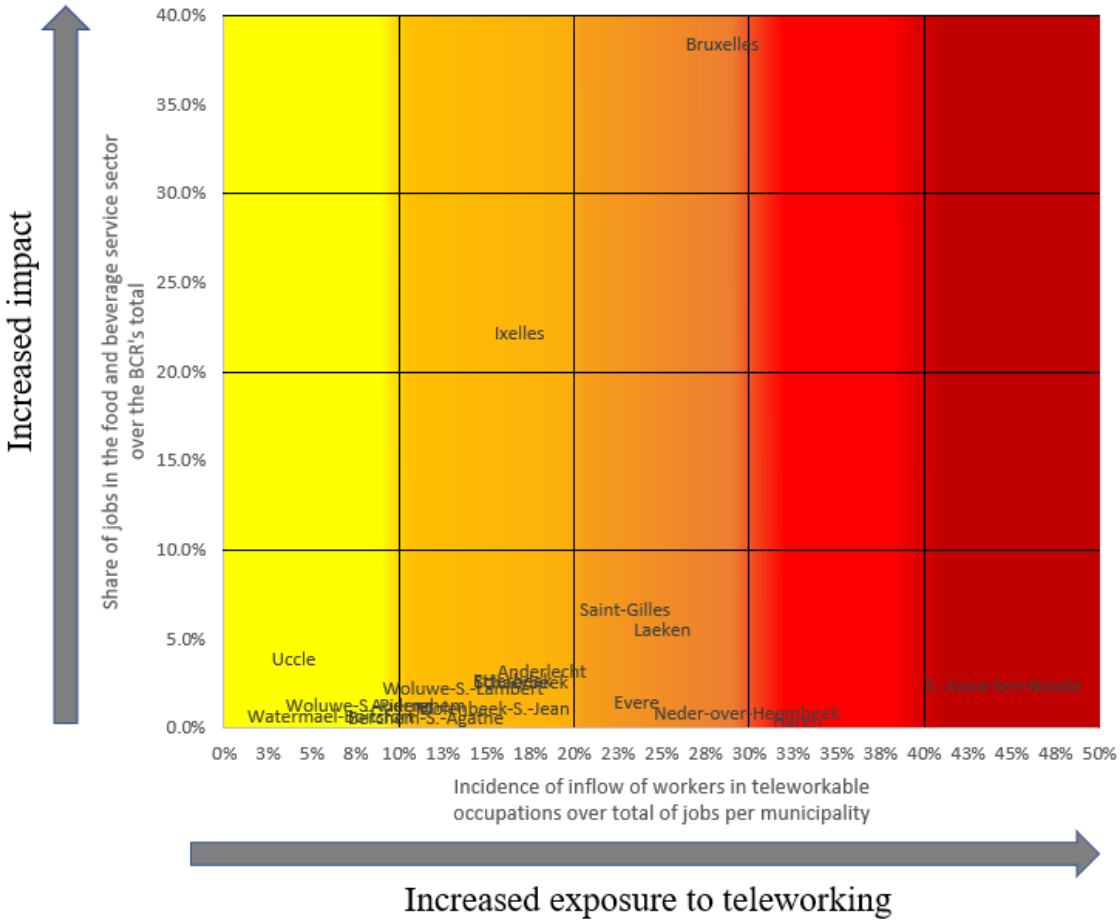
The number of food and beverage service activities, as well as the number of jobs in this sector (see chapter 4), can be put in relation with the exposure to teleworking of the municipalities in which these activities are located (see chapter 3), to better understand the different risk profiles in terms of what and potential impacts of what. The exposure is measured by the incidence of the inflow of workers in teleworkable occupations over total of jobs per municipality (see Figure 14) while the potential impact is measured by different metrics reported below.

Figure 21 shows the relationship between the exposure to teleworking of a municipality and the proportion of jobs in the food and beverage service sector over the BCR's total located in that municipality. Bruxelles and Saint-Josse-ten-Noode are the municipalities at highest risk of impact from teleworking, but they differ substantially in their proportion of jobs in the food and beverage service sector. In contrast, Bruxelles and Ixelles have the biggest shares of jobs in the sector, but they differ substantially in their risk profile. Figure 22 reports the shares of jobs in the food and beverage service sector per different risk profiles, and 55.9% of these jobs sector fall in a risk profile that is at least "medium". This needs a more detailed discussion to help the reader.

A similar story can be told for the relationship between the exposure to teleworking and the share of food and beverage service activities over the BCR's total located in the different municipalities (Figure 23). However, it is important to report this different impact metric because the proportion of jobs in the food and beverage service sector and the proportion of food and beverage service activities, though correlated, diverge in case a restaurant or bar has

no employees. Furthermore, a divergence can also be caused by the different number of employees, with large activities counting more in the proportion of employees than in the proportion or restaurants and bars. Finally, even though it is important to understand the impact on employees, many business owners, especially small ones, rely solely on their activity for their subsistence, and therefore should be properly considered in such an assessment. Furthermore, Bruxelles is substantially less prominent on this impact metric (27.4%) than on the previous one (38.4%). Overall, as shown in Figure 24, 44.5%% of food and beverage service activities fall in a risk profile that is at least "medium", compared to 55.9% of jobs in the sector. Rewrite for clarity

Figure 21: Exposure to teleworking and share of jobs in the food and beverage service sector potentially impacted over the BCR's total[13]

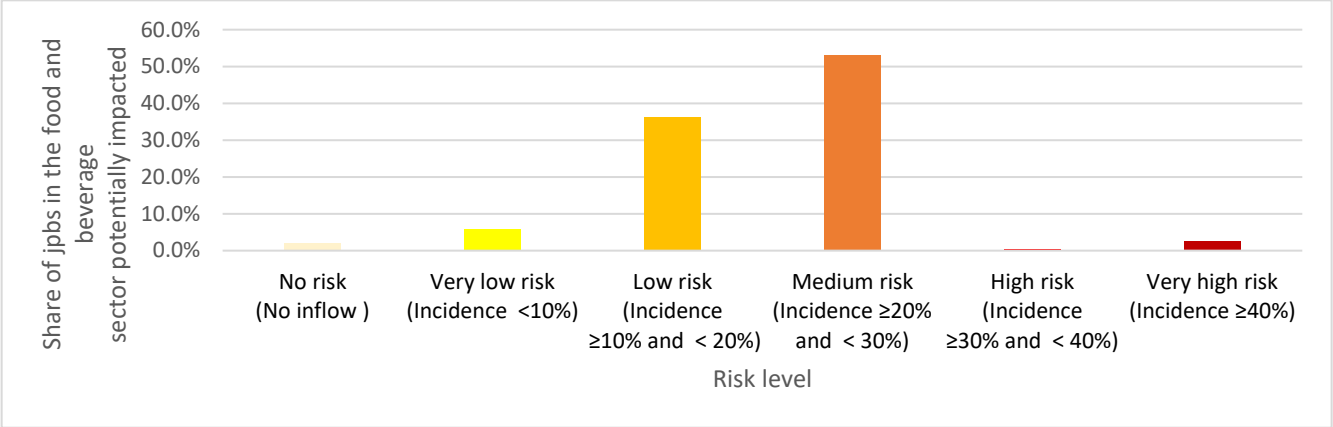


Data source: Institut Bruxellois de Statistiques et d'Analyse

Note: the values for Bruxelles (1000) and Haren (1130) is derived using a procedure detailed in the methodological note.

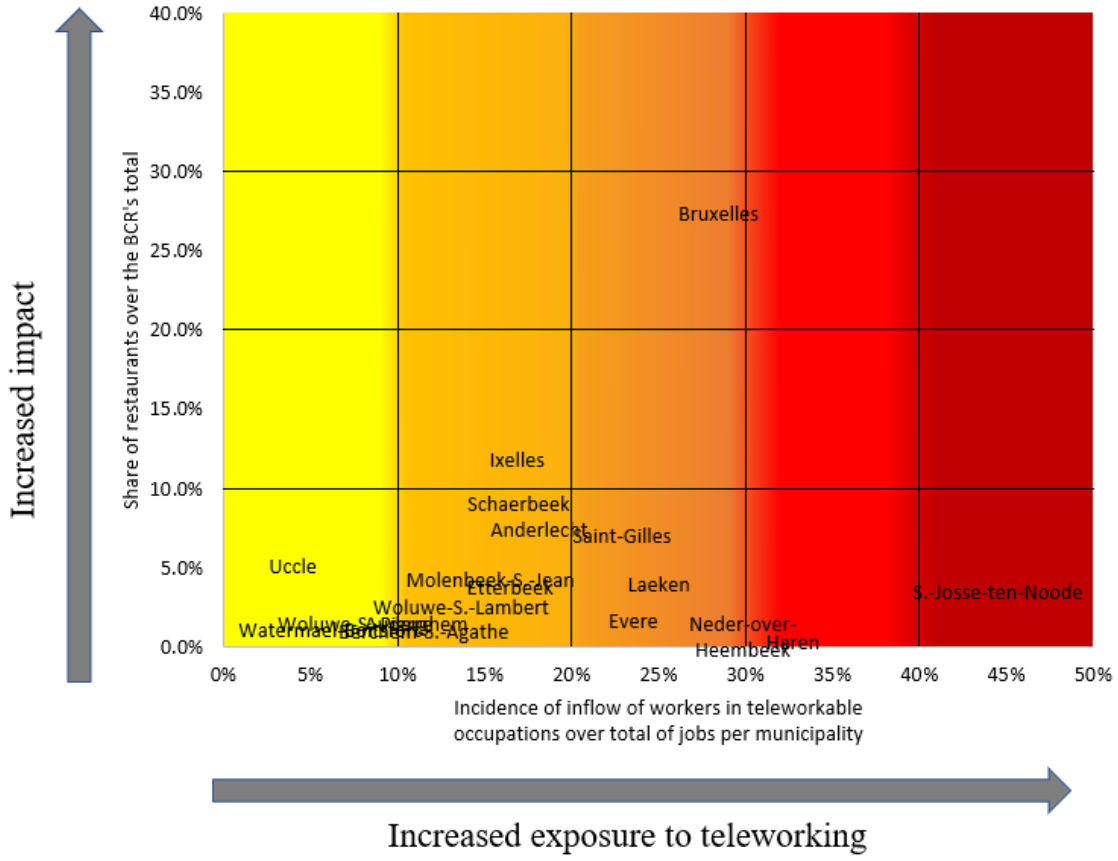
[13] Municipalities that see an outflow of workers in teleworkable occupations (e.g. Laeken) are not included, since an uptake in teleworking does not imply any risk for them.

Figure 22: Share of jobs in the food and beverage service sector at different risk levels



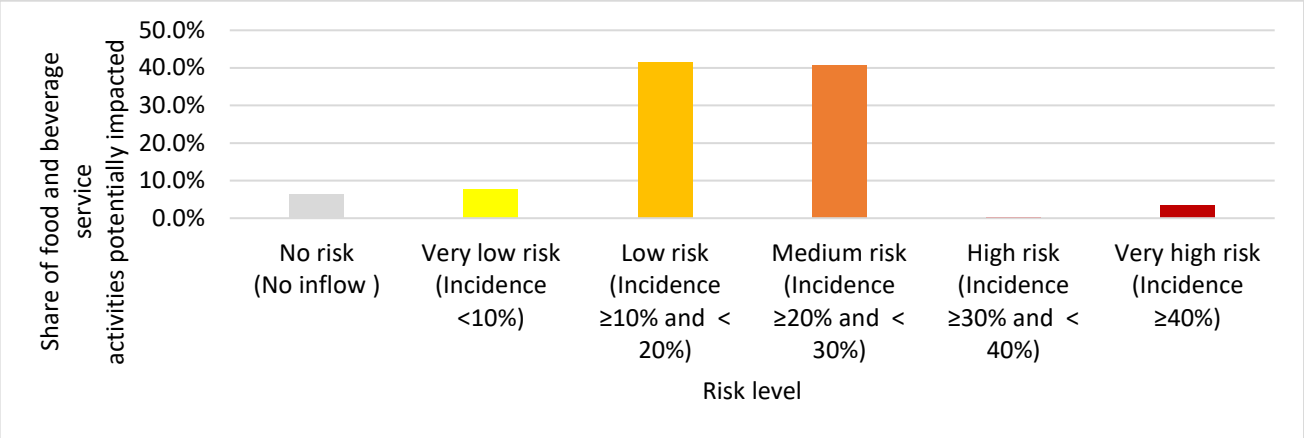
Data source: Institut Bruxellois de Statistiques et d'Analyse

Figure 23: Exposure to teleworking and share of food and beverage service activities potentially impacted over the BCR's total



Data source: Institut Bruxellois de Statistiques et d'Analyse

Figure 24: Share of food and beverage service activities at different risk levels

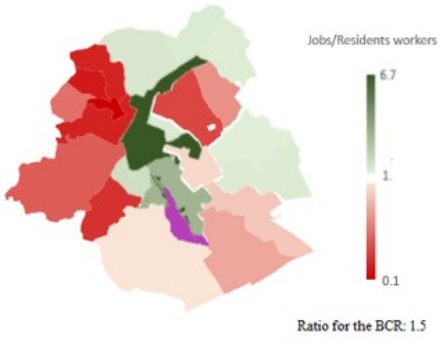


Data source: Institut Bruxellois de Statistiques et d'Analyse

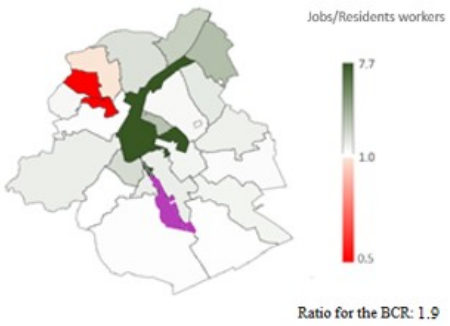
The analysis of the commuting flows for the food and beverage service sector returns a peculiar picture. Figure 25 shows the ratio of jobs to resident workers for each municipality, which is used as a proxy of commuting flows (see Chapter 1), both for the food and beverage service sector and for the whole economy. For the whole economy, most of the municipalities see, to varying degrees, an inflow of workers that commute to the BCR from its surroundings, while the inflow is present in far fewer municipalities when considering the food and beverage service sector. This means that the proportion of workers commuting to the BCR from its surroundings is lower for the food and beverage service sector than for the economy as a whole, as it is testified by the difference in the ratio for the BCR in the two figures (respectively 1.5 and 1.9).

Figure 25: Comparison between the ratio of jobs to resident workers (commuting flows) for the food and beverage service sector and for the whole economy

Food and beverage service sector)



All sectors



Data source: Institut Bruxellois de Statistiques et d'Analyse

Note: The area in purple is the portion of Bruxelles (1000) that is covered by forests. It has been removed to avoid giving a false impression of a "high-inflow" enclave in the south.

Figure 26 reports in detail the flows of workers in the food and beverage service sector between municipalities. The figure shows what is the number of jobs in the food and beverage service sector for each municipality, what proportion of these jobs is held by workers residing in the same municipality, what proportion of workers commute from an "outflow" municipality to an "inflow" municipality, and what is the risk level associated to teleworking that these jobs/workers are facing. For sake of clarity in the picture, only the flows between municipalities in the BCR are reported, and so the total number of jobs in the "inflow" municipalities is underreported, since the sizable number of workers commuting from outside the BCR is not included.

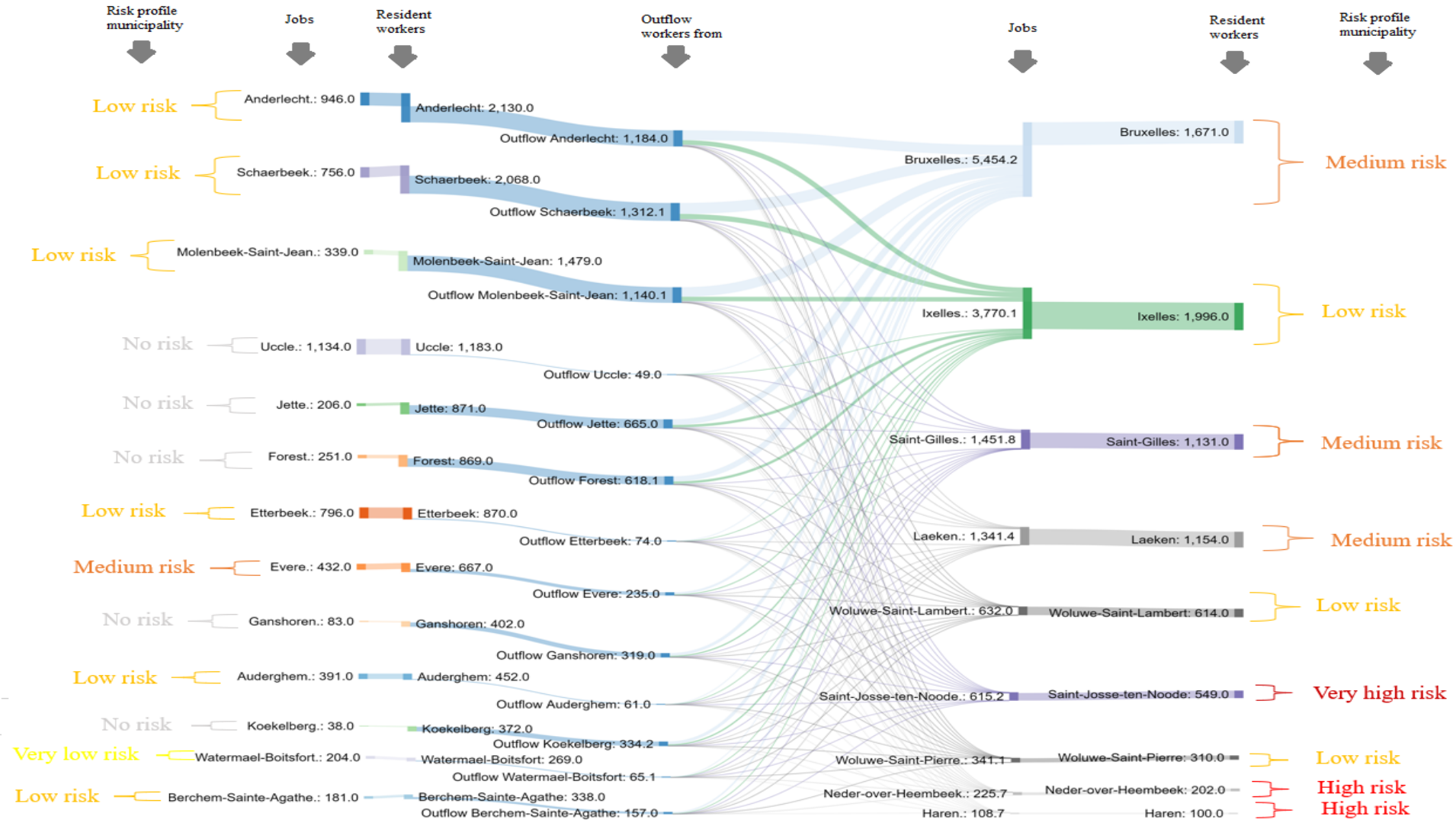
Figure 25 and figure 26 show that the bulk of the flows for the food and beverage service sector are from municipalities at the periphery of the BCR to municipalities at the core (especially Bruxelles, Ixelles and Saint Gilles), and that commuting workers usually reside in municipalities with a lower risk profile (but not enough jobs) and work in municipalities with a higher risk profile (where most jobs are located). The only notable exception is Ixelles, which is a high inflow municipality but has a low risk profile. Furthermore, figure 26 reiterates the finding that more than half of the workers in the food and beverage service sector works in municipalities with a risk profile that is at least "medium" (see also figure 21).

Now that the risk levels and the commuting flows have been calculated, it is time to explore what kind of urban dynamics could be triggered by a widespread uptake of teleworking. I will first explore what the consequence could be for the food and beverage service activities, and then I will focus on the consequences for the workers in the sector.

The consequences for the food and beverage service activities can be explored through the lens of the theories on retail location introduced in chapter four. In general terms, an uptake of teleworking would translate into a dispersion of the customer base from the CBD, since workers would not be commuting for work to the CBD anymore (or at least they would be doing it less frequently), and they would be spending more time in their place of residence (which would then more frequently also become their workplace).

Following the thesis of central place theory (see Chapter 4), this could mean that the food and beverage service activities in the CBD could not anymore exploit the mass of customers they used to have, and this could entail they would lose their economic viability, unless the

Figure 26: Overview of commuting flows in the food and beverage service sector between municipalities of the BCR



Data source: Institut Bruxellois de Statistique et d'Analyse

Note: For simplicity, the outflows from the "outflow" municipalities are split between the "inflow" municipalities based on the overall share of inflow absorbed by the latter. For instance, Bruxelles absorbs 60.9% of all the inflows, so it is assumed that 60.9% of the flow from each "outflow" municipality goes to Bruxelles. In reality, the exact origin of flows could be different, but this would not greatly modify the findings, since almost all the outflow municipalities are at "low risk" or "no risk" and the share of inflow absorbed by the inflow municipalities is the actual one.

range of the activity increases (because customers are willing to travel longer distances on average and/or travel more frequently for reasons other than work).

As mentioned before, online food delivery services provide a solution to increase the range without forcing customers to travel, but they are not suitable for all kinds of food and beverage service activities. Following, instead, the thesis of *principle of minimum differentiation theory* (see Chapter 4), the CBD could lose its attractiveness (derived from the concentration of workers), and therefore no longer provide the benefit from clustering in that area to the food and beverage service activities. Finally, following the thesis of *spatial interaction theory* (see Chapter 4), those food and beverage service activities that are able to attract customers because of their peculiar features, regardless of convenience of location, will be able to endure the changes potentially triggered by an uptake of teleworking.

It has to be underlined that the dynamics under analysis are tremendously complex in reality, and that their precise outcome is extremely hard to foresee. Below a non-exhaustive list of the feedbacks that could influence the outcome:

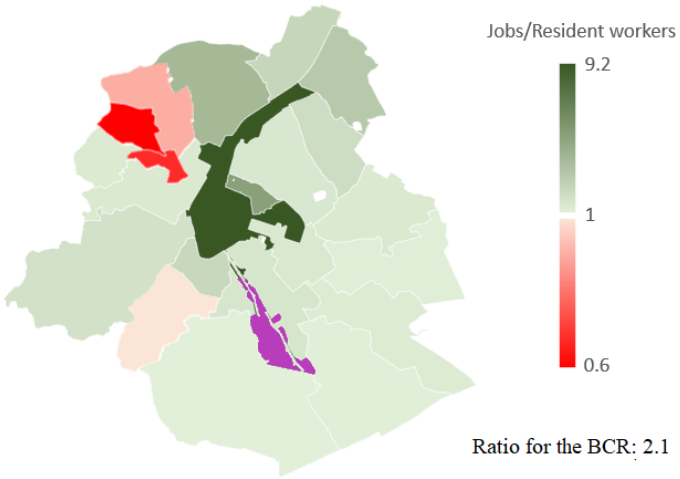
- The mass of customers in the CBD would depend on the frequency of teleworking (see Chapter 2), so on average workers could commute to the CBD frequently enough to keep the food and beverage service activities economically viable,
- The food and beverage service activities could reshape their offer to be more suitable for online delivery, therefore increasing their range (see Chapter 4),
- The loss of attractiveness of the CBD could trigger a fall in rents, and this decreased fixed cost could compensate for the decrease in demand, so as to keep the food and beverage service activities economically viable,
- The rents could be sticky, and so they would not adjust quick enough for them to compensate for the decrease in demand.

Let's now focus on the potential impact of teleworking on workers in the food and beverage service sector. Let's assume, with all the caveats mentioned above, that in the long run food and beverage service activities would tend (at least partially) to disappear from the CBD because of the decrease in local demand caused by workers deciding to telework from their place of residence. Let's also assume that in the long run food and beverage service activities would tend to appear in those municipalities where "teleworkable" workers reside, because of the increase in demand caused by these workers spending more time in their place of residence. However, the exact outcome of this dynamic is highly uncertain because the consumption habit

of the “teleworkable” workers could in turn change, and they could decide to spend more time eating at home rather then outside. Anyway, assuming that at least a certain level of relocation takes place, then those workers employed in the food and beverage service sector that used to commute to the CBD, as well as those residing in the CBD, could face two problems: having to look for a job elsewhere and having to commute to a different workplace. Depending on the resulting distance between places of residence and workplaces, two main issues may arise: disconnect from the job market (for job seekers) and strain from commuting (for workers). These two issues can be explored respectively through the literature on the so-called spatial mismatch-hypothesis, and the literature on commuting and subjective wellbeing (SWB).

Figure 27 shows which are the municipalities that see an inflow of workers employed in teleworkable occupations (i.e.,the number of teleworkable jobs is higher than the number of resident workers employed in teleworkable occupations). Only few municipalities see an outflow of workers employed in teleworkable occupations, and this means that a sizable share of the inflow comes from outside the BCR. Following the logic set forth earlier, this would entail that in the long run food and beverage service activities would tend to be pushed out of the CBD towards the periphery of the BCR.

Figure 27: Ratio of teleworkable jobs to resident workers in teleworkable occupations



Data source: Institut Bruxellois de Statistiques et d’Analyse

Note: The area in purple is the portion of Bruxelles (1000) that is covered by forests. It has been removed to avoid giving a false impression of a “high-inflow” enclave in the south

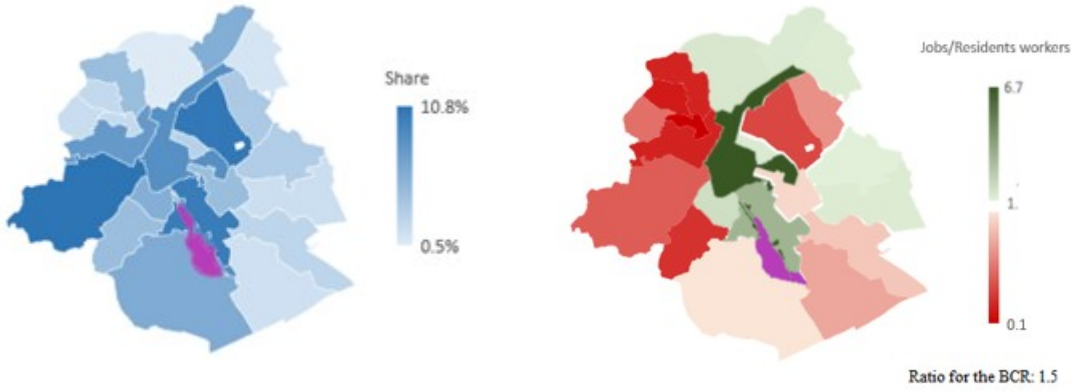
Figure 28 shows on the left where workers in the food and beverage service sector reside, and on the right the current inflows and outflows of workers of this sector in the different

municipalities (see Chapter one for details on this metric). Following the logic set forth earlier, the inflow of workers to the CBD would decrease in the long run, and this would modify the commuting flows of workers. However, also in this case, the dynamics under analysis are highly complex in reality, and their precise outcome is extremely hard to foresee.

Figure 28: Share of workers over the BCR's total and Ratio of jobs to resident workers

Share of workers in the food and beverage service sector over the BCR's total

Ratio of jobs to resident workers (Food and beverage service sector)



Data source: Institut Bruxellois de Statistiques et d'Analyse

Note: The area in purple is the portion of Bruxelles (1000) that is covered by forests. It has been removed to avoid giving a false impression of a "high-inflow" enclave in the south

Below a non-exhaustive list of the feedbacks that could influence the outcome:

- The remaining jobs in the CBD could either be held by workers residing close to the workplace, or by workers commuting from a distance, depending on the future commuting costs within the BCR (see Chapter 1), which will determine the pool of competing job-seekers for those jobs,
- The future commuting costs could influence the place of residence of workers and job seekers, which could try to adjust their residence to the new pattern of job offer under the constraint of such costs (see Chapter 1), thus influencing the feedback highlighted in the previous point,
- The residence choice of workers and job seekers could be impeded by housing market dynamics,
- The resulting commuting distances would depend, on one hand, on the previous three points, and, on the other, on the precise location of the food and beverage service activities that would be relocated outside the CBD,

- The precise location of these activities would depend on their attractiveness, their range and the resulting local density of demand (see Chapter 1, Chapter 3 and Chapter 4).

It is not unreasonable therefore to think that, as a result of the abovementioned dynamics, some workers could face longer commutes and some job seekers could find themselves physically disconnected from the local job market.

As concerns commuting and subjective wellbeing (SWB), the literature spans across various disciplines (e.g. economics, psychology, health, transport) and is highly heterogeneous in terms of the aspects of SWB considered, the characteristics of commuting considered, and the methodological approaches used. In general terms, commuting is found to be associated to stress and is widely considered the least favourite way to spend one's time (see Chatterjee et al., 2020 for a comprehensive review). For the purpose of the current research, the review of the literature will be narrowed down to the association between SWB and commuting distance and time. Below the most relevant findings:

- Longer commute duration is found to be associated with reduced Well-Being Index (WBI) score and reduced probability of being happy yesterday (Choi et al., 2013),
- Satisfaction with travel decreases with commute duration, and lower satisfaction with travel is associated with lower satisfaction with life (Olsson et al., 2013),
- Longer commute duration is associated with decreased life satisfaction and happiness (Nie and Sousa-Poza, 2018),
- Longer commute duration is associated with lower health-related quality of life via perceived stress (Rüger et al., 2017),
- Longer commute duration is associated with decreased life satisfaction, and with decreased satisfaction with health, job and spare time (Stutzer and Frey, 2008),
- Longer commute duration is associated with decreased mental health for women but not men (Roberts et al., 2009),
- Longer commute distance is associated with lower satisfaction with leisure time, and the association between commute distance and satisfaction with leisure time and family life is found to be partly explained by having less time for caregiving, spare time activities and sleeping (Lorenz, 2018).

As concerns, instead, the impact of the physical disconnection from the job market caused by distance between place of residence and place of work, this can be explored through the lens of the literature on the *spatial mismatch hypothesis,* which argues that the physical

disconnection between places of residence and places of work can have adverse labour-market outcomes. Kain (1968) was the first to hypothesise that the disconnection between places of residence and places of employment could be a key contributor to the high unemployment, low wages, and poverty in the black ghettos of central cities. Although the intuition initially applied to African Americans in US inner cities, spatial mismatch has a broader validity beyond the sole US context. A very abundant literature followed Kain's seminal paper for more than four decades and variants were expressed.

Gobillon and Selod (2019) provide a comprehensive review on the topic, and argue that there are at least five theoretical mechanisms that can make distance to job opportunities harmful:

- The first one theorises that when commuting costs are high enough, they could outweigh the benefits from even a well-paid distant job, and so the workers might prefer to remain unemployed or occupy a lower-wage job which is located closer to his place of residence,
- The second one theorises that distance could decrease job search efficiency. This would be particularly relevant for low-skill services jobs, since recruiting methods of employers for these jobs are often local (e.g. signs), which might reduce the information that job seekers have on distant job offers,
- The third one theorises that job search costs can be large enough to discourage job seekers from searching for jobs far from their place of residence, and this would be particularly true for workers who do not have a car and when public transports do not provide an efficient solution to reach the place in which jobs are located,
- The fourth one theorises that job seekers who reside in areas in which housing is more affordable might have an incentive to stay unemployed for a longer period of time. Since housing costs are influenced by distance from jobs (see Chapter 1), this could add to the issues highlighted in the previous points,
- Finally, the fifth one theorises that employer might consider that long commutes deteriorate the productivity of workers, by causing them to be late or tired, and may decide not to hire workers who reside too far from the workplace.

The authors report that there is some empirical evidence supporting the first three mechanisms, while the last two remain largely unexplored. On this note, there is just one paper empirically testing the *spatial mismatch hypothesis* in the BCR (Dujardin et al., 2008), and the authors found that, at least at the time, vulnerable groups were not largely disconnected from

jobs, and that the segregation effects in terms of nationality and skills (which were not explored in the context of the present research) were a stronger cause of unemployment than spatial mismatch.

Conclusions

The present thesis explored the potential impact of an uptake of teleworking on the food and beverage service activities and its employees in the Brussels Capital Region (BCR), and it found that almost half of the activities, and more than half of the workers in the sector, could potentially be impacted by such an uptake through a decrease in the demand for these services in the Central Business District (CBD). Indeed, it was shown that there is a very strong correlation between the number of food and beverage service activities and the number of workers in each municipality, with the highest number being in the CBD. A sizable proportion of workers working in the CBD commutes from the periphery of the BCR, and therefore the situation in which a share of these workers decided to work from home (or, at least, not to commute to the CBD as frequently as before) would likely impact the demand for food and beverage services in those municipalities that currently see an inflow of such workers.

This fall in demand would, on one hand, compromise the economic viability of at least part of the food and beverage service activities in the BCR, therefore also impinging on their ability to employ workers, and on the other, will cause such kind of activities (or at least part of them) to relocate outside the CBD. This could in turn modify the commuting patterns within the region and could relocate jobs further away from job seekers, thus physically disconnecting them from the employment opportunities offered by the sector. Longer commutes could have an adverse impact on the wellbeing of workers and the disconnection from job opportunities could hinder the likelihood of job seekers to find employment.

As explained in earlier chapters, the urban dynamics potentially triggered by an uptake of teleworking would be highly complex (due to a series of feedbacks) and it would be really difficult to precisely foresee their outcome. However, understanding the underlying dynamics has very important policy implications, since public authorities should have an interest in monitoring them and take precautions to mitigate any adverse impact. Without discussing in detail their pros and cons, as well as their feasibility, below a non-exhaustive list of policies that could steer the dynamics or try to mitigate potential adverse impacts:

- Imposing a limit to teleworking:
  The food and beverage service activities in the CBD could keep being economically viable if enough workers commute frequently enough to the CBD, and this could be brought about by imposing contractual limits to teleworking,

- Intervening in the housing market:

  As said, the potential displacement of food and beverage service activities outside CBD could impose longer commutes to the workers in this sector and cause jobseekers to be disconnected from job opportunities. One way to prevent this could be for these workers and jobseekers to choose to reside in a more convenient location. This choice could be prevented by internal dynamics of the housing market, which could cut off certain strata of society for several reasons (e.g., low income, race, gender, etc.).

  Housing, mortgage, and credit markets discrimination could be prevented is to enforce antidiscrimination policies through the legal system. A way, instead, to counter the discriminating dynamics of the housing sectors based on income inequality could be to build public dwellings, modifying zoning regulations or subsidising residential mobility. However, these interventions could in turn have an effect on neighbourhood composition, because high income workers (which, incidentally, are also those more likely to be employed in teleworkable occupations) could decide to move out, and therefore indirectly on the location of food and beverage service activities and of the jobs they provide (see chapter 5),

- Improving connections between people and jobs:

  Improving public transport capillarity and efficiency would decrease commuting costs, with a positive impact on wellbeing, as well as improve job search efficiency and workers productivity (see chapter 5). However, people residing in high income neighbourhoods (which usually own cars) could oppose the development of the transport infrastructure, to isolate from any social malaise by controlling the influx of people. Furthermore, the development of the public transport system also affects real estate prices and rents, thus in turn influencing all the dynamics mentioned thus far.

  Connection between people and jobs could also be achieved by subsidising private transport, but this could in turn increase congestion and therefore commuting costs, thus defeating the purpose of the implementation of this policy.

  Finally, beyond transport policies, facilitating the circulation of information flows between food and beverage service activities and jobseekers about job

opening could also help overcome the information hurdles associated with physical distance.

Methodological note

The present section clarifies how the metrics for those municipalities that were not readily available in the datasets of the Institut Bruxellois de Statistiques et d'Analyses (i.e. Bruxelles, Laeken, Neder-over-Hembeek) were derived from other available data. Below the metrics that were derived and the procedure to derive them:

- Number of jobs:

The number of jobs in these four municipalities was calculated using the database of the Banque-Carrefour des Entreprises, which provides the address of all the businesses in the BCR, divided by sector of activity (NACE-BEL 2008). It is assumed that the number of jobs per sector in each of the four municipality follows a similar distribution as the number businesses per sector, and therefore the share of businesses per municipality and sector is applied to the overall number of jobs in the whole municipality of Bruxelles in aggregate (i.e. not divided in the four sub-municipalities). The resulting number and distribution of jobs is likely not to perfectly coincide with reality, since there is no indication of the number of employees per business, but it provides a reasonable basis for a coherent analysis of the data. However, the findings for the four municipalities taken separately have to be taken with pinch of salt.

- Number of resident workers:

The number of workers for these four municipalities is derived by applying the rate of employment (expressed as the share of employed workers within the working age population) to the total working age population. These two metrics are provided by the "Monitoring des Quartiers" for neighbourhoods (which are smaller units than municipalities), so the calculation was first made for neighbourhoods and then the resulting number were added to come up with a single number for the whole municipality.

- Share of teleworkable jobs

The share of teleworkable jobs is calculated using the average taxable income of the municipality. It is found that the share of teleworkable jobs is strictly linearly correlated with income. Therefore, after running the linear regression of the share of teleworkable jobs against income for all the other municipalities in the BCR, the value

for the four municipalities is interpolated using the same equation. The resulting number is likely not to perfectly coincide with reality, since the correlation between the two variables is not perfectly linear, but it provides a reasonable basis for a coherent analysis of the data. However, the findings for the four municipalities taken separately have to be taken with pinch of salt.

- Average taxable income

The average taxable income for these four municipalities is calculated by averaging between the average taxable income of neighbourhoods constituting those municipalities, provided by the Monitoring des Quartiers.

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