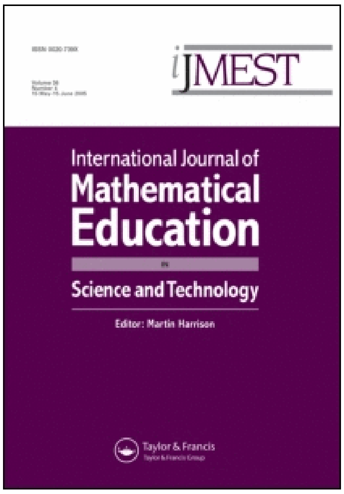

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The rise and fall of mathematical enrolments in the French educational system: a case study

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The rise and fall of mathematical enrolments in the French educational system: a case study

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In this article, we start by considering the relevant parts of the French educational system and the data relating to science at the end of secondary school and the early years of university. We show an increase, till 1995, and then a decline in the study of mathematics at baccalaureate and university level. However, our main conclusions relate to a decline in the study of all sciences, rather than just mathematics. The reason that we have to consider all sciences is because of the difficulty in getting accurate figures for mathematical enrolments at the university level. We do, however, have accurate figures for high school level mathematics enrolments. We consider the reasons for this downturn in enrolments, which appear to be largely political and social. It is also noted that there have been declines in the numbers of students in areas other than science. Finally, we show that for French tertiary students, well-paid secure jobs are at least as important as subject choice. This is dramatically illustrated by the numbers of applicants applying for competitive positions as secondary teachers.

Keywords: undergraduate mathematics enrolment; change in enrolments; French education system; classes préparatoire; grandes écoles; baccalauréat; secondary mathematics teachers

1. The French education system – academic hierarchies

It is clear that education systems vary from country to country. For example, in Finland there is an entrance exam to the university, which is not the case in Germany and in France. In the United States a number of universities are private (and very expensive), and, if they can afford to do so, they also choose their students on the basis of their academic results.

The French tertiary education system presents very special features that make it different from other national systems. The main feature is the existence, in France, of hierarchies in which one of the most important features (the *classes préparatoires*) does not depend on the universities, but on the high schools.

It turns out that unless we understand the hierarchies of the French system we cannot understand why enrolments of native French students in science at university have been falling. Consequently, it is important to describe the educational system here before we consider the question of changes in enrolment rates.[1]

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1.1. *The basic school system*

Figure 1 gives a simplified diagram of the French primary and secondary schooling system and shows a comparison with the United States grade system. The primary level includes *école maternelle* (3 years) and *école élémentaire* (5 years); the secondary level includes *collège* (junior high school; 4 years) and *lycée* (high school; 3 years).

It should be noted that young people in France must go to school from the age of 6 (the start of primary school) but most attend some formal education from as early as 2. It is compulsory to go to school in France until the age of 16 but most students go well beyond that.

Some 50% of students repeat at least 1 year of school. Many of them are average to capable students who their teachers believe will benefit by the repetition.

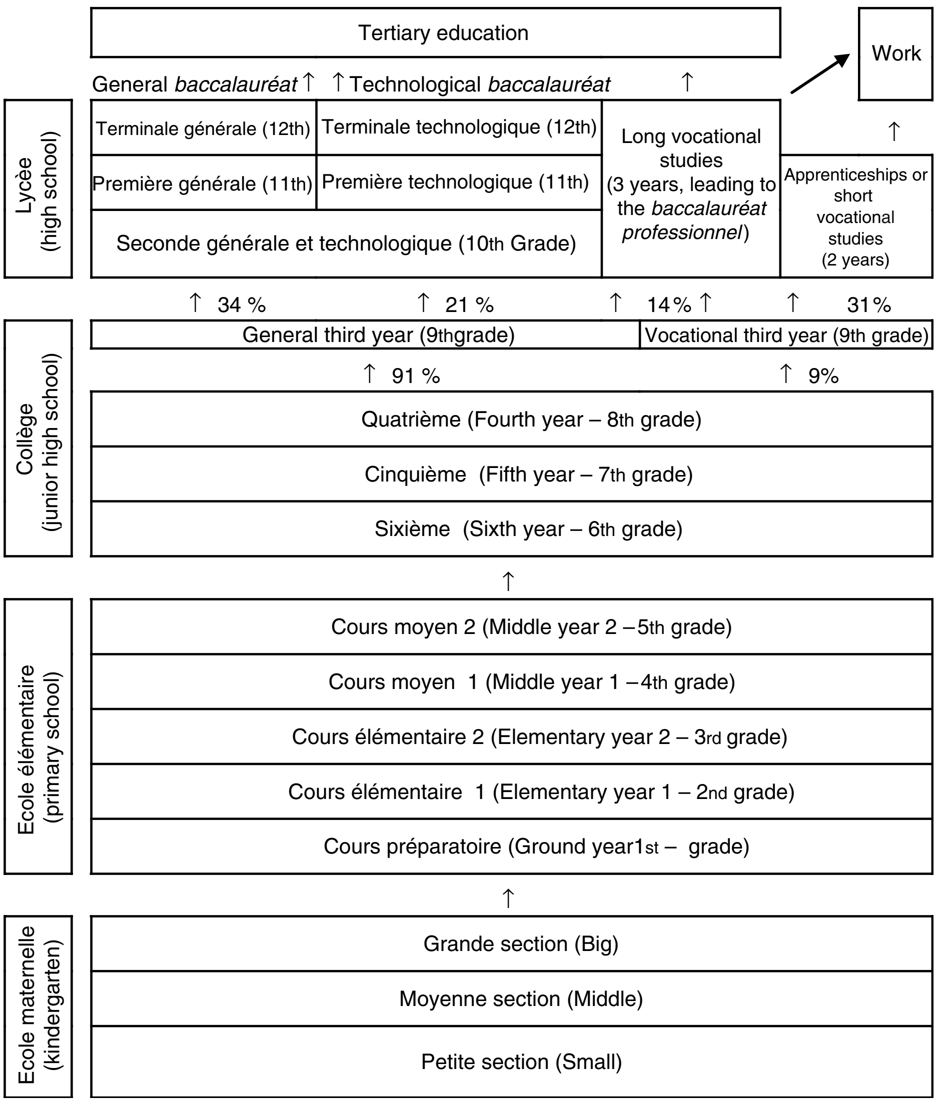

Figure 1. The French educational system.

The French primary and secondary education system is almost exclusively public: around 80% of it depends directly on the French Ministry of Education for funding. There are no fees at these public schools for the pupils or their families. Most of the remaining 20% are 'privately run' (mainly administrated by the Roman Catholic church), but are 'under contract', which means that the teachers' salaries and the schools' running expenses are paid by the state. As a consequence, the fees that the families have to pay are very low, and the curriculum is the same as for public schools. They are relatively few totally private schools in France.

The academic year lasts from the first week of September to the last week of June. During this period, there are 7 weeks of holidays: one around All Saints Day, two around Christmas, two in February and two in April.

French high school classes are numbered in reverse, like a countdown to graduation, the last class being called *terminale*. Consequently, students start *collège* in the sixth year (*sixième*) and then move progressively to the fifth, fourth and third (Figure 1). At this point students have to choose between general, technological or vocational studies (including apprenticeship).

As general high school studies (*lycée général*) are the main source of supply for mathematics-oriented tertiary education (including physical sciences, computer and engineering), we will now limit our study to this part of the French high school system.

The 34% or so of students who go on to general high school studies then go into the general 'second' year (actually the first year of high school). After this they choose between a 2-year program in science, economics or humanities. This 2-year sequence ends with the national baccalaureate examination that gives students the right to enter university. We will return to this point in Section 1.3.

These final 2 years of general high school are shown in the top half of Figure 2. In this figure, we also show the relative percentages of students who take the three sections of the general years of study (science 50%, economics 30% and humanities 20%). At this point it should be noted that the general scientific studies are 'general' in that a range of subjects are taught. As well as the obvious ones of mathematics, physics, chemistry, biology and

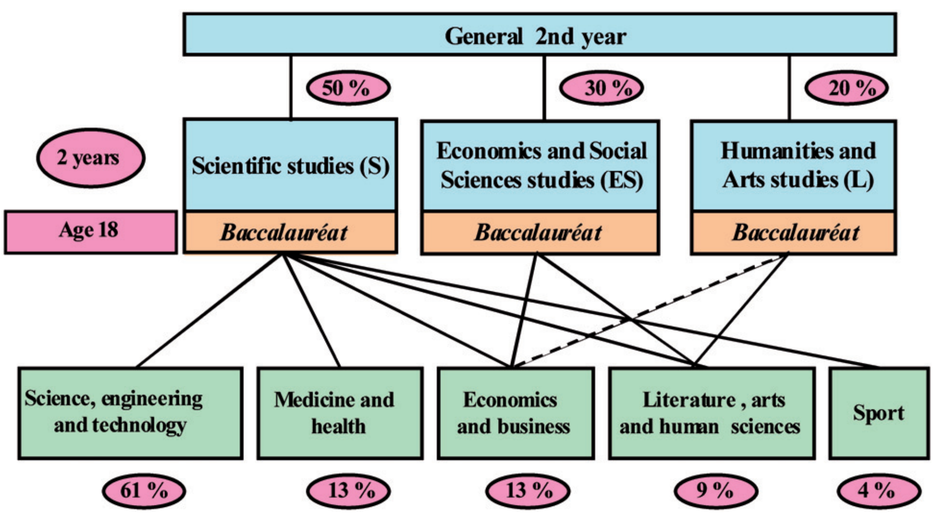

Figure 2. The divisions in the general baccalaureate.

geology, students also learn philosophy, history, geography and two foreign languages. All these subjects are compulsory; the week consists of 32 contact hours, of which 60% are devoted to science (maths, physics and chemistry, biology and geology). See Supplementary Material A (found online at www.informaworld.com/ijmest) for a table with the number of contact hours for the two final years leading to the science *baccalauréat*.

To give some idea of the level of the mathematics curriculum and its evolution, we have included a translation of the 1994 and 2007 baccalaureate mathematics tests in Supplementary Material B and C online for science students majoring in mathematics.

One reason that general science is so popular with both parents and students is the range of subjects that it covers. Moreover, the scientific section has the image of an elite section: not only a broad range of disciplines is covered, but even for the non scientific disciplines, requirements are equivalent to those of other orientations. This has two advantages for students: (i) it means that they are able to postpone the restricting of their studies to a specific discipline until after they have taken the baccalaureate; and (ii) it means that they have a wide range of choice in higher education, leading after three further years of tertiary study to job openings at the executive level (in engineering, business, law, administration, etc.)

As a result, almost all general science students go on to further study; in 2002 for example, some 61% chose science, engineering and technology, 13% chose medicine and health, 13% went on to economics, 9% literature, arts and social studies and 4% sports studies (Figure 2).

Note that among the laureates of the general baccalaureate, 62% are 'on time', that is, graduate at age 18, 6% are 'in advance' (younger than 18), and 32% are 'late' (older than 18). This usually means that this last group repeated one (23%) or more years (9%). This notion of timing is important in the French system, and strongly correlated to academic success.

It should be mentioned here that a reform of senior high school is taking place and that the organization described above, with the three main streams for general high school in grades 11 and 12, should disappear from 2010 and be replaced by modular system with common core and options from grade 10.

1.2. *Le Bac*

As we have said, students in France have access to three kinds of baccalaureate at the end of schooling: general, technological or vocational, with almost all of those students intending to go on to higher education. Study for the general baccalaureate examination takes place in the final 2 years of secondary school. From 1995, this examination has had three sections: L, ES and S.[2] These letters stand for *Littéraire* (Literature and Arts), *Économique et Social* (Economics and Social Studies), and *Scientifique* (Science). Prior to this the general baccalaureate was essentially made up of five sections, A, B, C, D and E. In 1995, section A became L; B became ES; and the rest became S.

The science baccalaureate is currently divided into two main groups: the Life and Earth Sciences and the Engineering Sciences. The former group is taken by 90% of the scientific candidates and has three *spécialités* (this can be translated loosely as 'majors'): Mathematics, Physics–Chemistry and Life and Earth Sciences. The latter group (engineering sciences) is much smaller and mainly taken by males of modest social origin.

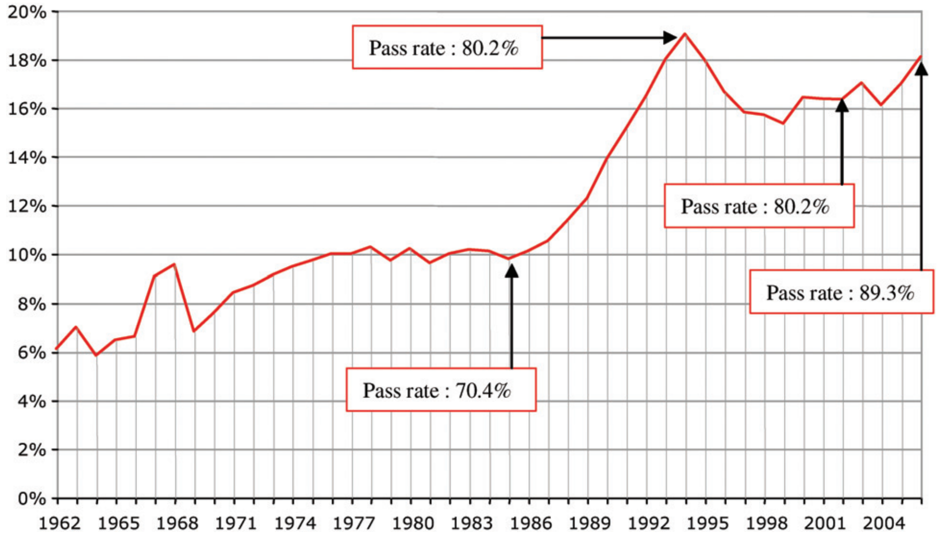

Figure 3. Percentage of students in the age group who gain the science baccalaureate.

The data collected by Duverney [1], show that, as a whole, a little over 260,000 students passed the general baccalaureate exams in 2004. They further show that the number of students passing from 1962 up until now, have gone through roughly four major periods. From 1962 to 1974, there was a strong increase in the numbers passing; from 1974 to 1985 the numbers were virtually static; from 1985 to 1995 there was another strong increase; and since 1995 there has been a slight decrease (of the order of 1% per year). These four periods may be linked to the mathematics being taught as the 'new math' reform (*mathématiques modernes*) was started in 1972, in 1985 there was a new mathematics syllabus, and in 1995 the time spent on mathematics was decreased.[3] We will return to this point later.

Beyond absolute numbers, one can study pass rates (percentage of the students taking the exam who succeed) for the general baccalaureate. Five periods can be distinguished but in recent years (from about 1984), there has been a gradual increase to just over 83% (as we shall see, this increase is even stronger in sciences).

It is worth noting that between 1962 and 2004, the ratio of the number of students gaining their general baccalaureate to the age cohort size increased from 11% to 32%, which is a steep increase (Figure 3). See Duverney [1, chart 3, p. 9].

Moreover, if one takes into account the technological baccalaureate (which was only created in 1966) and the vocational baccalaureate (which only appeared in 1985), the ratio of students gaining their baccalaureate to the age cohort size amounts to 62% at the present time (general baccalaureate 32%, technological baccalaureate 18%, vocational baccalaureate 12%). This is a significant increase because in 1985 this ratio was only 30% (20% for the general baccalaureate and 10% for the technological baccalaureate). This might be compared to the goal of 80% of the age group at the baccalaureate level proposed by J.P. Chevènement[4] in 1986.

It is here, though, that the science figures start to show some differences from the overall baccalaureate situation. Since 1994, there has been a significant decrease in this percentage from a peak of 19%. Numbers show that this decrease has been greater for boys than for girls. Since 1995, the proportion of boys to girls in science at the baccalaureate level has decreased from a little over 1.4 to less than 1.2.

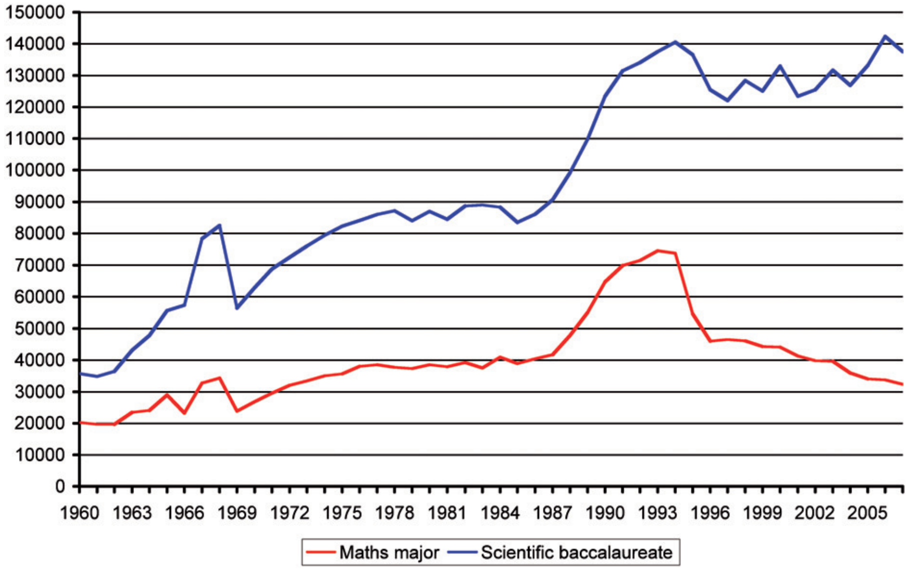

Figure 4. Total numbers of students who gain the science baccalaureate and who major in mathematics.

On the other hand, the absolute number of science students gaining their *baccalauréat* has risen to around 140,000 in 1994–2007 (Figure 4), while the ratio of science to general baccalaureate students has remained fairly constant since 1960. In the same diagram, we show the number of science students who concentrate on mathematics. This number has been in decline since 1993. The absolute numbers here have reduced to the 1972 figures but it is felt that the quality of recent students is considerably worse than those in 1972.

Indeed, it is worth noting that the number of hours of mathematics currently taken by science students has declined since 1972. Before 1994, taking a major in maths meant 9 contact hours per week in mathematics for Grade 12; from 1995 onwards, it means 7.50 h only.

This reduction of the place of mathematics in scientific high school studies has been part of a new conception of the teaching of science, which will be better understood by a quotation from Claude Allègre (see [2, pp. 451–452], and [3]):

> 'The French elitism has engraved the pre-eminence of mathematics, that is the rejection of reality, in the very heart of our educational system, therefore of our whole selection system ! . . . Mathematics in this affair only plays the role of an operator, a pedagogical symbol of a century-old trend, of a mystical and hoax spirit. It is not an easy task to reverse this trend, to give birth to modern scientific teaching, supported by the dialogue with reality, capable of stimulating imagination, creativity, mind versatility, confidence in the future. We do not mean to eliminate mathematics (which is a mind activity as noble as music, and an efficient scientific tool), but to put them in their right place.'[5]

A consequence of this policy has been both a severe fall of the number of students majoring in mathematics (Figure 4) and of their level of ability (compare the two exams in Supplementary Material B and C online). This seems to have been the result of a complex process. Before 1994, in Grades 11 and 12, science had two parts: the maths-physics section, called C (the elite section), and the natural sciences section, called D. After the 1994 reform, all the science students have been mixed in a common core and, in grade 12, had to choose a speciality between three: maths, physics and chemistry, or natural sciences.

Those choosing maths now have 7.5 hours of maths (instead of 9 hours) in grade 12, while those choosing physics or natural sciences have only 5.5. Thus there has been a drastic reduction for those choosing physics. At the beginning, the number of students choosing the maths speciality (still considered as the elite speciality) still exceeded those choosing the other specialities, but the situation deteriorated quickly, all the more as physics and natural sciences introduced an experimental part in their tests at the baccalauréat, whose results became much higher than those of the maths tests, which remained standard. In 2003 for example, the average mark in maths at the scientific baccalauréat was around 8 (out of 20), against 12 and 11 in physics and natural sciences respectively.

1.3. *Tertiary institutions*

Higher education in France has essentially four streams but perhaps more importantly, the higher education system is hierarchical. This hierarchy is not something that has been imposed but rather it has developed in much the same way as the hierarchy in universities in the United States has. Here we limit ourselves to tertiary education offering science. An essential feature here is that a large part of this tertiary education system, as we shall see, has competitive entry at baccalaureate level, but there is no restriction to access to university, and any student, with any type of baccalaureate, can enter any type of university. The result is that universities offering science are at the bottom of the hierarchy (except for medical universities).

At the top of the hierarchy are the *Classes Préparatoires aux Grandes Écoles* (CPGE). Entry to these is competitive and depends on assessments of a student's final 2 years of secondary school, entirely based on their teachers' estimation of their ability. This is founded on the accumulated and filed work of the student, and not on their grades at the baccalaureate tests. For these students, getting the baccalaureate is a mere formality.

The courses at CPGEs are taught over 2 years at a high school in classes with, relative to university lecture classes, small numbers of students (between 30 to 45 students). It is worth noting too that the teachers in these schools do not have to do research, though some do; their sole responsibility is to teach. Further, they are considered to be the best teachers at secondary school level (certainly they are the most highly paid), most of them having been trained at one of the *Écoles Normales Supérieures*. Over the 2 years, the teaching is directed towards the competitive entry examinations for the *Grandes Écoles*, mainly engineering schools, where students may study for 3 years for engineering or commerce, or prepare for a career in research.

Note that, although entry to all CPGEs is competitive, there also exists a hierarchy between them. Some very renowned CPGEs in Paris or in big French cities, for example, only select the best students from all around France.

Next in the hierarchy are the *Instituts Universitaire de Technologie* (IUT). These also have competitive entry and their courses last for 2 years. They are very popular because, although they are housed in universities, the students there are taught in schools under much the same conditions as the CPGEs. Another reason is that on graduation the students may rather easily get a job, but they often go on to study in universities or other places of higher education, directly entering at third year. The technical diploma from IUTs is recognized by industry and graduates are often hired as technicians.

Then there are the universities. These do not have competitive entry. Since 2004 they have provided 3-year degrees, followed by 2-year Masters and 3-year PhDs, in line with the Bologna convention. Typically, the students were taught in large lecture classes with

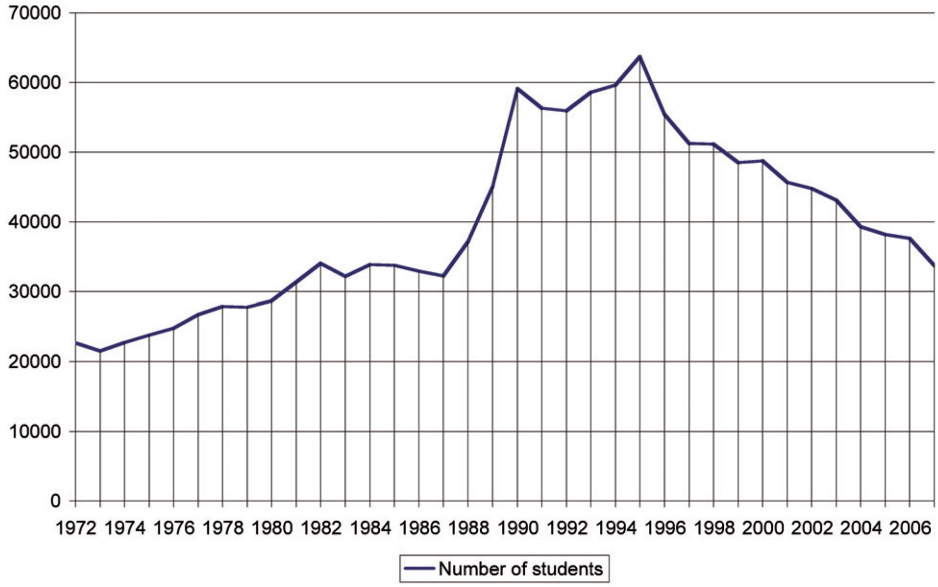

Figure 5. First year university enrolments in science (medicine and health excluded).

smaller tutorial classes where more individual attention can be given; this is no more the case with the recent decrease in numbers, which has only left small classes in many places.

Finally, there are the *Sections de Techniciens Supérieurs* (STS). These have competitive entry and their courses are 2 years long and taught in a high school. On graduation, most students go into the work force as skilled workers though some go into further education.

It should be noted that a greater part of the French tertiary educational system has very low fees. For example, fees for studying at a CPGE or an STS amount to less than 100 € a year,[6] while fees for studying in the IUT or universities are less than 300 € a year. However, study for paramedical professions or business can cost up to 7200 € a year.

Note also that the situation at universities is not as simple as it might appear. For example, we have already said that the IUTs form a competitive part of them. Similarly, about a quarter of the engineering schools also depend administratively on the universities. These institutes may have competitive entry just after the *bac* (as in the Universities of Technology) or 2 years after that.

2. The decline of science in France

2.1. *The decline*

Figures quoted in Convert and Gugenheim [4] show that there has indeed been a decline in the numbers of students taking science at universities in France. They cite figures from Lixi et al. [5], which show that science enrolments in universities dropped by 11.3% from 1995/2006 to 2000/2001 and those in CPGE by 7.3%. It should be noted that in recent times the influx of foreign students has masked this trend [4]. The data in Figure 5 are taken from the DEP, the Department of Evaluation and Long Term Planning (see [6]), an official department of the French Ministry of Education. They show first-year enrolments in science at university. There has been a clear decline in numbers since 1995. This decline amounts to around 48% between 1995 and 2007.

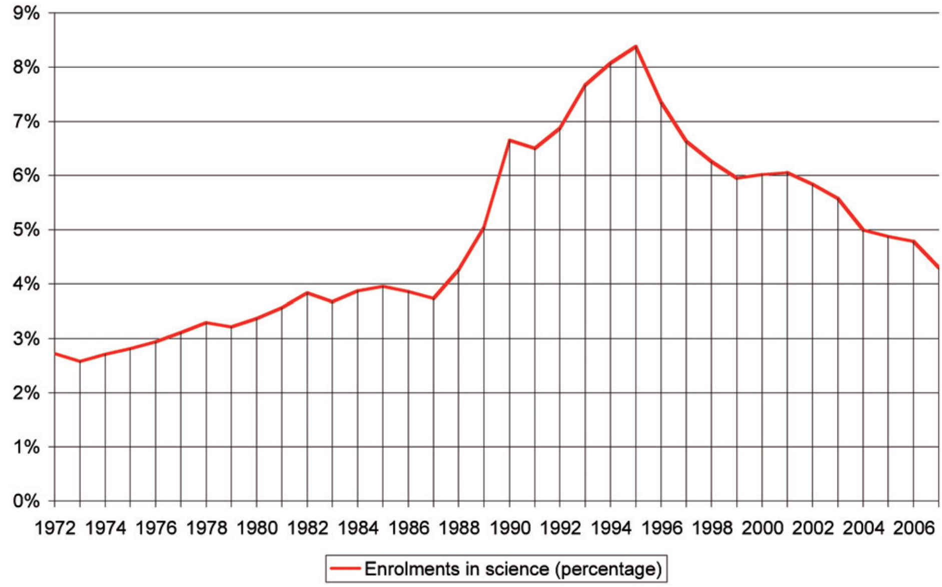

Figure 6. Percentage of the age cohort studying first-year science.

It might be worth remarking here that we study the new enrolments, that is the flow of incoming students for each year, while many people study the total number of students; this last variable is much less sensitive to variations, and does not correctly track the evolution. This explains some discrepancy in published data (we find a decrease of 48% where some find a decrease of 30%, because they consider the total number, not the new students).

But perhaps more disturbing are the figures shown in Figure 6, which show the percentage of the age cohort that enters a university offering science for the first time. This takes out the demographic effect, which is often said to explain a large part of the drop. As the figures show, it is exactly the contrary: the maximum flux was obtained at the moment of a demographic minimum! The demography partly explains why the absolute numbers became flatter between 1990 and 1995.

But what are the reasons for this decline? The problem is somewhat complicated. We go through the logic of this situation now.

2.2. *The sociological background*

The first thing to remember is the hierarchical nature of French tertiary education. This means that all other things being equal students apply first for CPGEs, then IUTs, then universities. Traditionally, students who enter CPGEs are more likely to be good students who come from more affluent homes. Students studying at university have been less successful in their school career than the CPGE students and come from more modest homes.

Precise figures on this subject can be found in the proceedings of a conference held in Paris, ENS, in 2003.[7] For example, the charts on page 40 give the social origins of the students in CPGEs: upper class, middle class, lower class and academic. It appears that this last group is over represented in CPGEs. This is probably due to the emphasis placed on education in such homes. However, the upper class is also well represented in these figures. It would seem that this class advantage has existed for some time and the families whose children attend CPGEs know how to prepare their children for entry into this most prestigious form of tertiary education. More on this can be found in Bourdien [7].

Because of the selective nature of CPGEs and IUTs, the students who successfully enter these institutions are the more capable academically. Hence, they are more likely to be able to cope with the theoretical study required of university than those who actually enter university. This is because many university students come from the group of students who have failed to gain entry to one of the selective institutions.

To make matters more difficult for university students, universities tend to expect their students to learn for themselves, and so the students who are most in need of learning support are not given it. The fact that the CPGE teachers' sole responsibility is to teach and care for their students in a classroom with from 30 to 50 students provides the students with a much more supportive learning environment. This adds to the CPGE's competitive advantage.

2.3. *The historical development*

We develop here arguments of Convert [8]. The decline of the enrolments of science students at the university from 1995 must be compared to the sharp increase in students gaining their baccalaureate over the 1985–1995 period.

During this period the number of science students at CPGE increased from 24466 to 39728 (an increase of 62%). This was achieved by the creation of many new *Classes Préparatoires* in middle-sized towns (around 100, 000 inhabitants), which has given many more students from modest homes access to the system. However, the percentage of students enrolled in CPGEs in the same period went down from 23.8% in 1985 to 19.5% in 1995.[8] Similar changes occurred in IUTs.

Hence from 1985 to 1995, a very large proportion of the new students were absorbed by the universities. In that decade, science numbers more than doubled in universities. As a result of the selective system, more and more students were entering university with weaker performances and from more modest home backgrounds. No attempt was made to make university entrance selective in any way nor were their teaching methods changed. An exception should be made for medical universities, where there is a difficult competition at the end of the first year.

But in the middle of the 1990s, the numbers of students obtaining the general baccalaureate started to decrease; and the number of students with vocationally oriented baccalaureate increased. Consequently, the number of students wanting to attend higher education institutions fell, and the proportion of university students in the baccalaureate age group stopped growing.

In addition, after 1995 the number of selective courses in IUTs and STSs, as well as vocationally oriented courses in universities, increased. This was in part, at least, because the poorly prepared baccalaureate graduates coming from non-professional homes had become aware of the difficulty of university courses. They had also realized that they could maximize their chances of a profitable occupation if they went into a vocationally oriented course. Hence, as these students were taking, for them, a more prudent option, fewer students were taking traditional university courses.

2.4. *The job situation*

It is important now to give some background to the job situation. It will become clear that university students are severely disadvantaged in the contest for some of the best jobs in France.

First, it is important to realize that there are a number of positions in administration, available to students of elite schools, that are not really available to university students. This is not because university students cannot apply for these jobs but because the students from the elite schools have had a better education and are better trained for the exams or are advantaged by tradition. So because of this, *école polytechnique* and *écoles normales supérieures* provide students for high administrative positions; *écoles normales* students, though competing with university students, are able to take many of the research and teaching jobs on offer; a part of the students from *école polytechnique* enter the civil service simply because they have attended *école polytechnique*.

But there are problems for university students in the private sector too. The very large majority of engineering school students, and a significant number of students of *école polytechnique*, enter the private sector. They have a huge advantage there, first because their training is directly tailored for these positions, which is not the case at the moment for universities, and also because the private sector people who hire them very often come themselves from engineering schools: therefore, they know and understand the education the students have been given, while they do not really understand the university situation and find university students unreliable.

This is particularly striking in the case of PhDs. Although engineering students only have 5 years of training (roughly equivalent to masters level), while PhDs have 8 years, the PhD students have quite a lot of trouble finding positions in the private sector. Most companies believe that the PhD is a '3-year extended holiday' spent uselessly studying an arcane subject, and they generally do not even consider PhD graduates as potential employees. However, this is not fully true in all areas. In the last decade, universities have increasingly developed professional programs at masters level and the students coming out of these programs do find jobs. For financial mathematics and computer sciences, for example, a great part of the best and attractive programs are university programs, and doctorate students also find employment.

Hence there is a big problem for universities. It is no wonder that after the initial increase in science numbers there has been a decrease. This would seem to be the result of the job situation. Now it has to be pointed out here that although this change certainly affected the numbers in science, it also affected numbers in arts, humanities and law (see Figure 2 of Convert and Gugenheim [4]). However, public attention seems to have concentrated on the sciences.

As a consequence of the job situation many students who might have gone to university have turned to more vocational institutions and many students have simply gone straight to work omitting any tertiary studies altogether.

2.5. *Level in mathematics and science enrolments*

A close look at Figures 4 and 5 suggests that there could be a link between the number of students majoring in mathematics at the scientific baccalaureate and the number of students enrolling in science at the university. Figure 7 shows the correlation between these two series of figures. The coefficient of correlation amounts to 0.8. This seems to suggest

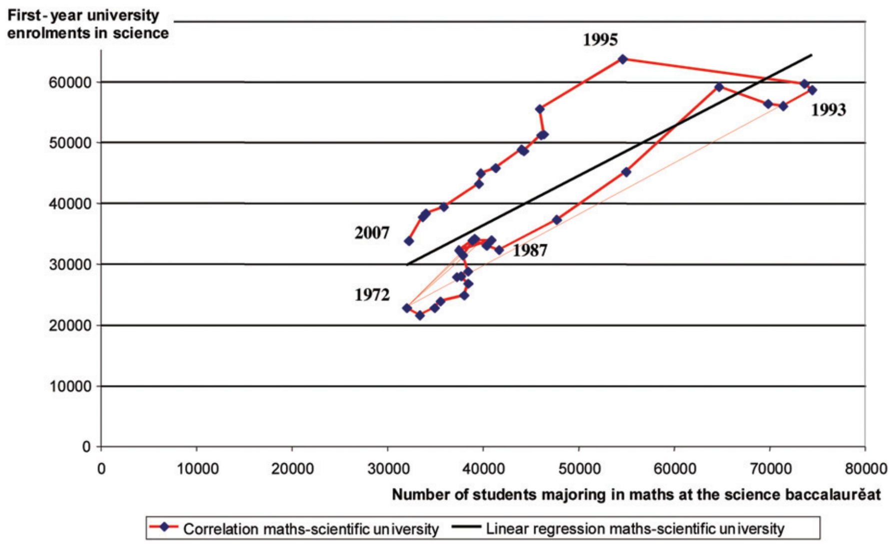

Figure 7. Correlation between students majoring in maths at the *baccalauréat* and first-year enrolments in science at the university.

that the decline of science at the university could have been produced, at least in part, by the fall of the level of ability in mathematics of French scientific students.

This should not be surprising: there is a lot of mathematics required in order for someone to be able to study physics, for example, and an insufficient level in maths can discourage students to go on in studying physics at the university. Some studies have shown that there is a very strong correlation between the mathematical level of a high school student, given by its grades, and his own opinion on his ability to continue with further studies in science.[9]

3. The link between jobs and enrolments

In this section, we look at a demonstrable link between availability of employment and enrolment. As with science everywhere, when there is a decline in student interest it is usual to put the decline down to factors associated with the subjects themselves. Things such as 'they are too hard', 'they don't lead to good jobs' and 'the teachers are boring' are often given as the reasons for this disaffection.

It is true that science is relatively hard. Evidence can be found for this in Biermans et al. [9] and Convert and Gugenheim [4, Table VI]. In the former article, Dutch secondary science students who chose a non-science discipline at university did so because they felt that their chances of getting a degree in that discipline were better than they were in science. In the latter article, it is noted that students who had taken a science baccalaureate did better than all other baccalaureate graduates in all degrees at university but, surprisingly, they were more successful in non-science disciplines than in science ones. But Convert [10] asks a pertinent question here: 'If scientific subjects both appear to be and are indeed difficult, why is this reputation dissuading students from studying them much more today than in the past?' Added to this is the work of French sociologist Boy ([11] and web sites in the references). He has asked the same range of questions such as 'Do you like science?' over a period of 30 years. Surprisingly, the level of response to those questions

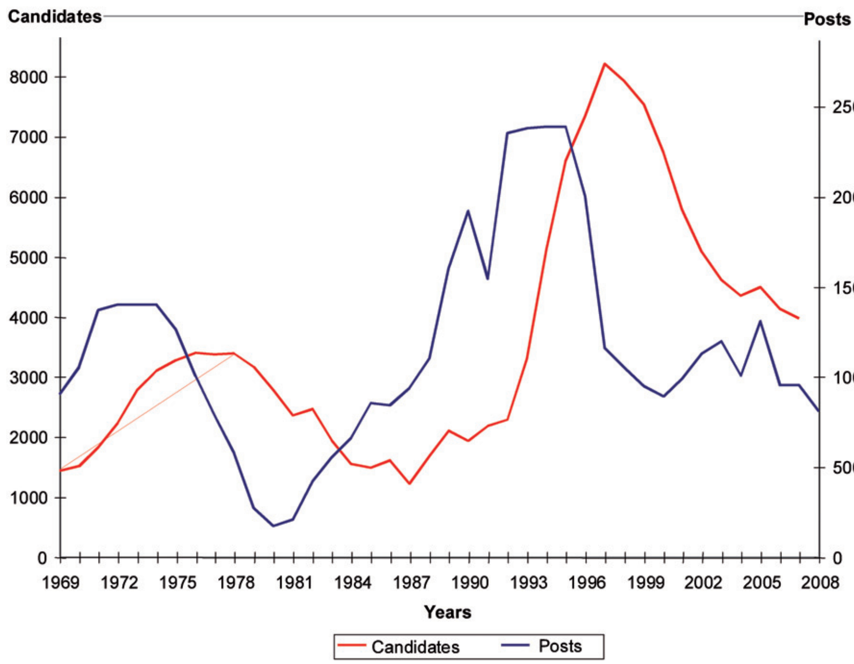

Figure 8. Numbers of positions plotted against numbers of candidates for high school mathematics teaching jobs.

has hardly changed in that period. This suggests that the changes in enrolments over that time have little or nothing to do with the disciplinary taste of students.

The other important factor in the decline of science numbers are the benefits a science education affords. There is evidence that students believe that non-science areas are more valuable today in terms of both pay and job quality. In Biermans et al. [9], Dutch science students with good school grades, opted for disciplines such as economics, law or medicine at university because they were not only less difficult but also more profitable. But there is even stronger evidence from France itself. Convert and Gugenheim [4] point out that skilled jobs in the public service pay well, have a good retirement scheme and good conditions. However, these positions are competitive. For those students who successfully gain such a job there are clear rewards, yet university graduates who are unsuccessful in these competitions have a greater difficulty getting a good job elsewhere than those from a vocationally oriented course.

But it is worth introducing another graph at this point that will help to explain what seems to be really happening here. In France, teaching positions are open to competition in a national examination and this is a job market which is in practice reserved for university students (and arguably one of the most valuable outcomes of university studies). Each year the government determines how many positions there will be for the next year and applicants compete for these positions. In Figure 8, we show two graphs comparing the number of positions each year from 1969 to 2009 with the number of applicants for those positions. It can be seen that there is a high correlation between the number of positions and the number of applicants 4 years later. This is no accident as the examinations take place in the fourth year of university, and it is probably the time needed to react to the changes in hiring patterns.

We have only given figures for mathematics here but similar results exist for people wanting to become physics teachers (or in fact any other subject, from literature to science) as well. So there is clear evidence to show that, in all disciplines, student enrolments are as least as susceptible to the job market as they are to the difficulty of a subject or to people's perception of the subject [12].

4. Summary

In this article, we have given an overview of the French education system and shown the changes in enrolments in science and maths at the baccalaureate and university levels. It would seem that recent declines in science at university, which follow a steep increase in the preceding years, are not due to a change in the taste or distaste of students for science. In a more prosaic way, they are the consequence, first, in a decrease in the number of science high school graduates due to a failed high school reform, and second, to bad conditions and particularly decreasing job prospects for university students, which discourages many new high school graduates from enrolling in university studies. There is concern, at least among academics, that this may well put France at a competitive disadvantage in the modern Europe.

A positive result of this study is that, if our conclusions are correct, student enrolments are not the result of unpredictable psychological factors, but of material conditions on which it is possible to act, if there is a will to do so.

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Notes

1. A more detailed account of the French education system with an emphasis on mathematics can be found in Dorier [13].
2. There were other sections at various times but these were studied by only a small percentage of the population.
3. During this time, the emphasis in mathematics (and physics) was on the experimental approach as against the more traditional approach. This seems in some way to mirror the 'math wars' of the United States that came to the fore at about the same time.
4. In 1986, J.P. Chevènement was the Minister of Education. The actual quote is '80% d'une classe d'âge au niveau du bac'.
5. Claude Allègre is a well-known specialist in Earth Sciences, a member of the French Academy of Sciences, a Special Counsellor of Lionel Jospin, Minister of Education, from May 1988 to April 1992 and Minister of Education himself from June 1997 to March 2000. When Lionel Jospin was Prime Minister, he was the project manager of the 'pedagogical renovation' for high school scientific studies.
6. 1 € = 1.5 $US.
7. *Démocratie, classes préparatoires et grandes écoles*. The proceedings of the conference (in French) can be found at: www.prepas.org/communication/colloquedemocratie/Colloque.pdf [14].
8. See *Démocratie, classes préparatoires et grandes écoles* [10, p. 36].
9. Poll SOFRES-French Ministry of Education-Usine Nouvelle, 2000, quoted in Maurice Porchet, [15, page 41].

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