Modelling a Centralized Academic Labour Market: Efficiency and Fairness

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Summary. A formalization of the centralized French Academic Labour Market in terms of Multi-Agent System is presented. Extensive simulations are used to investigate typical and possible regimes of the system, supporting a sensitivity analysis of the main parameters of the model, such as the applicative pressure and the preference bias towards local candidates. Based on the calibration of the parameters of the abstract model after the information disclosed from official sources, some positive and normative results are presented. Three prototypical settings are distinguished: the equilibrium setting corresponds to the perfect market case, where each candidate interacts with each University; the *Humanities and Sciences* setting; and the *Law and Management* setting. The differences between the last two settings concern both the applicative pressure (number of candidate per academic position) and the scope of each candidate (interacting with few or many Universities). Counter-intuitive findings, related in particular to the role of the preference biases, are presented and discussed.

1 Introduction

Academic labour markets reflect the historical and cultural specificities of the country under examination [1]. Whereas the US model is based on the direct negotiation between candidates and universities, the French system reflects an egalitarian and centralized tradition, involving global and local filters ("qualification", "auditions", "classement"), followed by a centralized matching process, analogous to the stable marriage algorithm [2].

A major concern, expressed e.g., in the French Senate reports [3], is that the above process might be biased by locality preferences, Universities tending to recruit their PhD students, which might adversely affect both the fairness and the efficiency of the labour market. While the labour market has been analyzed in a sociological [4] or combinatorial optimization [5] perspective, to our best knowledge, both perspectives still remain to be integrated in a comprehensive model, sociologically plausible and operational from an analytical or computational standpoint.

In this paper, a Multi Agent-based model (MA) of the French academic labour market is presented and investigated, taking advantage of the facilities of MA systems to simulate and study multi-step agent-centered processes [6]. Some positive and normative lessons are reported. based on extensive simulations calibrated after empirical data. In particular, a saturation regime is characterized, where efficiency and fairness happen to be antagonistic objectives.

The paper is organized as follows: Section 2 briefly reviews the state of the art and presents the goals of the study. A MA-based model of the French academic labour market is described in section 3. Section 4 relates this model to the empirical data, and proposes some assessment criteria. Section 5 reports on the lessons learned from extensive simulations, interpreting the sensitivity analysis of the main parameters of the model and discussing the possible remedies to the saturation regimes. The paper concludes with some perspectives for further research.

2 Related work and Goal of the study

Universities and academic labour markets can be seen as complex systems [7]. Extreme types of academic labour market are the decentralized American system, on the one hand, and the centralized French system, on the other hand. The former system has been investigated using e.g. Data Mining tools to study the hiring network [8], showing a highly centralized and directed career path toward the best universities. The latter system has been investigated in a sociological perspective by [4], focusing on the cognitive (quality assessment), organizational (team relationships, university organization) and societal (scientific and professional market impacts) aspects of the hiring process.

Centralized labour markets can also be viewed as combinatorial optimization problem, pairing the candidates and the positions. While the algorithm used by the French ministry to compute the actual pairing is unknown, it is essentially the same as the one presented by [5]. Given the preference order of each candidate/University, the algorithm constructs an optimal matching, in the sense that every affectation swap improving the situation of one candidate, would deteriorate the situation of at least another candidate[1]. The setting is "truthful" [9] in the sense that no agent could improve his lot by lying about his preferences. Note however that the above results consider ideal situations, in particular, with infinite numbers of candidates/Universities.

The goal of the study is to investigate the properties of the multi-step negotiation/matching process involved in the French academic labour market, within a bounded rationality perspective (limited number of candidates/Universities, cognitive limitations, preference biases and random noise).

The chosen modelling framework is based on Multi-Agent Systems, with the following rationale. On the one hand, MAS offer convenient simulation environments, amenable to the extensive study of social systems, like ModuleEco [10] and RePast [11], offering implementation, script and visualization facilities.

On the other hand, the main difficulty of the approach is to build an operational and realistic model. Various studies related to social systems have emphasized the flexibility of MAS-based modelling [12, 6]. For instance, [13] and [14] respectively use MAS to simulate stadium evacuation or pedestrian flow. Both propose a model for the agents, the environment and the interactions, and calibrate them using empirical data. They further demonstrate the ability of MAS modelling to sustain positive and normative objectives, respectively explaining emerging phenomena and suggesting/assessing some changes in the interaction rules or in the parameters of the system. For these reasons, a simplified model of the French ALM in terms of Multi-Agent System will be used in this paper.

3 A Centralized Labour Market

This section first briefly describes the French academic labour market, and details the proposed abstraction thereof.

3.1 In Practice

The actual procedure involves a sequence of steps:

1. The would-be candidates send an application file to a central agency, that decides whether the candidate is admissible ("qualification").

[1] While the algorithm gives the priority to the candidate preferences, it is clear that the roles of candidates and Universities are symmetrical during the matching phase.

2. Twice a year, the ministry publishes open positions in French universities.
3. Admissible candidates can apply for these positions; there is no restriction on the number of applications of any candidate.
4. For each position, a jury ("commission de specialistes") decides whether an actual candidate will be interviewed ("auditions").
5. Every candidate decides whether he will pass the interview (e.g. as the interviews for some jobs in the South/the North of France might be scheduled on the same day, the candidate cannot attend both).
6. For each position, the jury produces a shortlist of (at most) 5 persons, subset of the actually interviewed candidates. A candidate in this list is "shortlisted".
7. Candidates are informed about their rank for each position they have applied to, and produce their preference order (among the positions for which they are shortlisted).
8. The ordered preferences of the Universities and candidates are used to automatically compute an effective matching.

3.2 The model

The proposed model involves two types of agents, the candidates C_i and the Universities U_j. A simplifying assumption (supported by the empirical evidence on average) is that each University offers a single position. Furthermore, the rest of the paper uses as working hypothesis the existence of a total order on the candidates, on the one hand, and on the Universities, on the other hand. The rank of candidate C_i (University U_j) is respectively noted $\rho(C_i)$ (resp. $\rho(U_j)$) or $\rho(i)$, $\rho(j)$ when no ambiguity arises. The spatialization of the candidates and the Universities is modelled through a distance matrix $d(C_i, U_j)$, meant as the distance between U_j and the University where C_i passed his PhD, referred to as *home University*.

Candidate agent

Candidate C_i is characterized from i) his global rank $\rho(i)$; ii) his "elitism" e_i or bias toward the best universities; iii) his locality ℓ_i, or bias toward the universities nearest to his home University; iv) his degree of subjectivity s_i, modelled as the weight of a random variable V, uniformly drawn in $[0, 1]$; v) his risk-taking orientation r_i; vi) the number N_i of positions he will applied to; vii) the probability h_i of applying to his home University.

These characteristics together determine his personal ranking of the Universities[2]:

$$P(C_i, U_j) = \mathrm{e}_i \times \frac{\rho(j)}{\#U} + \ell_i \times d(C_i, U_j) + \mathrm{s}_i V$$

Based on this preference order, C_i must first decide the positions ($\equiv$ the Universities) he will apply to. This decision depends on whether C_i is risk-adverse or risk-taker, modelled through risk parameter r_i:

$$S(C_i, U_j) = r_i P(C_i, U_j) + (1 - r_i) \times \frac{|\rho(i) - \rho(j)|}{\#C} \tag{1}$$

A risk-adverse candidate C_i will discard the Universities deemed too good (or too bad) to match his own status. Risk-taker C_i will instead consider his personal preference order only. The normalization by the number $\#C$ of candidates and the number $\#U$ of universities ensures that both terms vary in $[0, 1]$.

Finally, C_i applies to the first N_i Universities after order $S(C_i, U_j)$; additionally, with probability h_i, C_i will apply to his home University.

Universities and positions

As mentioned earlier on, each University offers a single job; no distinction is thus made between positions and Universities. University U_j is characterized by i) its rank $\rho(j)$; ii) its "elitism" e_j, or bias toward the best candidates; iii) its locality ℓ_j, or bias toward local candidates; iv) its degree of subjectivity s_j (modelled as the weight of a random variable V uniformly drawn in [0,1]); v) its risk-taking orientation r_j; vi) the number N_j of candidates it will interview, uniformly selected in some $[a, b]$ interval depending on the setting considered (section 4); vii) its strategy h_j toward local candidates.

The main difference between the preferences of Universities and candidates regards the locality bias. In Eq. (1), the local bias of candidate C_i toward University U_j is expressed additively as term $\ell_i d(C_i, U_j)$; the local bias of University U_j is instead expressed multiplicatively:

$$P(U_j, C_i) = \begin{cases} (\mathrm{e}_j \times \frac{\rho(i)}{\#C} + \mathrm{s}_j V) \times \ell_j & \text{if } C_i \text{ is local, } d(C_i, U_j) = 0 \\ \mathrm{e}_j \times \frac{\rho(i)}{\#C} + \mathrm{s}_j V & \text{otherwise} \end{cases}$$

[2] Note that term $\mathrm{s}_i V$ could as well model the cognitive impairment of the candidate, e.g. under/over estimating the University ranks.

Based on its preference order, U_j likewise decides which candidates will be interviewed (among candidates applying to U_j), filtered through its risk-taking orientation, where $\#C$ indicates the number of candidates:

$$S(U_j, C_i) = r_j \times P(U_j, C_i) + (1 - r_j) \times \frac{|\rho(j) - \rho(i)|}{\#C} \quad (2)$$

U_j will interview the N_j first candidates after order $S(U_j, C_i)$; independently, local candidates will be interviewed with probability h_j.

Interaction rules

Every candidate C_i applies for the N_i job positions selected, N_i being uniformly selected in $[1, MaxApplication]$ interval depending on the setting considered (section 4); every University U_j ranks the applicants and interviews the first N_j of them, N_j being bounded by some global threshold *MaxInterviews*, depending on the setting. Universities thereafter produces a shortlist of (at most) *MaxShortList* candidates. Candidates thereafter disclose their preferences among the Universities where they appear on the shortlist. Eventually, the preferences of candidates and Universities are processed by a combinatorial optimization algorithm [5] to produce a global matching.

4 Experimental setting

Our model was implemented using the RePast framework [11]. The ground truth is described in section 4.1 and used to calibrate the parameters of the model. Observed variables are discussed in section 4.2 and section 4.3 describes the goal of the experiments.

4.1 Ground truth and Parameter Calibration

Universities are uniformly distributed in a rectangular 2D domain. Home university of candidates are uniformly distributed among universities.

Other quantitative parameters values are calibrated after empirical data published by the French ministry [15]. The positions are labelled after their scientific disciplines (57), which are regrouped into three fields: Law, Economics & Management (L&M), Literature & Humanities (H) and Sciences (S) (see Tab. 2 of App. A).

Empirical data show that the first field (L&M) significantly differs from the other two e.g. regarding the average number of applications of candidates (above 25 in L&M vs less than 10 in other fields) and selection pressure (2 admissible candidates for 1 position in L&M vs 4 in other fields). Accordingly, three typical situations (modeled after three parameter settings) have been modelled and investigated in our simulations (Table 1):

- The **perfect** market setting is when every candidate applies in every university, and every university interviews every candidate. Elitism is set to 1 and both universities and candidates are risk taker (risk is set to 1). A "mild" perfect market setting (**perfect50rdm**) differs from the above as the elitism parameter is set to 0.5 and the subjective (random) factor is set to 0.5.
- The **H&S** setting reflects the empirical data with #U =50, #C=200 and $MaxApplication$=20. Preference parameters were inspired from statistical studies reporting a high bias toward the quality**??**. Simulations showed a posteriori a good agreement with the observed variables (see below), and the good stability of the model wrt the parameter values in the considered ranges.
- The **L&M** setting only differs from the **H&S** setting in the number of candidates (100) and maximum number of applications (50).

Each result for the parameter sensibility analysis is the average over 200 simulations with same deterministic parameter values and independent stochastic parameter values.

For the sake of robustness, some agent parameters are defined as random uniform variables; notation $U[a;b]$ indicates that a random variable uniformly selected in interval $[a,b]$.

4.2 Observed variables

The choice of the observed variables was guided after two criteria: the fact that the information has to be officially disclosed for validation purpose, and its relevance to assess qualitatively and quantitatively the global efficiency of the ALM.

The first two variables are the number of positions fulfilled (*RecruitmentRate*) and the number of positions fulfilled by local candidates (*LocalRecruitmentRate*). On the one hand these observations are officially disclosed at the discipline level; on the other hand *RecruitmentRate* definitely characterizes the efficiency of the hiring process, and *RecruitmentRate* corresponds to a very controversial qualitative aspect. The ALM can actually be viewed as a multi-objective optimization problem; while the main criterion is to maximize the *RecruitmentRate*,

		Perfect	H&S	L&M
General	N. candidates #C	100	200	100
	N. universities #U	100	50	50
	MaxShortList	100	5	5
Candidate	N. applications N_i	100	U[1;20]	U[1;50]
	Elitism e_i	1	.7	.7
	Locality ℓ_i	0	.1	.1
	Risk r_i	1	U[.1; 1]	U[.1;1]
	Applying home h_i	1	1	1
University	N. interviews N_j	100	15	15
	Elitism e_j	1	.7	.7
	Locality ℓ_j	1	U[1;1.2]	U[1;1.2]
	Risk r_j	1	U[.1;1]	U[.1;1]
	Interview local h_j	1	1	1

Table 1. Parameters of the model

a secondary criterion might be to bound (or even to minimize) the *LocalRecruitmentRate*.

Two additional variables will be considered, which also characterize the efficiency and fairness of the ALM: the rank of the last hired candidate, noted *LastAccepted* (the higher, the better) and the rank of the first candidate which is not hired, noted *FirstRejected* (the lower *FirstRejected* the better). Although these observations cannot be compared to the "ground truth" for obvious reasons, they are available through simulations. They qualify the ALM process, and can be interpreted as type I and II errors in discrimination tasks: *LastAccepted* corresponds to type I errors (high *LastAccepted* values suggest that some hired candidates should actually have been rejected); symmetrically, *FirstRejected* corresponds to type II errors (low *FirstRejected* values suggest that some rejected candidates should actually have been hired). The optimal situation clearly is when *LastAccepted* is the number of jobs, and *FirstRejected*= *LastAccepted*+ 1.

4.3 Goals of the study

Our goal is to analyze the French ALM with respect to the typical situations described in section 4.1, along three perspectives: positive (explain the observed variables); normative (examine the effects of rule modifications); and computational (sensitivity of the system w.r.t. the parameter settings).

The computational analysis will primarily consider the *perfect* market case, assessing its efficiency and robustness with respect to the candidate and University models.

Secondly, the behaviour of the model will be discussed and compared to the empirical evidence (ground truth); the influence of the model parameters will be discussed along a sensitivity analysis, and some interpretations will be proposed. Lastly, some modifications of the process (concerning the selective pressure, the threshold on the size of the shortlists, and the constraints about local candidates) will be investigated and their global effects on the ALM will be analyzed.

5 Experimental study

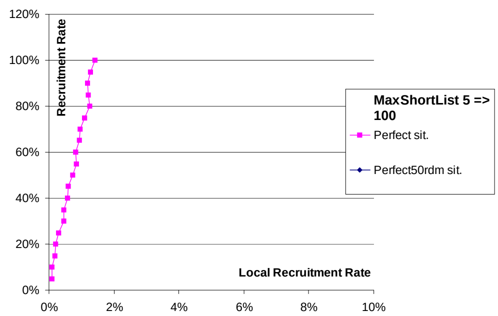
This section reports on the behaviour of the ALM model within all three settings respectively describing the perfect market case, the Humanity and Science (H&S) case, and the Law and Management (L&M) case.

5.1 Perfect Market Setting

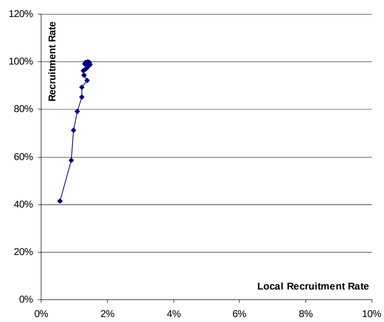
The perfect market setting, used as a sanity check to investigate the properties of the dynamic system in the complete information case, assumes that each candidate applies to each position and is interviewed. As shown in Fig. 1.(a), the efficiency of the market is governed by the threshold *MaxShortList* on the maximal size of the shortlists; since all Universities compete for the best candidates, a tiny fraction of the candidates only is actually hired and *RecruitmentRate* remains low. Random perturbations, e.g. high subjective preference weights ($\mathrm{s}_i = \mathrm{s}_j = .5$, Fig. 1.(b)) significantly improve the efficiency of the labour market, while the number *LocalRecruitmentRate* of successful local candidates remains low. These results suggest that, under an optimal matching process, Universities and candidates should either deviate from the single elitism based order, using subjective biases or risk-adverse filters − or relax the upper bound on the number of candidates shortlisted by Universities, and have *MaxShortList* be unbounded.

5.2 Humanity and Sciences Setting

The behaviour of the model closely follows the ground truth; the average *RecruitmentRate* amounts to 98% of the job positions and *LocalRecruitmentRate* to 28% against respectively 94% and 28% disclosed from official sources.

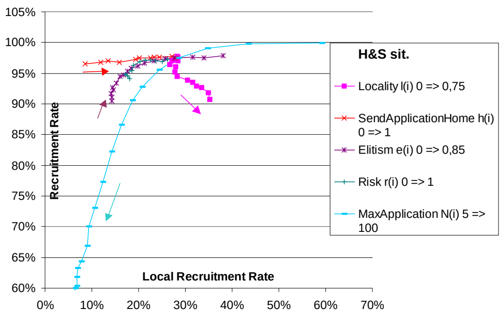


(a) without perturbations

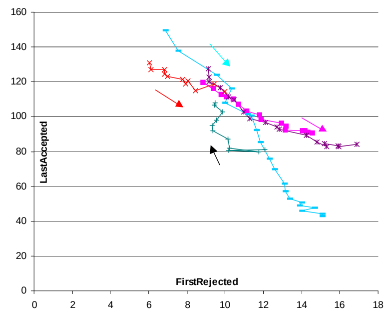


(b) with perturbations

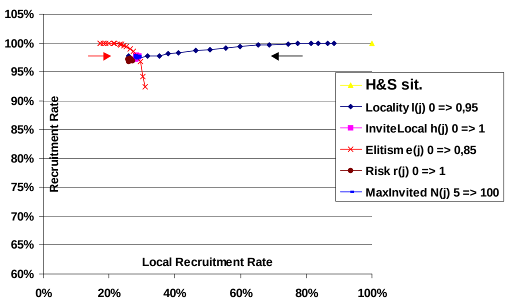
Fig. 1. Perfect Market: Influence of *MaxShortList* on *RecruitmentRate* and *LocalRecruitmentRate*



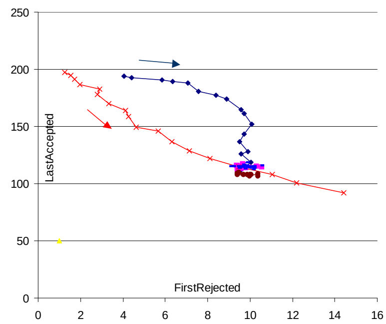
(a) *RecruitmentRate* and *LocalRecruitmentRate*



(b) *LastAccepted* and *FirstRejected*



(c) *RecruitmentRate* and *LocalRecruitmentRate*



(d) *LastAccepted* and *FirstRejected*

Fig. 2. H&S Setting: Sensitivity Analysis of the Candidate parameters (top) and University parameters (bottom).

The sensitivity analysis of the model parameters is reported in Fig. 2. The *RecruitmentRate* is close to 100% in all settings, and only depends on the maximum number of applications for the candidates. Actually, if candidates apply to many universities, the same saturation phenomenon as in the perfect case is observed; Universities tend to select the same candidates and eventually some job positions are not fulfilled.

The *LocalRecruitmentRate* depends as expected on the weight of the local preferences. Interestingly, the only fact that candidates always apply to their home University ($h_i = 1$), everything else being equal, increases the *LocalRecruitmentRate* from 8% to 28%. In the particular case where Universities and candidates have *no* preference toward local candidates/Universities ($\ell_i = \ell_j = 1$, $h_j = 0$), the fact that candidates systematically apply to their home Universities increases *LocalRecruitmentRate* from 2% to 15% (Fig. 3); in the meanwhile, this is found to improve both *LastAccepted* and *FirstRejected*.

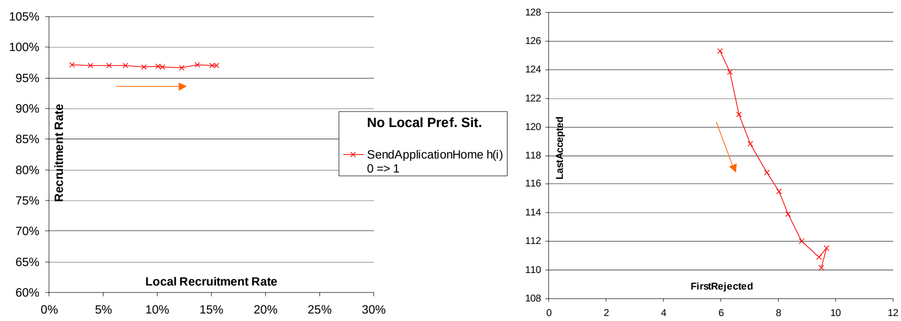


Fig. 3. H&S Setting: When candidates systematically apply to their home University, and Universities/Candidates have no local preference bias

Surprisingly, the fact that Universities always interview the local candidates does not make any difference on *LocalRecruitmentRate*; and the number of interviewed candidates makes no difference either. An interpretation of this counterintuitive result is that interviews do not bring any additional information in the proposed model, hence do not perturb the prior preferences of the Universities.

The efficiency and fairness of the process, as regarding *LastAccepted* and *FirstRejected*, are clearly under-optimal (being reminded that the optimal situation is for *LastAccepted*=50 and *FirstRejected*=51 in the experimental setting). Furthermore, candidate and university parameters do not allow *per se* to improve the efficiency or fairness of the market. Increasing the elitism weight will obviously improve *LastAccepted*, but at the expense of the *RecruitmentRate*. While increasing the number of applications of the candidates does improve *LastAccepted* and *FirstRejected*, a closer inspection reveals that this improvement only results from the lesser *RecruitmentRate*.

Modifying the market rules: efficient and inefficient modifications.

As mentioned earlier on, MAS enable the fast modelling and simulation of alternative models. Alternative models of the ALM have thus been investigated (Fig. 4). Forbidding the interview of local candidates has an overall positive impact; while *RecruitmentRate* remains high (96% as opposed to 98%), *FirstRejected* significantly increases. Increasing the number of candidates (e.g. relaxing the "qualification filter", see section 3.1) does not make any difference in the considered range (about 200 candidates for 50 positions). Significantly increasing the number of candidates decreases the *RecruitmentRate*, after the same saturation phenomenon observed in the perfect market case.

Note also that relaxing the constraint on *MaxShortList* does not make any difference, suggesting that the selective pressure in the H& S labour market is appropriate.

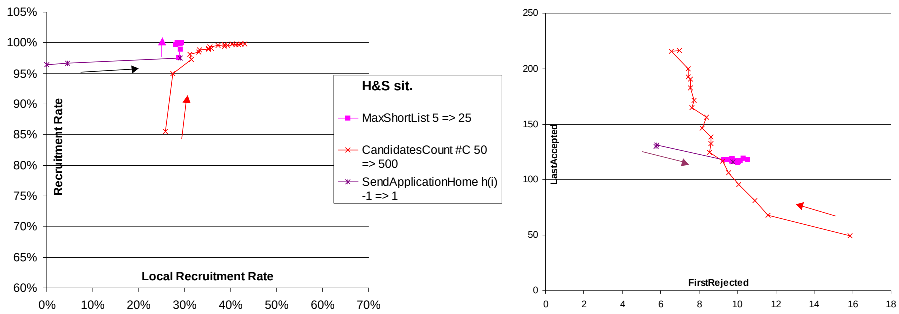
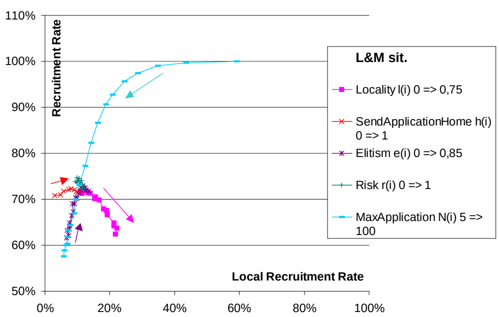


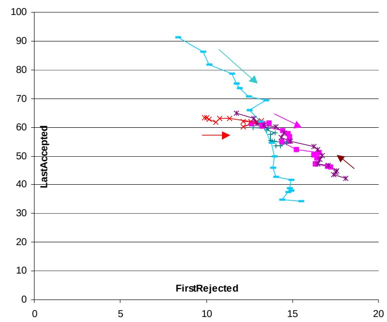
Fig. 4. H&S setting; Impact of increasing *MaxShortList*, increasing the number of candidates, or forbidding the interview of local candidates.

5.3 Law & Management Setting

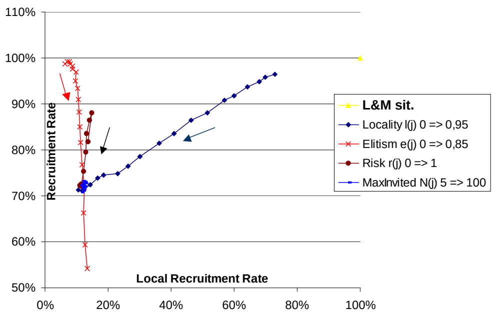
In the L&M context, using the same preference settings as in the H&S context with a lower selective pressure (100 candidates for 50 positions) and a higher exploration of the candidates (applying to 50%

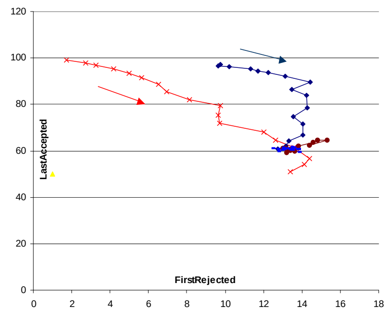
universities on average), produces results significantly different from the ground truth (Fig. 5), with *RecruitmentRate*=70% and *LocalRecruitmentRate*=5.5% (instead of respectively 94% and 37%). Further, the behaviour of the model is stable with respect to slight modifications of the parameter values.





(a) *RecruitmentRate* and *LocalRecruitmentRate* (b) *LastAccepted* and *FirstRejected*





(c) *RecruitmentRate* and *LocalRecruitmentRate* (d) *LastAccepted* and *FirstRejected*

Fig. 5. L&M Setting: Sensitivity Analysis of the Candidate parameters (top) and University parameters (bottom).

The low *RecruitmentRate* value is blamed on the saturation of the system, akin the perfect market case. Although the L&M setting involves less candidates than the H&S setting, these apply to more Universities; as Universities tend to select the same candidates, the number of positions eventually fulfilled decreases. Only two strategies have been found to overcome this saturation phenomenon: a high bias toward local candidates, or strong subjective preferences, modelled as a high weight of the random factor (incidentally degrading the *LastAccepted* and *FirstRejected* indicators). Computationally, a good match with the ground truth was obtained using high weights for the local and subjective preference bias.

After the above remarks, the L&M labour market does require high preference biases, based on locality or other information, to enforce an efficient *RecruitmentRate*. Nepotism thus appears to be a rational strategy, rather than some "bad habit" of Faculty members in the domain of Law and Management.

Clearly, the risk aversion might play a similar role: if Universities and candidates are risk-adverse and interview candidates/apply to Universities whose rank match their own, the *RecruitmentRate* also significantly increases. In practice however, University and candidate ranks are not publicly disclosed; risk aversion alone might thus be insufficient to overcome the saturation phenomenon.

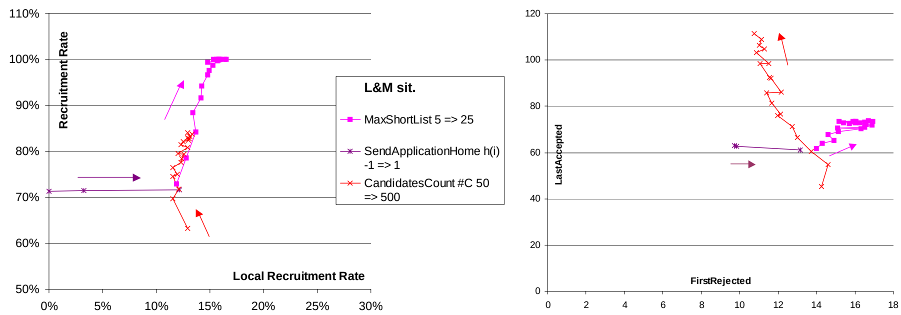


Fig. 6. L&M setting; Impact of increasing *MaxShortList*, increasing the number of candidates, or forbidding the interview of local candidates.

Complementary investigations (Fig. 6) show that relaxing the *MaxShortList* parameter would enforce an efficient labour market (*RecruitmentRate*=94% for *MaxShortList*=10, 99% for *MaxShortList*=15). Quite the contrary, increasing the number of candidates and/or forbidding candidates to apply in their home University would not in itself address the saturation problem.

6 Conclusion and Perspectives

The simplified model of the French Academic Labour Market proposed in this paper was investigated along intensive simulations of the corresponding Multi-Agent System.

A saturation phenomenon was observed, in both the perfect market case, and in the L&M case. The proposed interpretation is the following. The stronger the elitism of candidates (respectively, Universities), the more they tend to apply to the best Universities (resp., shortlist best candidates); when the University shortlists strongly overlap, only the best candidates are hired, and most job positions remain unfulfilled. The reason why the saturation is not observed in the H&S case, despite a stronger pressure (4 candidates for a job instead of 2), might be the fact that H&S candidates apply to significantly less Universities (10 on average, vs 25 in the L&M case). The higher diversity of the candidate pools in diverse Universities, contributes to a better efficiency of the Academic Labour Market.

The saturation faced by L&M Universities makes it necessary to use strategies to diversify their candidate pools. Risk-adverse strategies (e.g., only interviewing candidates whose rank matches the University status) would fix the saturation problem; however, the *prior* knowledge about the ranks (of Universities and candidates) might be too limited to enable efficient risk-adverse strategies.

Secondly, the *LocalRecruitmentRate* was thoroughly investigated in relation with the candidate and University models. It has been shown that, assuming that the Universities have *no preference* toward the local candidates, the only fact that candidates systematically apply to their home University, explains half the *LocalRecruitmentRate*.
Independently, localism was found to be a rational strategy in the saturation case, to enforce the diversity of the candidate pool and eventually ensure that the job positions will actually be fulfilled.

Another important lesson learned is that the main constraint behind the saturation phenomenon is the *MaxShortList*; according to the simulations, relaxing this constraint is by far the most effective way of overcoming the saturation problem. Indeed, the longer the shortlist, the more demanding the task of the University jury ("commission de spcialistes") is.

Further research will improve the proposed model of the Academic Labour Market along the following directions. Firstly, the modelling of the rank effects will be refined to account for the fact that ranks are at best fuzzily estimated. In particular the "optimism/pessimism" of candidates and Universities will be modelled as they over-estimate/under-estimate their own rank, and accordingly adopt a risk-taking/risk adverse strategy. Secondly, an "iterated game" version of the ALM will be studied, investigating the relative benefits or costs of optimism/pessimism. One wonders whether one key principle in game theory, the "optimism in the face of uncertainty", holds in the considered context.

7 Acknowledgments

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Appendix

A Empirical data

Table 2. Empirical data for the three fields and total

2007 first procedure	Total	Law & Man.	Literature	Science
Candidates	9318	555	3135	5540
Applications	76900	14896	27687	32986
Jobs	2110	324	695	1000
nbApp/job	36,4	46,0	39,8	33,0
nbApp/cand	8,3	26,8	8,8	6,0
nbCand/Job	4,4	1,7	4,5	5,5
RecruitmentRate	98%	94%	99%	99%
No hire Cand choice	37	17	8	12
No hire No cand	6	1	2	3
LocalRecruitmentRate	28%	37%	24%	28%
nbSection	57	6	25	23
Avg. nbJob / section	37,0	54,0	27,8	43,5

Only the total number of candidate was available in official data. The number of candidate for each field is deduced from the part of newly qualified hired candidates and from the total number of newly qualified people.

The total column is not equal to the sum of the three fields because they do not include the pharmacy sections.