The point of departure of the present paper aims to determine whether the analysis made for Paris in 2012 could be extended to several gastronomic capitals all around the world such as New-York, London, Barcelona, Madrid, Florence, Milan, Lyons, Turin, ... And whether there is one or diverse profiles of the gastronomic supply proposed by Michelin in its issue Main cities Europe 2013 and its specific Red Guide for New-York. In fact, are there regularities between these cities? Can we compare them and make appear some common gastronomic guidance? And this even if each gastronomic city is the result of the construction of its gastronomic history through its regional culinary and cultural heritage and presents specificities such as Pubs in London, Tapas in Barcelona and Madrid and so on. What is the structure of the gastronomic supply for the western gastronomy imagine by Michelin? Is there a standard profile of the western world gastronomy?

We use the Red Guide data to compare the main gastronomic cities. Unhappily some very important gastronomic cities cannot be considered. The first one is obviously Tokyo. Tokyo has 16 three stars, 52 two stars and 179 one star establishments for a total number of restaurants of approximately 160.000! This extraordinary number prevent from selecting all the gastronomic establishments (usually around ten per cent of the total number), so the Red Guide for Tokyo gives us only the starred restaurants. Chicago and San Francisco raise other problems as the Guide includes the regional area of these big metropoles (some restaurants are located more than fifty miles from the downtown), that prevent comparison with other cities. Then we use the Michelin data concerning New-York, London, Paris and Lyons, Madrid and Barcelona, Rome, Florence, Milan and Turin, and Berlin, thus eleven cities.

We start by developing a systematic consideration of the descriptive data given by the Red Guide (section 1), that allows us to establish some classifications and segmentations. They are confirmed by a principal component analysis (section 2). It is then possible, through a multiple correspondence analysis (MCA), to study the main profiles underlying the structure of the gastronomic supply in the different cities (section 3). Some concluding remarks follow.

1 Diversity and similarity

When we study the descriptive statistics the first clear observation is the strong diversity of the situations of every city. The idiosyncratic character of gastronomy, related to local culture and to culinary heritage shows on the differences between cities regarding to the size of the gastronomic supply, its composition, prices and quality. For instance, local specialties appear through the selection of pubs in London and of tapas bars in Barcelona and Madrid. Nevertheless we can try to identify different models. The manager of the French Red Guide offers us a new justification when he said, presenting the results for 2014, the starred restaurants are judged by inspectors belonging to different countries, to avoid national tastes and preferences.

We organise the indicators around four main features: the gastronomic weight or power of the city, the structure of supply regarding comfort and amenities, the structure of supply considering the quality of cooking, and the prices.

1.1 The gastronomic weight

The gastronomic weight of a city, which leads to its attractivity, depends on several elements which allow to answer the questions: have consumers a large choice of gastronomic restaurants? within them, have they a large choice of high quality restaurants? is the city specialised in gastronomy?

To measure it we can use seventeen indicators (see table 1, appendices):
1) the gastronomic capitals: Paris, London and New York

They have a big number of restaurants (2); Paris 484, London 392, and NY 896. These gastronomic capitals have a higher ratio of restaurants to total establishments (3), more than 80%; Paris (92%), London (86%), that indicates gastronomy is not a joint product of hospitality but is the main motive of eating. They too exhibit a high density of gastronomy. The number of restaurants for 1 million inhabitants (4) is higher than for other cities: NY 38.4, Paris 38.4, and London 31.5 when the mean for others is 18.8. The number of restaurants for 1 million inhabitants plus tourists (5): NY 25.7, Paris 18.5, and London 13.8 (mean for the others, 7.3). The ratio of selected restaurants on total number of restaurants (10) is higher than in other cities: Paris (4.1%), London (2.4), New York (7.9) against 1.6 for Florence, 1.5 for Madrid and less than 1.4 for Barcelona, Berlin, Milan, Rome, Turin.

Considering the quality of gastronomic supply, they firstly propose a high degree of comfort and amenities. The number of 4 and 5 forks restaurants (6) is 21 for Paris, 14 for London and 12 for New York. They too propose a high quality of cooking. The number of starred restaurants (7) is 81 for Paris, 66 for New York and 49 for London, the number of starred and bistro-ones (8) is, respectively, 153, 192 and 72 (less than 31 for the others); it is also true for the top gastronomy: the number of 2 and 3 stars restaurants (9) is 25 for Paris, 14 for New York and 10 for London (less than 6 for the others). Paris and New York show a high relative quality of cooking, with a big proportion of starred restaurants (the ratio of starred restaurants on total number (11) is 0.68 and 0.58) while London (0.34) offers a more dispersed quality, within restaurants which, nevertheless, succeeding in the Michelin process of selection, can be considered as gastronomic ones (the ratio of starred and bistro-ones, (12) is 1.69 for New York, 1.29 for Paris but 0.44 for London, when the average ratio for the other cities, excluding Lyons and Barcelona, is 0.30). Other indicators of quality corroborate this information: the ratios number of starred restaurants on population (14) and on population and tourists (15) are 6.59 (6.69 starred restaurant for 1 million people) and 3.09 for Paris, 2.83 and 1.89 for New York and 3.94 and 1.72 for London, that shows a quantitatively and qualitatively strong supply of quality of cooking in the Big Three cities.

2) the middle gastronomic cities: Madrid, Berlin, Milan

They have a smaller number of restaurants (2); Madrid 125, Berlin 97, and Milan 77. They also have a smaller ratio restaurants on total establishments (3), less than 80%; Madrid 74%, Berlin 58%, and Milan 65%, that means there are big cities with traditional establishments, without strong gastronomic specificity and attractivity.

They show a smaller density of gastronomy, with a low number of restaurants for 1 million inhabitants (4): Madrid 14.6; Berlin 12.6; and Milan 7.4 and a low number of restaurants for 1 million inhabitants plus tourists (5): Madrid 8.3; Berlin 6.9; and Milan 3.7. The ratio of selected restaurants on total number of restaurants (10) is between 1.03 and 1.53, hugely lesser than the previous group.

Considering the quality of gastronomic supply, they propose a less developed gastronomic niche. The number of 4 and 5 forks restaurants (6) is only 7 for Madrid, 5 for Berlin and 8 for Milan (from 12 to 21 for the Big Three). The number of starred restaurants (7) is around ten (49 to 81 for the first group), the number of starred and bistro-ones (8) around 15 (more than 72), the number of 2 and 3 stars restaurants (9) less than 7. It is the same for the proportion of starred restaurants (10), moreover for the ratio of starred and bistro-ones (12): from 0.23 to 0.33 against more than one for New York and Paris, for the ratios number of starred restaurants on population (14) and on population and tourists (15).

3) the little gastronomic cities: Rome, Florence, Turin

This group has lower indicators which reveal a lower gastronomic attractivity; low number of restaurants (2) (Rome 44; Florence 29; and Turin 25) and of establishments (Rome 61; Florence 48; and Turin 30). For Rome and Florence, a low ratio restaurants on total establishments (3); Rome 72%, Florence 60%, indicates an old structure of gastronomic supply (linked to hotels and, likely, to tourist frequented of cultural heritage but not to gastronomy). It is not true for Turin, probably because tourists are rare.

They have a low density of gastronomy, inferior to that of the second group. Their results are less homogeneous than the first and the second groups. The number of restaurants for 1 million inhabitants (4) and the number of restaurants for 1 million inhabitants plus tourists (5) are low for Rome (10.3 and 4) and Turin (11.1 and 5.9) but not for Florence (32.2 and 10.7); their ratio of selected restaurants on total number of restaurants (10) also low (0.56 and 1.1), except for Florence (1.57).

Considering the quality of gastronomic supply, they propose a little gastronomic niche. The number of 4 and 5 forks restaurants (6) is only 5 for Florence and 2 for Turin but 12 for Rome. The number of starred restaurants (7) and of starred and bistro-ones (8) is low except for Rome (14 and 20), the number of 2 and 3 stars restaurants (9) only from 1 to 3. The proportion of starred restaurants (11) and of starred and bistro-ones (12), the ratios number of starred restaurants on population (14) and on population and tourists (15) are similar to those of the second group.

4) the specialised gastronomic cities: Lyons and Barcelona

Barcelona and Lyons include an important number of restaurants (102 and 77 establishments. 76 and 68 restaurants, just after the Big Three and Madrid). Lyons with 88% of restaurants on the total of establishments (3) reveals its specialisation in gastronomy, also indicated by its reputation (Curnonsky talked about Lyons, « world capital of gastronomy »). It is a small city, in comparison with the capitals, but Lyons owns a strong specialisation in gastronomy with restaurants dedicated to eating and not deriving from the hotels. The ratio (10) selected restaurants on total restaurants is very high, 3.8, close to Paris and higher than London. That also explains its high ratio number of selected restaurants on population and on population and tourists (31.2 and 13.3) and of starred on population (14) and on population and tourists (15): 6.41 and 2.75, close to the Paris scores. The quality of cooking is too very high as indicated by the ratios number of starred restaurants (0.79, the highest within all the cities) and number of stars on restaurants (13): 1.07, also the highest. Barcelona is in a close situation, even if its specialisation appears inferior.

The figure 1 summarises these first results. The gastronomic weight has two main dimensions; an absolute one, which depends on the population of the city, on the number of tourists it can attract and so on, and a relative one which expresses the specialisation in gastronomy of the city, inde-
1.2 The supply structure according to comfort

We are now interested in the study of the supply structure according to comfort and amenities: it is the field of « outside the plate ». This structure is defined by three segments (Barrière, Bonnard, and Chossat, 2014): the elist niche joining the 4 and 5 spoons and forks establishments, the middle segment joining the 2 and 3 spoons and forks establishments, and the low segment (0 and 1 spoon and fork). We use six indicators (see table 2, appendices): the number of 4 and 5 forks and spoons (1), we already used, to represent the absolute size of the elist niche, the number of Red Forks (2) as an associated indicator, the relative size of the first segment (no fork and one fork) (3), the second segment (2+3 forks) (4), and the third segment (4+5 forks) (5), and the average rating of the selected restaurants in the city (6). As we are interested in the type of gastronomic supply, mainly in its relation with the traditional gastronomy often linked to hospitality, we also consider the structure of establishments (i.e. restaurants and hotels with restaurants) according to comfort (7).

1) The gastronomic niche

We already observed that the Big Three offer a quantitatively large gastronomic niche with a strong number of top restaurants according to comfort and amenities: 21 4 and 5 forks for Paris, 12 for New York and 14 for London; 58 Red forks for Paris, 54 for New York and 32 for London. They are far above the other cities, excepted Rome. Nevertheless the group of specialised cities also owns fine restaurants: 14 Red forks in Lyons, 11 4 and 5 forks in Barcelona, more than the second (middle gastronomic cities) and third (little gastronomic cities) groups of the last section.

Nevertheless the relative size of the niche is very different: Paris, New York and London have a big number of top restaurants but they also have a very big total number of restaurants, thus the relative size of their niche is small: 4.3% for Paris, 1.3 for New York and 3.6 for London. If we consider the total number of establishments the relative size is increasing (8.4 for Paris and 8.3 for London). That means that the niche is for an important part composed with hotels offering a top cuisine, as the palaces. That also means that the niche suffers quantitative limits: when the total number of restaurants and hotels with restaurants selected in the Red Guide increase, the niche cannot increase in the same proportion, probably because the outlets for a very expansive gastronomy depends on the population and the number of tourists, only a part of which can pay for the cooking of the niche. Outlets of the niche are more constrained than outlets for the standard and low gastronomic suppliers.

Then the relative size of the niche is bigger for the other cities, excepted Lyons. For Rome (27.3 for restaurants and 34.4 for establishments), Florence (17.2 and 29.2), Milan (16 and 24.7) and Barcelona (14.5 and 22.6) this size is strong. This niche includes a higher proportion of hotels with restaurants than for the other cities, that suggests these old touristic cities own traditional and luxury hotels, more supplying comfort and luxury than sophisticated and original cooking, or, as in the case of Barcelona, join old and new gastronomy.

2) The low segment

Let us now consider the low segment. Three groups can be distinguished:

- a) Paris and Lyons have very important low segments, more than 50% (Paris, 58.5% and Lyons 58.8% of the restaurants, 53.8 and 52 of the establishments), Barrière, Bonnard and Chossat (2014) explained this situation by the changes introduced in 1990 in the French gastronomy with the development of a more democratic cuisine, standing aloof from the elist model of the traditional French gastronomy.
- b) New York (48.1%), Berlin (44.6 and 28.9), Madrid (40.2 and 30.4), London (39.3 and 33.8), constitute the second group, the cities with a strong low segment.
- c) Barcelona (28.9 and 21.6), Florence (27.6 and 18.8), Milan (24 and 15.6), Rome (18.2 and 13.1) and Turin (12 and 10) constitute the group which has a small low segment.

3) The middle segment

Its size derives from the two previous ones. The situation of Turin is exceptional with a very high middle segment (80%), but the low segment is very small (only 12% of restaurants and 10% of establishments) and the number of restaurants is small (25 restaurants, 30 establishments). Almost all cities have a strong and similar middle segment. Milan, London, Barcelona, Florence, Rome, Madrid and New York have a middle segment which represents between 50 and 60% of the restaurants. Berlin has a lower ratio (46.4), Paris and Lyons a hugely lower (37.2 and 36.8).

These results define four different situations (fig. 2). Paris, New York, London and Lyons have a very large scope of segments. Even if they propose an elist gastronomy they also propose a ‘democratic’ gastronomy, with a standard comfort. Berlin and Madrid also offer a large choice of different segments but the weight of elist gastronomy is more important in comparison with the previous group. Rome, Florence, Milan and Barcelona have a more elitist structure of gastronomy, with low segment and a proportionally strong elitist segment. Turin has a specific situation with a very strong middle component.

Figure 2 The different segments
Paris, Lyons, New York and London keep the same characteristics (London has a bit smaller low segment and a bigger middle segment). The traditional character of the gastronomy supplied in Berlin and Madrid appears more clearly: the proportion of elitist gastronomy, the upper segment, increases when we join the consideration of hotels with restaurants, a symbol of the old traditional gastronomy. Berlin and Madrid become nearer the traditional gastronomies of Rome, Florence, Milan and Barcelona; nevertheless they have a more important low segment than the others cities, that indicates a form of development of democratic gastronomy.

If we consider the average level of comfort, the indicator (6) shows that the main difference sets between, on one hand, the first and the second group, Big gastronomic cities and Lyons, plus Madrid and Berlin, which have a large or medium scope according to comfort, so a large low segment given a lower average ratio (1.63 for Paris, 1.59 for New York, 1.8 for London, 1.63 for Lyons, a 1.73 for Madrid and 1.84 for Berlin) and, on the other, the old cities without strong gastronomic reputation, which show an upper average level (2.24 for Milan, 2.45 for Florence, 2.73 for Rome, and 2.4 for Turin); Barcelona is between both groups with a ratio of 2.

We can summarise these results in the figure 3 by focusing on two main dimensions of the supply structure according to comfort. The first is the average level of comfort, the second is the average scope of the supply according to comfort. Three groups emerge: the cities with a highly diversified gastronomy (Paris, New York, London and Lyons), the cities with a medium diversification (Madrid and Berlin) and the cities centred on the elitist gastronomy, with a low diversification (Rome, Florence, Milan and Turin). Barcelona is apart, with a low diversification but a low average level of comfort.

**Figure 4 The structure comfort**
1.3 The supply structure according to quality of cuisine

We are coming to a new field, that is « inside the plate ». As the Red Guide selects around ten per cent of the existing establishments all them offer a gastronomic quality. Nevertheless there is a difference between, standard, high and extra quality. Standard is usually the quality of no starred restaurants; high quality is given by starred restaurants and we name extra quality the top quality, given by the elitist niche, composed by the two and three starred restaurants.

Statistics (see table 3, appendices) teaches us the great difference between the Big Three (Paris, New York, and London) and the other cities according to quality of cooking. As already seen in the point 1.1, there is a strong gap between the number of starred restaurants (2) of The Big Three (Paris: 81, New York: 66, London 49) and the number in the other cities (Barcelona: 21; and less than 15 for the rest). Adding the Bibs to the group of cities supplying high quality (3), this group remains hugely different from the others (more than 70 starred and Bibed restaurants against 31 for the next, Barcelona, 27 for Lyons, 20 for Rome and even lesser for the rest). The first indicator, the number of stars (1), shows the same thing: 61 to 116 stars collected by the Big Three when the others cities own less than 25 stars. This domination is reinforced by the importance of the elitist niche of two and three starred restaurants. Therefore the Big Three have an important advantage for the quality of cuisine, which is not diminished by the consideration of Bibs. The indicator (5) of the total number of awards (stars and Bibs, a Bib being considered as equivalent to 0.5 star) shows that Paris (152), New York (150) and London (72.5) are far from the next cities (30 for Barcelona, 25.5 for Lyons, 21 for Rome and less than twenty for the others).

These observations reveal a size effect. It does not mean that the starred restaurants or, even, the elitist restaurants are more frequent in the Big Three as seen with the indicator (7), the ratio of starred restaurants on the total number of selected restaurants (Paris: 16.7, New York: 7.4, and London: 12.5, against 31.8 for Rome, 28 for Turin, 22 for Milan and 21.4 for Berlin) and by the indicator (8), the ratio of 2 and 3 starred restaurants in the total number of selected restaurants (Paris is seventh on eleven, London and New York are the last) but that their global supply is more large and includes, for a part, a high quality supply. So, the Big Three have simultaneously a high number of starred and awarded restaurants and offer a more diversified quality of cuisine. On the contrary, Barcelona, Rome, Milan, Berlin, Turin and Lyons have a high ratio of starred restaurants. More generally, within the eight other cities, the ratios (9) and (11) concerning starred and awarded (starred+Bibed) restaurants, show very similar situations, the awarded restaurants representing around 30-40% of selected ones, except for Madrid with a lower ratio (only 9.8% starred restaurants and 15.2% awarded restaurants, but we could consider the tapas bars). Even if we introduce the role of elitist niche by weighting the number of awards according to their level – indicators (12) and (13): New York and London are far behind the other cities and Paris is also above. That is corroborated by the values of the average star and of the average award of the gastronomic supply - indicators (16) and (17): Rome (0.41 and 0.48), Barcelona (0.33 and 0.36), Turin (0.32 and 0.36), Berlin (0.29 and 0.34), Lyons (0.28 and 0.38), Milan (0.28 and 0.34), Paris in the seventh position (0.24 and 0.31), Florence (0.21 and 0.31), Madrid (0.16 and 0.19), and at the end London (0.16 and 0.18) and New York (0.14 and 0.17).

The concentration of quality is increasing with the level of extra-quality. If we focus on the elitist niche, the 2 and 3 starred restaurants, Paris is the first with 25 restaurants, owning 60 stars - indicator (9) -; a long way behind, New York proposes 14 restaurants with 35 stars and London 10 with 22 stars, all the others having less than 6 two and three stars establishments - owning less than 13 stars. One more time, the strength of the Big Three in the extra-quality does not show that the relative part of this extra-quality gastronomy is more important than in the other cities. The indicator (8) shows that the relative size of the gastronomic niche is close in Paris, Madrid, Berlin, and Rome, Lyons, Barcelona, between five and seven per cent of selected restaurants and inferior for London and New York. This size effect, and specially the big size of the elitist niche in the Big Three, can be illustrated by the indicators (14) and (15), relating quality of cuisine and population or population and tourists. The Big Three are ahead, with Lyons, a specialised in gastronomy city (Barcelona is a bit above), and Florence (which has numerous Bibs).

Thus, observing quality of cooking reveals the size effect, symbolised in the figure 5 by the horizontal axis, the number of quality restaurants, and the degree of specialisation in quality of cuisine, the vertical axis.

![Figure 5 The quality of cuisine](image)

1.4 Prices

We start by considering the relation between prices and levels of comfort. We can use seventeen indicators (table 4, appendices): the average price of selected restaurants (1), the prices for each city according the comfort (2 to 7), the dispersion of prices relatively to London prices (base 100) for each level of comfort (8 to 12), and the dispersion of prices in a same city between different levels of comfort from 13 to 17.

a) The average level of prices. London and Madrid are characterised by a low average price (41.4 and 43.7), when Barcelona, Lyons and New York have a medium level (47.7, 52.3 and 53) and the others a high level (Turin: 61.1, Paris: 62.7, Milan: 64.9, Berlin: 66.5, Florence: 66.7, Rome: 68.9).
79). It is interesting to observe that the difference between the structures of the supply, according to comfort and to quality of cuisine, does not explain the observed differences in the price structure.

b) The dispersion of prices according to comfort between cities. According to comfort, the relative difference between prices in different cities for the same category is low for the down categories (see indicators 3) and (8), 1 fork: from 33.8 in London to 49.4 in Berlin, as to say from 100 to 146.2; indicators (4) and (9), 2 forks from 42.82 in London to 66.46 in Berlin, 100 to 155.2 but is increasing with the quality of comfort: for the 3 F&S, from 100 to 207 and, for the elitist niche from 100 to 289.6 (4 F&S) and to 272.8 (5 F&S).

c) The dispersion between prices of different levels of comfort in a same city is different when considering the dispersion within low and middle segment and when introducing the elitist niche (4 and 5 F&S). The dispersion between 1, 2 and 3 F&S levels, is very low in London, and Madrid, medium in Barcelona, Rome, Berlin, Florence, Turin, and New York, but already strong in the cases of Paris, Lyons and Milan. The access to the elitist niche is very costly in Paris and Lyons (where the prices of the 5 forks and spoons are extremely high) when it is easier in London, New York, Rome, Madrid, and Florence and medium in Berlin, Milan, Turin, and Barcelona.

We continue by considering the relation between prices and quality of cuisine. The table 5 gathers sixteen indicators: the average price of selected restaurants [1], the absolute prices of awarded restaurants (2 to 6), the dispersion of prices relatively to London prices (base 100) for each level of quality of cuisine (7 to 11), the dispersion between prices of different qualities of cooking in a same city (12 to 16).

If we compare the prices between the different cities for a same level of cuisine we note that the differences are important: with a basis 100 for London, for no awarded restaurants, prices are between 100 and 160 (with an exceptional level of 187.1 for Rome; for Bib restaurants, from 100 up 152). The difference increases with the quality of the cuisine: for one starred restaurants, from 100 up to 211 (188.4 for Rome, 198.4 for Paris and 211.2 for Berlin); for two starred restaurants, from 100 up to 226 (169.2 for Milan, 170.6 for Rome, 200.9 for Lyons, 214.6 for Turin and 226 for Paris); for three starred ones, from 100 up to 220 for Lyons, 272.4 for Florence and 298.6 for Paris. We also observe that high quality cooking (symbolised by one star) is much more expensive in Paris, Rome, Florence, Berlin and that top quality (symbolised by two and three stars) is extremely expensive in Paris, Turin, and Lyons. On the contrary London prices appear as very low in comparison.

If we now consider the dispersion of prices, for a same city, according to levels of quality of cooking, we can clearly identify a first group, the French cities, with a very high dispersion, between the selected but no awarded restaurants and the starred restaurants. And the difference is strongly increasing with the top level, the two and three starred restaurants from 100 (no awarded) to 230 (one star) for Paris and 255 for Lyons, 425 (2 stars) for Paris and 333 for Lyons, and, finally, 492 (3 stars) for Paris and 486 for Lyons. There, accessing the top of the elitist niche (three stars) implies very strong expenses: the average ticket reaches 182 € in Lyons, and 247 in Paris! At opposite case is the situation of London and New York from the point of view of the relation prices-quality of cuisine. The dispersion is much lower, between no awarded and starred restaurants and between no awarded and top level (2 and 3 stars). For the other cities, the elitist niche is so small (less than 7 restaurants with 2 or 3 stars for all them) that the analysis of price dispersion has to be limited to the difference between no awarded and some star restaurants. The dispersion is quite similar, the average price of a one starred restaurant approximatively one and half-twelce the price of no awarded ones, a bit larger for Milan (100 to 211) and a bit smaller for Madrid (100 to 142), far away from the French cities.

The previous statistics gives us indications on two main questions regarding prices: their dispersion, according to comfort and quality of cuisine, their average level. Their values are not strictly connected to the structure of supply according to comfort and to quality of cooking but exhibit some idiosyncratic characteristics. So the composition of the different groups is not the same as previously.
Lyons, one for Barcelona, but also a different combination of the same or, contrarily, of different profiles within each city: Lyons is closer to the first group (the Big Three) than Barcelona, even if it is obviously a smaller city.

- C, the group of small capitals, mainly centered on an old model of gastronomy, a traditional gastronomy. Madrid, Milan, and Berlin. They have a middle gastronomic weight, with a medium number of restaurants and no particular specialization in gastronomy. Madrid and Berlin offer a medium level of average comfort and a medium scope when Milan is above, with a relatively strong elitist niche (high ratio of starred restaurant and high prices, but on the basis of a small number of restaurants and a small low segment). They are similar concerning the quality of cuisine, medium for Milan and low for Madrid. That probably indicates a majority of old gastronomy, mainly organized around luxury restaurants and hotels with restaurants supplying a traditional gastronomy, without specific quality or creativity, a model today undermined.

- D, the last group joining Rome, Florence, and Turin. It has a small gastronomic weight. The number of restaurants supplying a high quality cuisine is small, given the size effect, but their ratio is high. The average level of comfort is high with a smaller scope of comfort. The three cities have a small low segment, that indicates they have not yet developed a democratic and mass-oriented gastronomy but are dependent from an old gastronomic profile, close to elitist gastronomy.

To understand the diversity of gastronomic situations we may suppose that different models can differently organise the relations between comfort, quality of cuisine, prices and gastronomic power, or that each city has a specific combination of different gastronomic profiles, as shown in our previous study of the Parisian gastronomy (Barrière, Bernard, Chossat, 2014). Thus we will try, by the way of MCA, to identify gastronomic profiles in the eleven cities. Before we want to confirm our results by using a Principal Component Analysis.

2 The learnings of PCA

The dataset used covers gastronomic restaurants for the eleven cities signaled above (Paris, Lyons, London, New-York, Barcelona, Madrid, and so on) and listed in the following issues of the Red Guide: France 2013, Main Cities of Europe 2013, New York City 2013. The question here is to determine whether we can establish several groups of cities having inside similar profiles according to the PCA method.

The axes two of the PCA mix quality of cuisine and comfort with the number of restaurants. In details the vertical axe deals with gastronomic quality and comfort. So this axe makes appear the gastronomic power and the comfort and then corroborates the proximity between these two characteristics of restaurants (you cannot have three Michelin stars in a rotten restaurant). For instance, we can see in the same group restaurants with 5 F&S, Red F&S, 1, 2 and 3 stars. Conversely, restaurants from 0 F&S to 3 F&S and Bib restaurants belong to the same other group.

The second axe presents the number of restaurants according to their characteristics of comfort or quality of cuisine and then their representation in each eleven cities that is their weight in each city.

The analysis of these two axes reveals the specificity of the big three: New York, Paris and London. These cities gather a huge number of gastronomic restaurants compared with the other cities. Paris appears as a massive gastronomic city and opposite to NY with a more democratic profile and between these two extremes, there is London less elitist than Paris but upper than New-York. The gastronomic power is in these cities.

From the smaller gastronomic cities, some appear upper than the others. This is the case of Rome, Lyons, Florence and Berlin: the level of comfort is more elevated and the proportion of starred restaurants is also more important. The other cities (Milan, Turin, Barcelona and Madrid) show a more democratic profile with much more restaurants in the bottom of the comfort hierarchy, more Bib notably.

Figure 7 The principal components of gastronomy in 2013

Figure 8. PCA of gastronomy in 2013 [Scatter Plot]

Our PCA explains 89.35% of the total variance. In Illustration 8, 76.93% of inertia is explained by the first axis, and 12.42% is explained by the second axis.
Therefore the PCA confirms the main previous results without substituting them as they were, on some points, more precise. Now we can consider the composition of the supply structure of the different groups that we have obtained. For that we use a MC analysis because this type of data treatment is precisely made to reveal hidden structures lying in a data set.

3 The different profiles

MC analysis gives us six different profiles. In a first time we consider them and in a second one we infer from these results a view of the structure of the gastronomic supply in every observed city.

3.1 Six coherent profiles

The MCA made for the eleven cities show that different profiles coexist within the gastronomic supply. The tables 1 and 2 indicate the common characteristics of the cities (table 1) and their main differences (table 2). We see that every city gathers approximately the same profiles. Six coherent profiles are present:
- (P1) the local restaurant (pubs for London, tapas bar for Barcelona and Madrid, and small plates for New York), with low prices and low comfort;
- (P2) the bib restaurant, without a low comfort (1 F & S), no wine list, no special amenities;
- (P3) the no awarded restaurant, with medium comfort (2 F & S), standard quality of cooking, no special amenities, no wine list;
- (P4) the one starred restaurant, with medium comfort (3 F & S), high quality of cooking, wine list; in some cases these restaurants have too a nice view, in others no
- (P5) the two starred restaurant, with high comfort (4 F & S), very high quality of cooking, wine list; in some cases these restaurants have too a nice view, in others no

On the contrary, the specificities of local gastronomic supplies firstly concern the presence of local cuisines. London, Madrid, Barcelona and New York have local specificities awarded by the Red Guide (pubs, tapas bar, small plates). Nevertheless, beyond local specificities, the profiles are very similar. That means that we succeed in reducing the hugely numerous characteristics of the descriptive analysis (more than seventeen indicators) and of the MCA (sixteen variables with more than forty classes) to only six coherent profiles which constitute the basis of the different structures of the supply in our eleven cities.

The table 1 represents the correspondences and the small differences between the six theoretic profiles and the real profiles in the cities (for instance, in New York, the one starred restaurants have three F&S as the theoretic profile but not necessary a wine list).

<table>
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<tr>
<th>P1: local, low prices, low comfort</th>
<th>P2: Bib, no star, 1F&amp;S, no wine list, no special amenities</th>
<th>P3: no star, 2F&amp;S, standard quality of cooking, no special amenities, no wine list</th>
<th>P4: 1 star, 3 F&amp;S, high quality of cooking, wine list, nice view or not</th>
<th>P5: 2 stars, 4F&amp;S, very high quality of cooking, wine list, nice view or not</th>
<th>P6: 3 stars, 5F&amp;S, very high quality of cooking, wine list, nice view</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paris</td>
<td>1 F No view No wine</td>
<td>2 F No view No wine</td>
<td>3 F Wine</td>
<td>4 F Wine</td>
<td>5 F View Wine</td>
</tr>
<tr>
<td>London</td>
<td>1 F No view No wine</td>
<td>2 F No view No wine</td>
<td>3 F Wine</td>
<td>4 F View Wine</td>
<td>5 F View Wine</td>
</tr>
<tr>
<td>New York</td>
<td>1 F No wine</td>
<td>2 F No wine</td>
<td>3 F No Wine</td>
<td>4 F Wine</td>
<td>5 F Wine</td>
</tr>
<tr>
<td>Lyons</td>
<td>1 F No view No wine</td>
<td>2 F No view No wine</td>
<td>3 F Wine</td>
<td>4 F View Wine</td>
<td>5 F View Wine</td>
</tr>
<tr>
<td>Barcelona</td>
<td>1 F No view No wine</td>
<td>2 F No view No wine</td>
<td>3 F Wine</td>
<td>4 F Wine</td>
<td></td>
</tr>
<tr>
<td>Florence</td>
<td>1 F No view No wine</td>
<td>2 F No view No wine</td>
<td>3 F Wine</td>
<td>4 F Wine</td>
<td>4 and 5 F View Wine</td>
</tr>
<tr>
<td>Rome</td>
<td>1 F No view No wine</td>
<td>2 F No view No wine</td>
<td>3 F Wine</td>
<td>4 F Wine</td>
<td>5 F View Wine</td>
</tr>
<tr>
<td>Milan</td>
<td>1 F No view No wine</td>
<td>2 F No view No wine</td>
<td>3 F Wine</td>
<td>4 F Wine</td>
<td></td>
</tr>
<tr>
<td>Turin</td>
<td>1 F No view No wine</td>
<td>2 F No view No wine</td>
<td>3 F Wine</td>
<td>4 F View Wine</td>
<td></td>
</tr>
<tr>
<td>Madrid</td>
<td>1 F No view No wine</td>
<td>2 F No view No wine</td>
<td>3 F Wine</td>
<td>4 F View Wine</td>
<td></td>
</tr>
<tr>
<td>Berlin</td>
<td>1 F No view No wine</td>
<td>2 F No view No wine</td>
<td>3 F Wine</td>
<td>4 F View Wine</td>
<td></td>
</tr>
</tbody>
</table>

We can observe a very close relation between real and theoretic profiles for the eleven cities. On the contrary, table 2 focuses on the divergences. They mainly concern the question of prices.
Table 2 Theoretic and real profiles: similarities and small differences

<table>
<thead>
<tr>
<th></th>
<th>P1: Local</th>
<th>P2: Bib</th>
<th>P3: 0 star</th>
<th>P4: 1 star</th>
<th>P5: 2 stars</th>
<th>P6: 3 stars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paris</td>
<td>&lt; 50</td>
<td>50-100</td>
<td>No view 100-150</td>
<td>No view &gt; 150</td>
<td>&gt; 150</td>
<td></td>
</tr>
<tr>
<td>London</td>
<td>Pubs</td>
<td>25-45 £</td>
<td>View 45-65 £</td>
<td>View &gt; 65 £</td>
<td>&gt; 65 £</td>
<td></td>
</tr>
<tr>
<td>New York</td>
<td>Small plates</td>
<td>25-50 $</td>
<td>50-75 $</td>
<td>&gt; 75 $</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lyons</td>
<td>&lt; 30</td>
<td>30-50</td>
<td>No view 60-90</td>
<td>View &gt; 90</td>
<td>&gt; 90</td>
<td></td>
</tr>
<tr>
<td>Barcelona</td>
<td>Tapas bar</td>
<td>15-50</td>
<td>View 50-100</td>
<td>View &gt; 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Florence</td>
<td>&lt; 50</td>
<td>50-75</td>
<td>No view 75-100</td>
<td>&gt; 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rome</td>
<td>&lt; 50</td>
<td>50-75</td>
<td>No view 50-75</td>
<td>No view 75-100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milan</td>
<td></td>
<td></td>
<td>View 75-100</td>
<td>View &gt; 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turin</td>
<td>&lt; 50</td>
<td>50-75</td>
<td>No view 75-100</td>
<td>View &gt; 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madrid</td>
<td>Tapas bar</td>
<td>15-50</td>
<td>50-100</td>
<td>&gt; 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Berlin</td>
<td>&lt; 50</td>
<td>50-75</td>
<td>View 75-100</td>
<td>View &gt; 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Then we can use the MCA to define the structure of the supply in the different cities as a specific combination of the six theoretic profiles, prices are set out of the present analysis. The table 3 shows the composition of the different supplies. It indicates the profiles which are present in the supply and some limited observations on their combination.

Table 3 Profiles belonging to the supply

<table>
<thead>
<tr>
<th>City</th>
<th>Profiles</th>
<th>City</th>
<th>Profiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paris</td>
<td>(P2) (P3) (P4) (P5) (P6) large segmentation</td>
<td>Milan</td>
<td>(P2) (P3) (P4) (P5) strong (P4)</td>
</tr>
<tr>
<td>New York</td>
<td>(P1) (P2) (P3) (P4) (P5) (P6) large segmentation</td>
<td>Florence</td>
<td>(P2) (P3) (P4) (P5) strong (P4)</td>
</tr>
<tr>
<td>London</td>
<td>(P1) (P2) (P3) (P4) (P5) (P6) large segmentation</td>
<td>Rome</td>
<td>(P2) (P3) (P4) (P5) (P6) strong (P4)</td>
</tr>
<tr>
<td>Madrid</td>
<td>(P1) (P2) (P3) (P4) (P5) large segmentation</td>
<td>Turin</td>
<td>(P2) (P3) (P4) (P5) strong (P4)</td>
</tr>
<tr>
<td>Berlin</td>
<td>(P2) (P3) (P4) (P5)</td>
<td>Lyons</td>
<td>(P3) (P2) (P4) (P5) (P6) large segmentation</td>
</tr>
<tr>
<td>Barcelona</td>
<td>(P1) (P2) (P3) (P4) (P5) strong (P4)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Paris, London, New York, Lyons and Rome join the five last profiles; Barcelona, Milan, Turin, Madrid and Berlin have the same excepted the most elitist one, the three starred restaurants. Florence has not the profile of two starred restaurants but this of three starred ones.

The MCA gives us three main answers:
1-beyond the apparent diversity of local gastronomies, clearly shown by the descriptive statistics, there are very coherent profiles, which are the basis of gastronomic supplies
2-the different gastronomies make specific combinations of these profiles, according to different factors, mainly their size (the Big Three for instance) and their culinary heritage and reputation
3-independently of these different combinations, the prices are hugely different, even for the same categories, according to the reputation and the location. As already seen, the gastronomies owning a strong reputation (Paris, Lyons, Barcelona) or located in historical sites (the Italian cities) are able to set higher prices.

On this basis we can now define some characteristics of the structure of the gastronomic supply in every observed city.

3.2 Different structures of gastronomic supply

If our cities share the same basic profiles every own combination is specific. It is interesting to precise and compare them. For that we observe, for each city, how many restaurants can be defined as representative of each profile (some are not strictly related to one profile, when they join some characteristics of one profile and some of another, for instance they have 4 or 5 F&S but are not starred). We define thus a structure-type for the gastronomy of the considered city, and we also indicate how many restaurants are included in this structure-type and how many remain out. The figure 9 recapitulates the results.
The relation between the number of restaurants corresponding to the six profiles and the total number of restaurants is given below:

**Table 4 Ratio of restaurants out of the profiles**

<table>
<thead>
<tr>
<th>City</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paris</td>
<td>2.1%</td>
</tr>
<tr>
<td>London</td>
<td>9.2%</td>
</tr>
<tr>
<td>New York</td>
<td>1.7%</td>
</tr>
<tr>
<td>Lyons</td>
<td>0</td>
</tr>
<tr>
<td>Barcelona</td>
<td>9.2%</td>
</tr>
<tr>
<td>Madrid</td>
<td>15.2%</td>
</tr>
<tr>
<td>Berlin</td>
<td>1.8%</td>
</tr>
<tr>
<td>Florence</td>
<td>34.5%</td>
</tr>
<tr>
<td>Milan</td>
<td>10%</td>
</tr>
<tr>
<td>Rome</td>
<td>25%</td>
</tr>
<tr>
<td>Turin</td>
<td>16%</td>
</tr>
</tbody>
</table>

A first interesting point derives from the consideration of the table 4. Its data show that we can distinguish two types of structure. In the majority of them the real structure corresponds to a combination of our six coherent profiles (all the cities with a ratio equal or inferior to ten per cent). In these cities, explaining the structure of the gastronomic supply by ranking restaurants according to six profiles gives a good image of the structure. In some others, it is not true. For Madrid (15.2%), Turin (16%), and moreover Rome (25%) and Florence (34.5) a lot of restaurants combine characteristics which are, in the eight other cities, linked to different profiles. That can be an indication of an "old" gastronomic system, not yet adapted to the modern criteria corresponding to the profiles (and legitimated by the red Guide).

A second point is about the structure-types we observed in the figure 9. Four main learnings can be obtained:

- the elitist profile, corresponding to the profiles 5 and 6 (starred restaurants with 4 and 5 F&S and very high prices), is more frequent in the less developed gastronomic systems than in the most developed. In the cities which have a small gastronomic weight in the sense of 1:1 and in the cities with an old structure as defined above, the part of the profiles 5 and 6 is: Rome, 9; Madrid, 6; Berlin, 7; Milan, 6; Barcelona, 6; Turin, 5; Florence, 5. On the contrary, in the cities that have a strong gastronomic weight, with a developed gastronomy or a specialised gastronomy with strong reputation, the part is small: Lyons and Paris, 4; London, 3; New York, 1. Nevertheless, as the gastronomic weight of these cities is important, their elitist niche is powerful. That may indicate that, in these modern gastronomies, the elitist niche has a strong role for increasing the global reputation of the city but cannot be developed beyond some limits, according to the prices it uses and the derived limits of its outlets.

- the most developed gastronomies developed strong low segments and their development is founded on their extension. The part of profiles P1 and P2 are: Paris and Lyons, 59; New York, 49; London, 43 when their part is: Barcelona, 32; Milan, 27; Rome, 24; Turin, 14. Two exceptions have to be discussed: Madrid and Berlin, with a strong ratio of 47 and 46. According to the other characteristics of these gastronomic systems, already seen, it is difficult to interpret these high va-
lies in the same sense that for the Big Three and Lyons. It rather indicates the importance of old gastronomic supply, with a low level of comfort and quality of cuisine.

- if we join the three high profiles (P4+P5+P6), that means the starred restaurants, we observe that in the modern gastronomies (the Big Three and Lyons) they gather a big number of restaurants but represent a small part of the gastronomic supply: Paris, 15; New York, 7; London, 14; Lyons, 16. On the contrary these ratios are very high for Turin (34) and Rome (42), that is a new indication of the “old” character of these gastronomic supplies and medium (but higher than the first group) for Florence (21), Milan (24), Berlin (18), Barcelona (23). The only exception is Madrid with a low ratio (12) but which has to be rather interpreted as a sign of the old age of this gastronomy (a structure with a strong low quality segment and a relatively strong very high segment, the elitist niche).

- it is curious to observe that the results of Lyons and Paris are very similar, and that their real structure is very close to a strict combination of theoretic profiles. That may signal the existence of a “French model” of gastronomic supply, a model that has inspired the Red Guide and its system of normalisation and legitimation.

4 Concluding remarks

Our analysis is only an exploratory analysis on a less-known field. A lot of precisions and refinements are obviously to make. Nevertheless it shows that gastronomic supplies, even in different countries, belonging to some different culinary and social cultures, reveal some hidden structures. Six different but coherent profiles emerged; their combination is possible as they represent a ranking, which uses many criteria (the Red Guide indicators), but is also coherent. Different combinations, giving a dominant role to different segments, are also emerging. They probably may be related to different models of gastronomy which have today to be studied. Prices also appear to be more dependent on local contexts than the gastronomic characteristics of the supplies and call for next analyses.