Is quality central?

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1. Introduction

A city is a geographical space in which functions are gathered in order to bring out interactions. These interactions are a central subject in the urban economics research. In these researches the notion of Central Business District (CBD) points out a central place in the city, where the prices are maximal. Hussy et al. (1985) describe the city as the place of "maximization" of these interactions, if there is enough concentration. They are growth by the gathering in a given space of a quantity of economic agents. The way these agents are distributed in the urban space is addressed by many theories about the morphological structure of cities, especially with regard to the notion of centrality.

In this article, we want to question the notion of centrality under the prism of the perceived quality, for the Parisian office buildings stock. The theories of centrality (Bailly, 1973) define the urban morphology according to many paradigms. We are interested in two of them; the monocentric paradigm (like Burgess, Von Thünen, Christaller, Hyot) and the polycentric paradigm (Harris & Ullman). The first one assumes that it exists a central place around which the city develops. The second one considers several centers of attractiveness within a city. The questions we address are the following. Is the global perceived quality score monocentric or polycentric? In the first case, can we consider the CBD as the place of the maximal quality? Regarding the components of the global score, we expect a monocentric spatial structure for the location quality sub-score. As for the building quality sub-score, the maximal quality might be reached for the first ring of the Parisian metropolis, in relation with the 'Grand Paris' urban project.

The first time of this research consists in estimating a perceived quality rating model, based on the revealed preferences of the market players. This market-driven evaluation is an extra-financial notation. Our perceived quality rating is based on the theory of reasoned action (Fishbein and Ajzen 1979) which documents the links between beliefs, attitudes, norms, intentions and behaviours. According to this theory it is the adequacy between the beliefs and the norms that determines attitudes and behaviour towards a property, and by extension his judgement.

In a second step we seek to refine the overall quality analysis, splitting the global quality score into its building component and its location component. We hypothesize that the location quality is higher in the center of Paris (relative to its periphery), which would confirm the monocentric hypothesis. However, we hypothesize that the building quality is maximal within the first ring around Paris.

We hypothesize and test with our sample if the global perceived quality is monocentric or polycentric within the Parisian Region. The natural candidate for the monocentric hypothesis is the CBD. However, we test if alternative choices for the center could be interesting. We expect either to confirm the centrality of the quality, or to overturn it in favor of the polycentric quality assumption. In the second case, the various quality centers should be determined.

The main results suggest that overall quality score follow a centrality curve (when CBD is the best quality score) in the Parisian metropolitan area. This means that Paris office markets are monocentric. But when we split qualitative score into building dimensions (location and built structure) we suggest that only location score follow a monocentric centrality. Built structure doesn't seems to do.

2. Measuring building quality: theoretical foundations and empirical implementation

a. Theoretical foundations

i. Information and information asymmetries in real estate market

A building can be defined by a great number of characteristics, which makes it complex to analyze. The real estate practionners involved in the building are also numerous (developers, builders, managers, marketers and service providers). Understanding a property requires an important quantity of data (both property and market). Information access is decisive in the performance of investment portfolios (Holtermans, 2016).
However, real estate markets are characterized by important asymmetries (Palm, 2015), leading the actors to base their assessments on the available information that can be very limited.
For experts and real estate practitioners, the building's price represents the best information on the building's quality. The value estimated by professionals corresponds to a multiple of individual evaluations which mean an asset can be have a lot of value (capitalizarion value, discount cash flow value, depreciation cost value, open market value…). Thus, the price is in a set of possible values individually attributed (Downie, Adair, McGreal and Vos, 2005).
However, the approach taken by Holbrook (1999) in the marketing Sciences allows us to emphasize the multidimensional character of the value and provides a general framework for analyzing an experiment. This is what we will try to study through our methodology.

ii. Building quality : a mix between attitudes and subjective norms

The objective here is to better understand the formation of a judgement concerning the real estate quality. This quality judgement, which may explain the actors ' interest in a property (buying, selling, renting, etc.), is the one that will be considered by the market players. This quality judgement has two important components: an asset valuation of the property itself and a share of the normative beliefs related to several characteristics. This perspective corresponds to the theory of reasoned action (TAR) which generated a very large research current and has been empirically validated in many contexts. The TAR is a model of social psychology developed by Fishbein and Ajzen (1975) which defines the links between beliefs, attitudes, norms, intentions and evaluations by individuals. The authors suggest that the behaviour intent (the purchase of a property for example) is the result of two processes : on the one hand, the beliefs and assessments made about a good (or a service) from all of its characteristics that define his attitude towards that good ; and on the other hand the integrated normative beliefs and social norms that that define his subjective norms.
Applying this model to the problem of real estate quality judgment, we propose that it be determined on the one hand by the attitude that the assessor elaborates in relation to all the characteristics of a specific property, and on the other hand by its subjective norms concerning the importance of the characteristics in question in a general perspective .

b. Empirical implementation

In order to identify the relevant elements to evaluate a building , a first step was to analyze the existing classification grids in force (CIBE grid, IPD grid, LEED, BREAM, etc.)

i. *A reduction in the number of relevant characteristics and a structure in the form of a representation tree.*

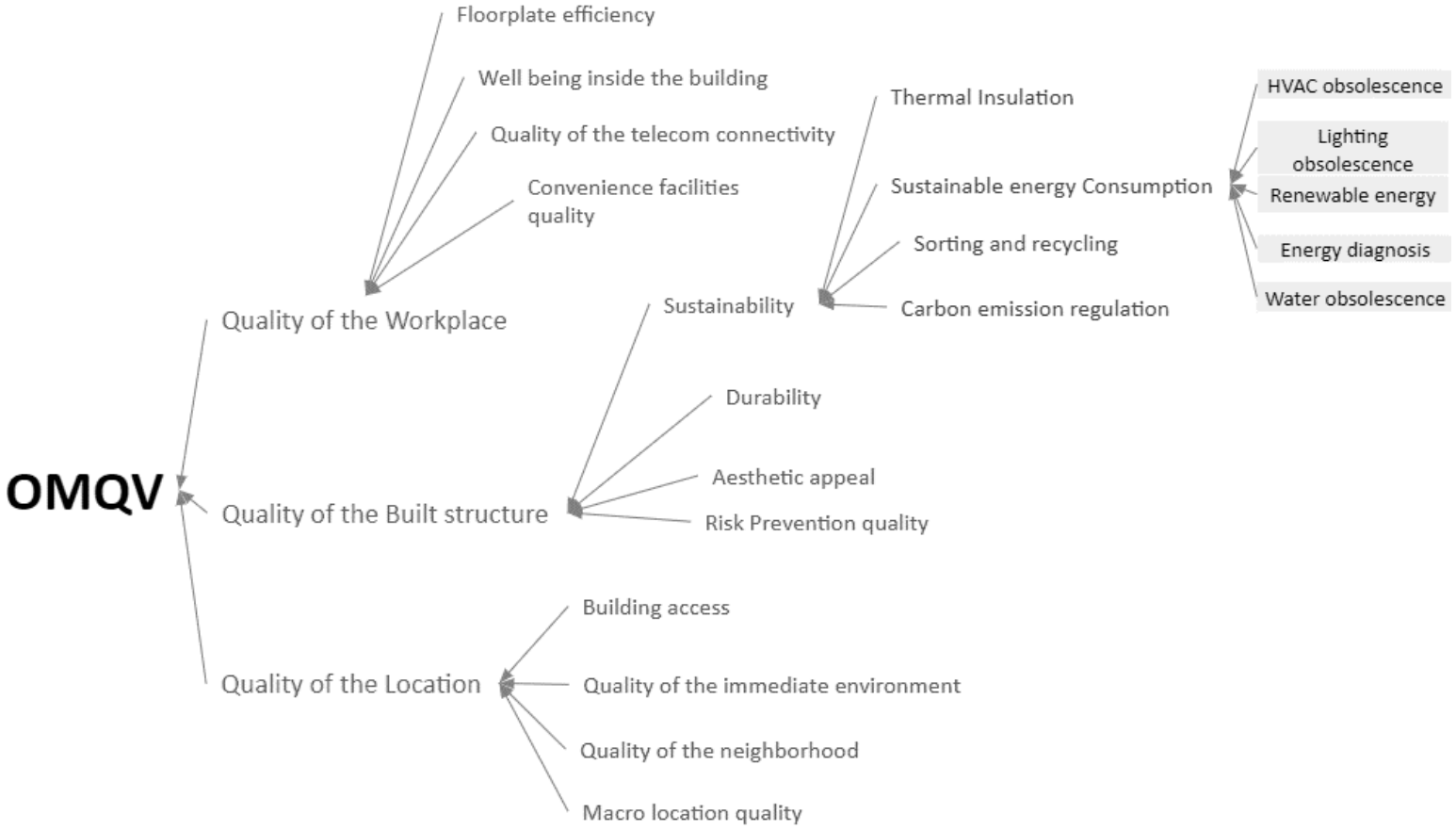
Interviews with asset managers brought us to retain a list of 160 characteristics and to organize it with a tree. This work resulted in 3 levels of composition: the global quality is first decomposed in three dimensions: workplace, built structure and location. Each dimension consists in 3 to 5 sub-dimensions for a total of 12 sub-dimensions (or expected functions). In the same way, each sub-dimension refers

to several components (50 components equivalent to benefits) that are themselves structured via 160 characteristics.

At the end of this stage, a tree of representation was built and pre-tested with professionals. This process allowed us to test the characteristics that made sense to a manager and to exploit this sense with another manager. The lower level of the characteristics relate to "objective" elements and more "subjective" assessments, whereas the upper level (components, sub-dimensions and dimensions) intend to capture judgments

Figure 1 represents the tree structure, when OMQV is the acronym of “Objectivized Market Quality Value” (equal to the value of an asset view from real estate stakeholders). In appendix we show all the components of the data model.

Figure 1. Tree structure of the building data model



ii. *Methodology and outcome for the subjective norms*

The next phase is to identify the subjective standards integrated by the real estate actors. For this, we recruited a panel of 140 professionals and sent them a questionnaire via qualtrics. For each level N respondents judged on a Likert scale (from important to priority) the importance of its constituents For instance, to estimate the overall quality of a real estate asset, Panel members identify location as the main element (46.11%), then the quality of the workspace (25.62%) and finally the quality of the building (26.64%). Similar results are obtained for the link between dimensions and sub-dimensions, and for the link between sub-dimensions and components.

The retained weights consist in the averages of the responses. Responses are given 'in general' (not for a specific building), and the questionnaire is descending (from the global quality to the components)

iii. *Methodology and outcome for the attitude toward a specific property*

In order to estimate the weight that the actors actually give to each elements when they analyze a specific building, we proceed in several steps.

- Building a set of fictitious buildings: Thanks to a partnership with an investor we accessed to 20 real buildings described by their 160 characteristics. From these real buildings, a hundred fictitious buildings were generated For each simulated building, a report of fifteen pages that describe in a pedagogical way the building, is produced.
- Administration of the questionnaire: Each simulated building was evaluated by the Panel members. The evaluators had to read the description of the building and then to answer the questions via the qualtrics software. In front of each case, respondents had to estimate on a 7-point scale (from very bad to very good) all the measures identified in the pre-requisite phases (overall quality, dimensions, sub-dimensions, components) from the modalities of characteristics of the building.
- Estimation of the weights; The weights of each element of a level (N-1) in the upper level (N) are obtained using regression methods .

For this phase, responses are given for a specific building (and not 'in general') and the process is ascending (from the characteristics and the components to the global quality estimation).

iv. Construction of a quality score for each building

The objective of the econometric analysis is then to estimate the weights of each N-1 level to form the N level, for example to estimate the weights of the workspace, the built structure and the location in order to assess the overall quality evaluation. Thus, at each level, the level N is expressed as a linear function of its level N-1 factors: for example, the evaluation of a component is expressed as a linear function of the characteristics. The coefficients in component's function represent the implicit weights of each of its underlying characteristics. Those implied weights are determined using a hedonic approach and the OLS methodology.

The construction of a quality score requires the definition of weights using a composition rule based on the two types of evaluation. In the literature, compositions vary according to the objectives and the situations to be evaluated.

Azjen et al. (2011) have empirically estimated the weights of attitudes on the one hand and of subjective norms on the other in adopting a particular behavioral intent (saving energy, drinking alcohol, and going in a mosque) and have found a weight of .55 for attitudes and .13 for subjective norms. This result being related to daily consumption products and not directly transposable to our research.

We built the two score of global quality, the first based on the first questionnaire, the second on the second. We then obtained two measures of quality, called Q1 from the subjective norms, et Q2 from concrete attitudes. On a database of 70 buildings rated in France with the two methods, we explained the exchange value, operationalized as the Open Market Rental Value (OMRV) by the specific valuations of Q1 and Q2. Results from the OLS regression show standardized Betas of 1.353*** for Q1 (51.8%) and 1.257*** for Q2 (48.2%).

The final score of the "reasoned valuation" of the building, called "Quality", is then calculated along with this rule of weights.

3. The Parisian case study

a. The office market of the Parisian metropole

i. *The European office markets*

In 2018 the take-up[1] in the Parisian metropole reached 2 500 000 sqm) making it the first European office market, as for the investment volume that reaches nearly 20 billion euros. The premium rent in the Central Business District is almost €860/sqm/year and the rental return equals 3%.

Regarding the vacancy rate, it is the Berlin market that presents the lowest level with 1.7%. This situation of low vacancy rate is often relevant in the others German metropolises (Munich, 2.3%).

Table 1 : The ten main office markets in Europe[2]

Rank	City	Take-up (sqm) (2018)	Office investment (2018)	Vacancy Rate (2018)	Net prime rental return (2018)
1	Central Paris	2 541 900	18 849 340 000 €	5,50%	5,25%
2	Central London	1 400 461	15 654 100 000 €	5,00%	4,75%
3	Frankfurt	678 000	8 387 780 000 €	7,40%	3,50%
4	Munich	975 000	4 266 880 000 €	2,30%	4,75%
5	Berlin	831 000	4 234 530 000 €	1,70%	4,00%
6	Hambourg	563 000	3 065 400 000 €	4,50%	3,50%
7	Amsterdam	381 077	2 253 080 000 €	7,20%	4,70%
8	Stockholm	185 000	2 106 800 000 €	5,00%	6,50%
9	Milan	389 530	2 068 300 000 €	10,60%	2,90%
10	Brussels	361 423	1 964 160 000 €	7,90%	4,00%

ii. An historic perspective

In the center of Paris more than 80% of the office spaces were built before 1939. For the historical central business district, (8th district, north-west of the Parisian center) this rate equals 60% The development of the 15th, 16th and 17th districts took place after the war. Since , most of the new office areas are located outside of the Parisian administrative limits.

In Paris, the « triangle d'or » is the center of the central business district. Its prestige is build from a long past history that dates back to the time when the Parisian bourgeois left the District of the « place des Vosges » to join the 8th arrondissement, after 1848 (Revolution of « February »). This district which brings the wealthy families of Paris, the big luxury houses also brings the business center of Paris. Nowadays, this central district comprises the most important employment centre in the Paris metropolitan area. At the same time the Palais Brogniart was erected for the stock exchange of Paris. In general the central business district of Paris brings the 1st, 2nd, 8th, 9th, 16th and 17th arrondissement.

[1] Take-up, as it defined here represents the cumulated floorspace of all new lettings or sales to occupiers. It is expressed in square meters (sqm) of usable floorspace.

[2] According to the BNP Paribas, European Real Estate Market study (2018)

A second business district (La Défense) was developed during the sixties. When the « Defense » district was erected, it quickly became the headquarter of the most powerful companies in France, the same ones found in the CAC40 index. The reason is since up to the 70 the local choice to set up a company was essentially its proximity to other actors. This cluster grouping thus providing easier circulation of information, symbol of the power of the business of the time

During the years 70 the Office Park has developed in the region, notably in the Hauts-de-Seine and Seine-Saint-Denis. Indeed, if the average surface is 3 400 sqm in 1939, it is 6 200 sqm in 1980 to reach 11 000 sqm in 2000 (for new constructions).

iii. Spatial organization of the Parisian office market [3]

Île-de-France region is a territory that concentrates nearly 12 millions of inhabitants on an area of about 12 000 km² , it corresponds to 20% of the French population within a territory that represents 2.8%. Inner Paris, is populated by 2,220,000 inhabitants on an area of 105 km² whereas the Parisian agglomeration gathers 212 cities. Paris is the first world tourist destination (with 21.2 million tourists in 2016) and it regularly hosts major international events (such as the future Olympics of 2024, the clime conference COP21...) It is also at the center of European and international communication networks. The Parisian metropole GDP equals 612 billion euros. The real estate Park has 450 business development zones. In the Paris market, 53% of jobs are exercised in offices, for a total surface of 44 650 000 sqm.

The only business districts accommodate 25 380 000 sqm which are spread over the territory. The metropolis accounts numerous business districts, such as the Central Business District (8th distric) with 7 500 000 sqm, La défense for 4 700 000 sqm, Boulogne/Issy/Balard for 2 400 000 sqm and Saint-Denis/Pleyel for 1 000 000 sqm. The rest of the offices sqm are located in the other business zones. Although the metropolis has developed around a central point, many non-central business districts exists. The Parisian center is intensely connected to public transport . The ongoing 'Great Paris' development project aims to reinforce the existing polarities, while accompanying the emergence of new polarities .

In order to analyze the geography of building quality in the Parisian metropolis we use the Immostat spatial segmentation[4].

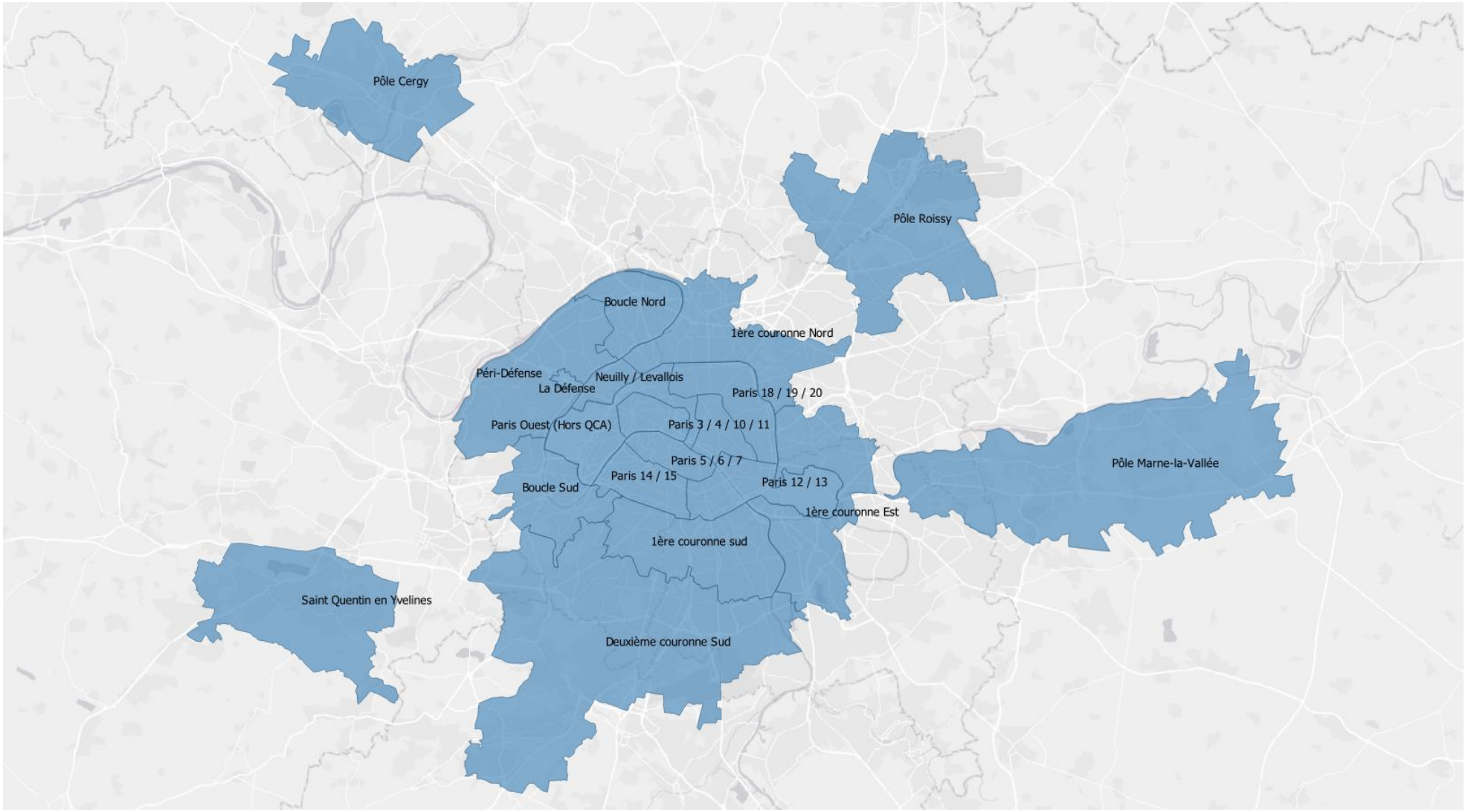
This segmentation is composed of 5 main areas, 8 sectors and 21 sub-sectors. The latter are as follows:

- Zone Paris Ouest, grouping the Paris QCA and the rest of Paris Ouest,
- Zone rest of Paris, grouping Paris Sud and Paris Nord Est,
- West Crescent area, comprising La Défense and the West Crescent,
- Zone first ring, grouping the first Crown North, East and South,
- Second ring zone, regrouping the second South Crown, the new cities of St Quentin, the new cities Marne-la-Vallée, the Pôle de Roissy, the new towns of Cergy, and the "remainder" of the second Crown (figure 2 below).

[3] Metrics from APUR and IAU-IdF studies (urban planning agencies)

[4]The main companies of the Parisian real estate market the GIE Immostat. This Company purpose to collect and structure market datas and build indicators. The actors that make up this structure (brokers, investors, experts) have proposed a segmentation of the Parisian market which gives rise to a map which is broadly consensus in the real estate professions.

Figure 2. Office markets as they are perceived by brokers and valuers in the Paris office markets



Basemap : Open Street Map (OSM) Light grey

b. The building sample

i. Descriptive statistics

The above methodology was implemented within a research project with the society RQR (Real Quality Rating. We evaluated the perceived quality of a sample of 90 office buildings. These buildings are held by investment funds, insurance funds, French REIT and funds) and are located in the Île-de-France region.

The global perceived quality score can be split into a perceived building score and a perceived location score. The building score (the association of the "Shelter" and "workspace" dimensions) as well as the location score are rated between 0 and 20. The average building score is about 13/20 in the sample, while the average location score is 12.3/20. It should be noted that the majority of the assets are located in Paris and its first periphery (77 of the 90 assets).

The average building surface equals 11 000 sqm, for an expertise value of almost 86 000 000 €. The total building wealth studied reaches 7 billion euros for more than 1 million sqm. The average market value is 7 369 €/sqm, whereas the average rent equals to €404/sqm/year with a range from 113 to €840/sqm/year. In the great majority buildings are entirely owned. The quality of the data collection for the 140 characteristics required to estimate the building quality[5]. The average rate of collect is about 92% (the minimum is 0% of data missing).

Geographically, the average distance of the buildings to the center of the central business district is 5,5km. 26% (23/90) of the buildings are located in the CBD. The farthest building is at 23 km

The global range of quality score is started from 400 points (/1 000) to 900 points. The median is 634 points and the standard deviation of the score is approximately 84 points. When we take a look to the quality of the buildings (which includes the quality of the building structure and the quality of the Interior fittings) varies between about 7.6 points (/20) and about 18 points (with a median at 13 points and standard deviation of 2 points). This two score show us that the building sample seems to have a good level of quality. Finally, the notes on the quality of the location are a little bit below to the building quality. They are including between about 7 points and about 18 points. The median is 12 points. The standard deviation is approximately 2.5 points.

None of these variables present important abnormalities (the asymmetry coefficient being relatively small; between-. 161 and. 159 for the skewness) it will not be necessary for the continuation of the tests to operate at of transformations.

[5] When the data is missing we proceed to give the worst level to the characteristic.

Table 2. Description of the building sample

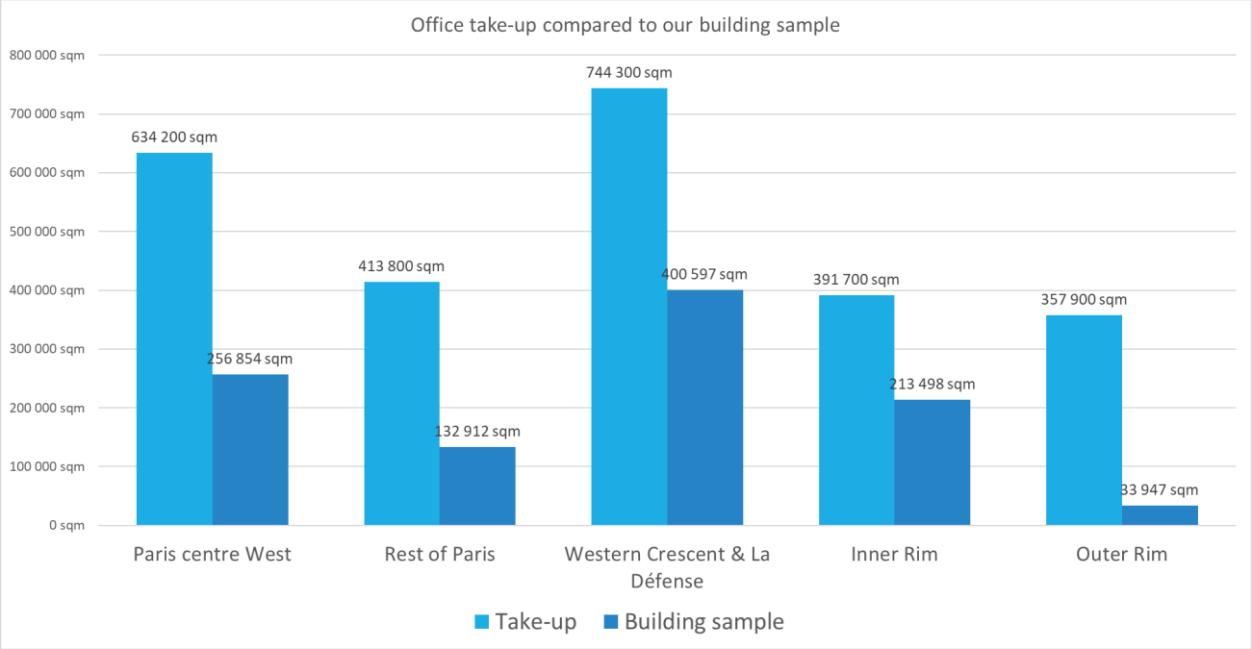
Descriptive Statistics

	Description	N	Minimum	Maximum	Mean	Std. Deviation
SURF_IMM_M2	Surface of the building in square meters (SQM)	90,00	804,08	70840,00	11613,13	12504,78
CAPITAL_VALUE_EUROS	Sum of the Capital value (CV) in euros of the building	81,00	1288668,23	740000000,00	85680791,74	123612707,60
CAPITAL_VALUE_EUROS_M2	CV in euros of the building per SQM	81,00	,00	18732,53	7369,05	4286,19
VLM_E_M2_AN	Open Market Rental Value (OMRV) per SQM per year	90,00	113,00	840,00	404,90	151,36
DISTANCE_QCA_CENTER	Distance to the center of the Paris CBD	90,00	279,61	23473,35	5855,27	5596,05
NOTE_QUALITY	Quality score	90,00	403,84	897,30	638,63	84,61
NOTE_BUILDING	Building score (merge of workplace and shelter quality)	90,00	7,58	18,22	13,02	1,99
DIM_QUALITY_OF_THE_WORKPLACE	Worplace score	90,00	8,21	18,16	13,00	2,41
DIM_QUALITY_OF_THE_SHELTER	Shelter score	90,00	7,15	18,25	13,04	2,11
DIM_LOCATION	Location score	90,00	6,98	17,88	12,29	2,64
MISSING_DATA	Share (%) of missing information	88,00	,00	0,27	0,08	0,06

ii. *Sample location*

The following diagram shows the distribution of our sample (in sqm) in relation to the take-up distribution in the île-de-France region (2018).

Figure 3. distribution of the building sample to the take-up in the Île-de-France area



Note that the coverage of our sample is more than 50% for the West Crescent and the first ring The cover for the second ring is relatively low with only 9%.

4. Building quality and business centrality

a. What is a Central Business District?

Paul Claval (2000), re-analyzing the central places theory of Christaller (1933)) as a system of communication networks, reminds us that a location presents a high centrality degree when it allows gathering inhabitants at low cost. If the distance to the concentrated activities growth and the transport costs increases, an agent is no longer in a situation of maximal centrality. At the point where the demand is null (Claval, 2000) when the gain, born from the interaction is equivalent to the cost of transport. William Alonso (1964), relying on the principles of the space economy, introduced the idea that land markets are an actor in urban morphology (Bailly, 1973).
The central space would therefore be an "exceptional" spatial "reference" can be perceived as the best location. Crouzet (2001) reminds us that the central space is based on a "limited" total real estate stock.
Centrality is not unique and a center does not always exist . This is what the authors (Alonso, 1964; Bailly, 1973; Claval, 2000; Crouzet 2001; Hussy et al., 1985) are characterised by a single-Centre system and a polycentric system (several centres). The authors also indicate that these centres may have different sizes, urban meshes and networks.

Thus, an agglomeration with a high level of centrality would thus exhibits a "cluster" structure (i.e. groupings of activities and jobs) in a monocentric situation This kind of situation is characterized by the dependence of the peripheral spaces to the Centre (Porter, 1995; Quigley, 1998). On the other hand, if the cluster was proportionally distributed in all points of the urban space then the centrality of the city would be low or very dispersed that is what is characterized in the urban research literature of urban acentrism. Finally, when activities have become concentrated in relation to the Centre and grouped into sub-clusters, the authors will discuss polycentrism (Anas, et al., 1998; Lee, 2006). Polycentrism suggests a hierarchization of spaces around a central space (Fujita, et al., 1999).

The Center in a city is the place where the interactions are strongest (Huriot and Perreur, 1994; Raynaud, 1992). It is in this place that power activities are exercised involving the most skilled and rare jobs (Gaschet and Lacour, 2002). Therefore, centrality in addition of being a physical place is also aunifying functional place capturing the flows of goods, people and information (Gaschet and Lacour, 2002).

Choosing offices in a city for a company is not a random task. Firms tend to retain the most advantageous place to realize their activity (Hartman, 1950). This decision is the result of an arbitrage between minimizing transport costs and maximizing turnover gain (O'Hara, 1977). Although operational planning is a facilitating element in producing offices' area , the office stock in the city center is generally quite stable. This situation generates a competition for space, leading to the emergence of central and privileged districts (traditionally called *Central Business District (CBD))* and others less desirable districts. .
Historically, the creation of the central business district (CBD) is the result of the opportunity to reduce production costs (transportation costs, mutualization of human resources…) and create comparative advantages (informations exchange, cluster of companies with the same business…) such as the flow of information. If the modern city is often polynuclear (Archer & Smith, 2003), the offices' organization tends to be monocentric. The most central areas are regularly the most coveted by companies
Anas, Arnott and small (1998), Galster et al. (2001) and Lee (2006) suggest a measure of centrality (provision of employment in relation to CBD) in which a space can be central or decentralized (all

human resources in a same place or dispersed) and a measure of the size of the cluster (number of enterprises) that can be grouped or dispersed (all offices in a same place or dispersed).

b. Geography of the quality for the Parisian offices

The next maps represent the quality of office buildings. When we look at the overall quality (first map, figure nb. 4) of real estate assets, we find that the buildings benefiting from the highest perceived global quality are located in Paris (inside and outside the CBD), in the second CBD (La Défense) and in the direct south periphery. With an average of 675 points on 1 000, the CBD is the place where the level of quality is the most important. At first sight, the distance to the CBD seems to organize the quality levels in a monocentric structure (correlation of -.501**), however the situation is more complex than it seems.

When we look only at the quality of the built (figure 5) building (its structure and its layout) we surprisingly find lower quality scores in the CBD (12,56/20). Moreover, this map doesn't seem to validate the hypothesis that the building quality follows a radio-concentric gradient around the center of the metropolis (correlation of -.155).

Finally, the third map (figure nb. 5) presents the structure of the quality of the location . With an average of 15.28, the CDB exhibits the higher level. The location quality decreases progressively as one moves away from the center of the metropolis (correlation -.715**) to finish with a location note of on average 8.06 for the farthest submarket.

In the next tests (part c) we will try to highlight the parameters of the quality of the buildings that are impacted by the distance to the center of the metropolis.

Figure 4. Average global quality in the paris office markets *(nb. of observations)*

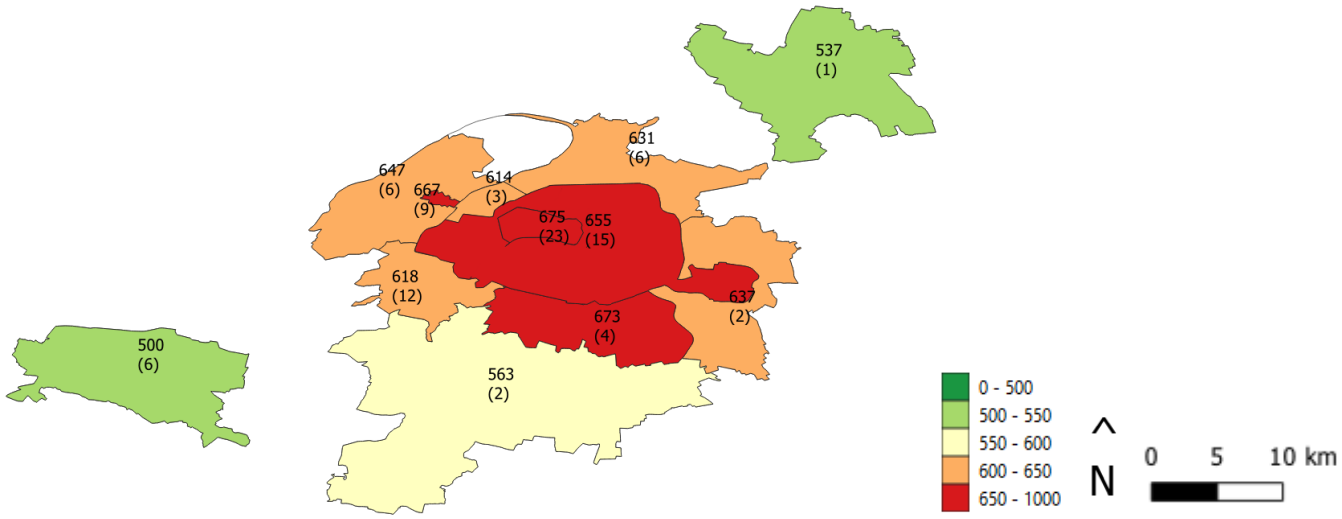


Figure 5. Average building quality in the paris office markets *(nb. of observations)*

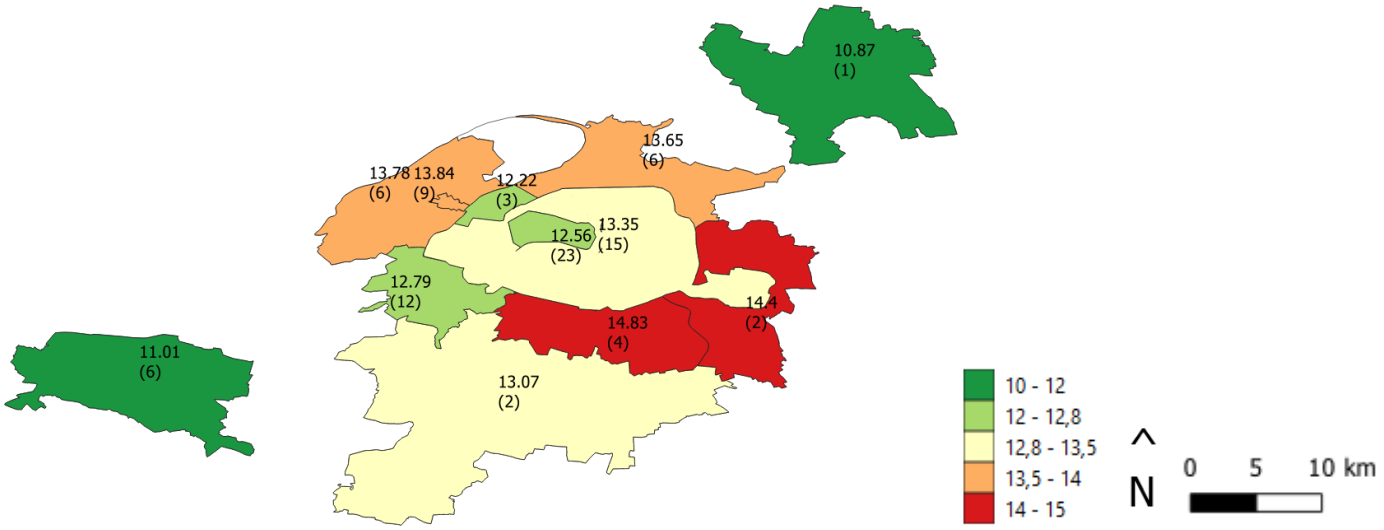
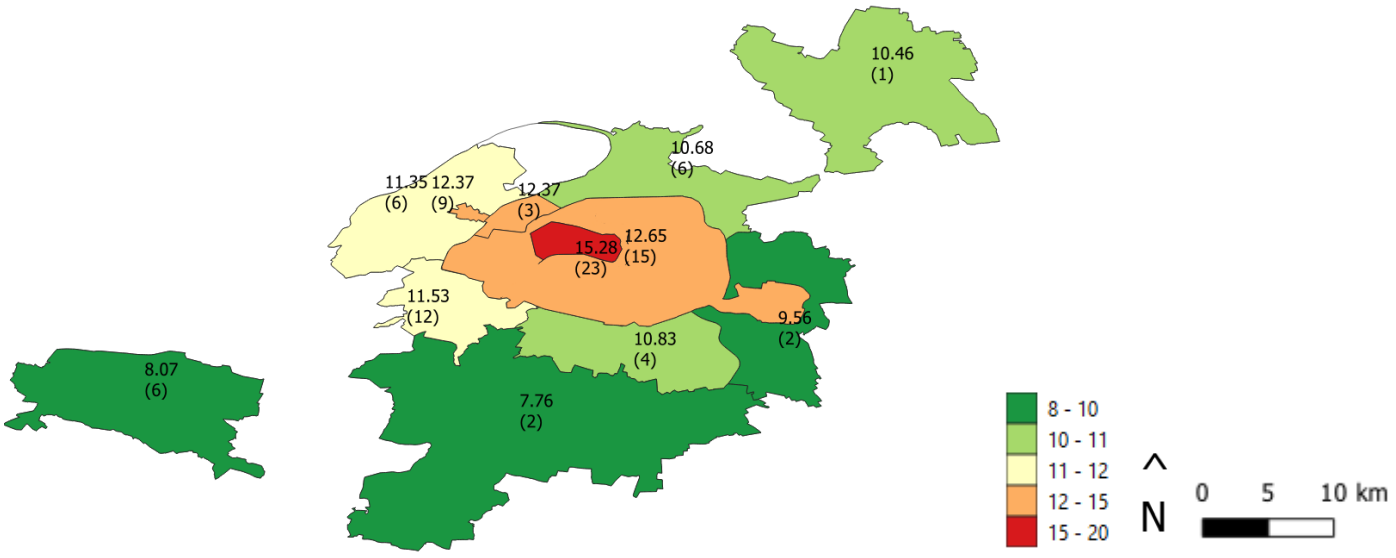


Figure 6. Average location quality in the paris office market *(nb. of observations)*



c. Financial and quality gradients to the CBD

i. The effect of the distance to the CBD over the financial indicators

We know for 80 (90) buildings their capital value per sqm, their yearly rental market value per sqm, and their income returns[6]. In order to better understand the effect of the distance to the CBD over these indicators, we estimated OLS regressions (table nb. 3). For the capital and the rental market values, the fit is better when the endogenous variables are in logarithm, whereas the income return is kept unchanged. This single factor strongly explained the capital and the rental values, with R^2 between 0,6 and 0,7. When the distance to the CBD increases by 1km, the capital value decreases by 8,71% and the rental value by 6,07%. Logically, these unequal gradients generate induces an increase (+0,21%) for the income return for each additional kilometer. However, it should be noted that the distance has a much smaller explaining power for the income return (R^2=0,272). These financial indicators clearly exhibit a monocentric structure.

Table 3. Effect of the distance to the CBD over the financial indicators

	Coefficient	**P-value**	**Gradient**	
Ln(Capital value per square meter) (80 observations)				
Constant	9,28	0,000	Estimated capital value at d = 0	10 768 euros/sqm
Distance to QCA	$- 9{,}12 . 10^{-5}$	0,000	Gradient for 1Km	- 8,71%
	Adjusted R^2: 0,628	*Fisher test:* 0,000		
Ln(Rental market value per square meter) (90 observations)				
Constant	6,29	0,000	Estimated rental market value at d = 0	540 euros/sqm/year
Distance to QCA	$- 6{,}26 . 10^{-5}$	0,000	Gradient for 1Km	- 6,07 %
	Adjusted R^2: 0,699	*Fisher test:* 0,000		
Income return (80 observations)				
Constant	4,95 %	0,000	Estimated income return at d = 0	4,95 %
Distance to QCA	$2{,}08 . 10^{4}$	0,000	Gradient for 1Km	+ 0,21 %
	Adjusted R^2: 0,272	*Fisher test:* 0,000		

ii. The effect of the distance to the CBD over the quality measures

As illustrated in the previous section, the global quality score and the location quality score seem to behave monocentrically, whereas the quality of the workplace and the quality of the built structure don't. Regressions in table 4 corroborate these elements. For the global quality measure each additional kilometer decreases by 8 points (/1000) the score. However, this effect is quite limited and the R^2 for the regression is also small, compared to the R for the financial indicators. As indicated above, this situation is the result of the combination of a non-monocentric situation for the quality of the workplace and the built structure, and a clearly monocentric structure for the quality of the location.

Table 4. effect of the distance to the CBD over the quality measures

	Coefficient	***P-value***	**Gradient for 1 km**
Global Quality - /1000pts			
Constant	683,016	0,000	*- 8 pts / 1000*
Distance to QCA	-0,008	0,000	
	Adjusted R^2: 0,243	*Fisher test :* 0,000	

[6] Capital value divided by rental market value.

Dimension Quality of the workplace - /20pts			
Constant	13,419	0,000	*0 pts / 20*
Distance to QCA	0,000	0,116	
	Adjusted R² : 0,017	*Fisher test :* 0,116	
Dimension Quality of the built structure - /20pts			
Constant	13,302	0,000	*0 pts / 20*
Distance to QCA	0,000	0,268	
	Adjusted R² : 0,003	*Fisher test :* 0,268	
Dimension Quality of the location - /20pts			
Constant	14,264	0,000	*- 0,34 pts/20*
Distance to QCA	-0,00034	0,000	
	Adjusted R² : 0,505	*Fisher test :* 0,000	

Note : 90 observations

In order to better qualify these elements, we tested the effect of the distance over the lower level of the sub-dimensions of the quality (table 5). Regarding the quality of the workplace, the aggregated null effect appears as being composed of two opposite effects: the flexibility of the workplace that increases with the distance, whereas the telecom infrastructure decreases. It has also to be underlined that distance has a poor explaining power, with R^2 lower than 0,10. The components of the built structure do neither present a monocentric structure, except for the aesthetic appeal, but still we a very low R^2. On the other hand and logically, the sub-dimensions of the location are clearly monocentric, with interesting R^2. It is also important to remark that the more central is not always the better, for instance with the well-being around the building that increases with distance.

The assumption of a monocentric structure for the building stock quality cannot be proved with the sub-dimensions level. Five components are not correlated with distance, and two are correlated but with a positive effect. Over the eleven components, there are just four that exhibit a negative gradient, and among these four just two that present convincing R^2.

Table 5. effect of the distance to the CBD over lower level of quality measures

	Coefficient	***P-value***	**Gradient 1km**		***Coefficient***	***P-value***	**Gradient 1km**
DIMENSION WORKPLACE				**DIMENSION BUILT STRUCTURE**			
Flexibility of the workplace				**Aesthetic appeal**			
Constant	13,827	0,000	*+ 0,15 pts*	Constant	11,512	0,000	*- 0,14 pts*
Distance to QCA	0,00015	0,009		Distance to QCA	-0,00014	0,007	
Adjusted R²: 0,066 / Fisher test: 0,009				*Adjusted R²: 0,070 / Fisher test: 0,007*			
Internal environment conditions and their				**Shelter durability**			
Constant	12,529	0,000	*0 pts*	Constant	14,604	0,000	*0 pts*
Distance to QCA	-0,00003	0,726		Distance to QCA	0,00006	0,209	
Adjusted R²: -0,010 / Fisher test: 0,726				*Adjusted R²: 0,007 / Fisher test: 0,209*			
Telecom infrastructure				**Shelter sustainability**			
Constant	10,551	0,000	*- 0,36 pts*	Constant	7,256	0,000	*0 pts*
Distance to QCA	-0,00036	0,001		Distance to QCA	-0,00007	0,266	
Adjusted R²: 0,101 / Fisher test: 0,001				*Adjusted R²: 0,003 / Fisher test: 0,266*			
Convenience facilities				**Risk prevention**			
Constant	9,288	0,000	*0 pts*	Constant	14,394	0,000	*0 pts*
Distance to QCA	-0,00011	0,253		Distance to QCA	-0,00004	0,604	
Adjusted R²: 0,004 / Fisher test: 0,253				*Adjusted R²: -0,008 / Fisher test: 0,604*			

DIMENSION LOCATION							
Building access				**Location standing**			
Constant	16,126	0,000	*- 0,45 pts*	Constant	13,320	0,000	*- 0,48 pts*
Distance to QCA	-0,00045	0,000		Distance to QCA	-0,00048	0,000	
Adjusted R²: 0,714 / Fisher test: 0,000				*Adjusted R²: 0,342 / Fisher test: 0,000*			
Well-being around the building							
Constant	4,233	0,000	*+ 0,19 pts*				
Distance to QCA	0,00019	0,000					
Adjusted R²: 0,462 / Fisher test: 0,000							

Note : 90 observations, sub-dimension / 20pts

d. Do appraisers exclusively rely on centrality?

As liquidity is low in real estate markets, financial indicators are traditionally appraisal-based and it also the case in this article. The clear monocentric structure for the financial indicators compared to the limited, non significant or even opposite monocentric features of the quality measures raises the issue of how appraisers integrate quality in theirs estimations. We explore this question by regressing the financial indicators over the quality measures (table 6). By comparing with table 3, it appears that the global quality measure has a clearly lower explaining power compared to the distance, for each of the three financial indicators. At the level of the dimensions the performance stays smaller in terms of R^2. Appraisers do not seem to integrate in their valuations the quality of the built structure(!) and the quality of workplace is just captured with the income return (but still with a smaller R^2). At last, when we explain the three financial indicators by the eleven quality sub-dimensions, the R^2 laboriously reach the same levels obtained with the single distance. Retaining a level of significance of the 5%, over these 33 factors (3x11), there are only 6 cases where financial indicators integrate the building quality. By excessively relying on a monocentric structure that doesn't clearly exist in the geography of the quality, real estate valuers are today confronted to a new challenge: How could they improve their estimations?

Table 6. regression of the financial indicators over the quality measures

	Capital value/sqm		**Rental market value/sqm**		**Income return**	
	Coefficient	***P-value***	***Coefficient***	***P-value***	***Coefficient***	***P-value***
Explained by the global quality score						
Constante	-8377,459	0,015	-246,602	0,017	12,71%	0,000
Quality score	25,004	0,000	1,020	0,000	-0,00010	0,001
Adjusted R²	*0,214*		*0,318*		*0,118*	
Explained by the dimensions of the score						
Constante	-6811,236	0,026	-230,467	0,010	12,14%	0,000
Quality of the workplace	318,649	0,106	3,147	0,591	-0,00340	0,005
Quality of the built structure	-145,860	0,509	9,151	0,171	0,00192	0,155
Quality of the location	986,717	0,000	38,667	0,000	-0,00329	0,000
Adjusted R²	*0,387*		*0,495*		*0,121*	
Explained by the sub-dimensions of the score						
Constante	-6098,534	0,095	-265,247	0,020	14,29%	0,000
Flexibility of the workplace	-147,327	0,263	-0,681	0,870	0,00052	0,521
Internal environment conditions	204,400	0,086	1,470	0,694	-0,00200	0,008
Telecom infrastructure	114,203	0,112	1,317	0,540	-0,00060	0,177
Aesthetic appeal	208,495	0,189	11,931	0,017	-0,00135	0,171
Shelter durability	-30,179	0,830	3,913	0,346	-0,00045	0,605
Shelter sustainability	-262,439	0,043	-3,001	0,440	0,00094	0,238
Convenience facilities	-15,697	0,869	2,030	0,494	0,00102	0,088
Risk prevention	66,101	0,562	1,185	0,726	-0,00002	0,979
Building access	830,518	0,000	30,406	0,000	-0,00450	0,000
Well-being around the building	-60,424	0,731	-2,399	0,664	0,00021	0,845
Location standing	58,836	0,541	5,151	0,080	0,00067	0,260
Adjusted R²	*0,554*		*0,625*		*0,409*	

Appendix. Components of the office data model

Dimensions	Sub-dimensions	Components
Workspace		
Workspace	Floorplate Efficiency	
Workspace	Floorplate Efficiency	Floorplate modularity and collaborative spaces
Workspace	Floorplate Efficiency	Ability to maximise occupation
Workspace	Floorplate Efficiency	Efficiency of horizontal circulation
Workspace	Floorplate Efficiency	Accessibility
Workspace	Floorplate Efficiency	Efficiency of vertical circulation
Workspace	Well-being inside the building	
Workspace	Well-being inside the building	Individual ambient comfort
Workspace	Well-being inside the building	Individual light comfort
Workspace	Well-being inside the building	Acoustic comfort
Workspace	Well-being inside the building	Internal air quality
Workspace	Well-being inside the building	Centralized technical control
Workspace	Quality of telecom connectivity	
Workspace	Quality of telecom connectivity	Quality of internet connection
Workspace	Quality of telecom connectivity	Telecom infrastructure security
Workspace	Quality of telecom connectivity	Ability to adapt to evolution in connectivity
Workspace	Convenience facilities quality	
Workspace	Convenience facilities quality	Fooding services capacity
Workspace	Convenience facilities quality	Business services capacity
Workspace	Convenience facilities quality	Employees services capacity
Built Structure		
Built Structure	Aesthetical appeal	
Built Structure	Aesthetical appeal	Internal aesthetic
Built Structure	Aesthetical appeal	Quality of the view
Built Structure	Aesthetical appeal	External aesthetic
Built Structure	Aesthetical appeal	Prestige of the building
Built Structure	Durability	
Built Structure	Durability	Building divisibility
Built Structure	Durability	Evolution capacity
Built Structure	Durability	Maintenability
Built Structure	Durability	Convertibility
Built Structure	Durability	Building health
Built Structure	Sustainability	
Built Structure	Sustainability	Thermal insulation
Built Structure	Sustainability	Sustainable energy consumption
Built Structure	Sustainability	Sorting and recycling
Built Structure	Sustainability	Carbon emissions regulation
Built Structure	Prevention quality	
Built Structure	Prevention quality	Business continuity
Built Structure	Prevention quality	Compliance with regulations
Built Structure	Prevention quality	Structural fire protection
Built Structure	Prevention quality	Resistance to natural and anthropic risks
Built Structure	Prevention quality	Cyber risks prevention
Location		
Location	Quality of access to the building	
Location	Quality of access to the building	Proximity to public transports infrastructure
Location	Quality of access to the building	Proximity of resources
Location	Quality of access to the building	Accessibility by car
Location	Quality of access to the building	Proximity to metropolitan center
Location	Quality of the immediate environment	
Location	Quality of the immediate environment	Air quality
Location	Quality of the immediate environment	Safety of the area
Location	Quality of the immediate environment	Peacefulness
Location	Quality of the immediate environment	Security of natural environment
Location	Quality of the immediate environment	Security of technological, industrial and mining environment
Location	Quality of the neighbourhood	
Location	Quality of the neighbourhood	Prestige of the building's location
Location	Quality of the neighbourhood	Stability of competition
Location	Quality of the neighbourhood	Attractiveness of neighbourhood
Location	Macro location quality	
Location	Macro location quality	Size of the office real estate market
Location	Macro location quality	Dynamism of the wider metropolitan area
Location	Macro location quality	Attractiveness of the country

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