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Abstract

After a long historical process, the principle of coeducation became accepted within the French education system, and since the 1980s the fight against gender inequality has been at the heart of educational reforms. The rationale for equality is not simply moral: gender inequalities slow down human capital accumulation and thereby slow economic growth.

The aim of this paper is to determine whether various recent reforms have led to a decrease in gender inequality, measured according to three dimensions: access to prestigious post-baccalaureate courses; access to "male" academic courses; and access to higher diplomas.

We use a multinomial logistic regression to compare the Cereq databases *Generation 1998* and *2010*. Our results show that in spite of a reduction in inequality, access to prestigious courses and access to higher diplomas remain affected by gender inequality. We also show that some "male" academic courses remain highly gender-biased. In this sense, then, we can conclude that human capital accumulation in France is not yet optimal.

Keywords: Access, France, Gender Inequalities, Higher Education, Human Capital Accumulation

JEL classification: C25, I23, I24, I28

If coeducation appears today as a fact of life, this is only as a result of a long historical process. Having applied only to primary schools at the end of the XIXth century, equality spread gradually up the educational levels, and so effective was this process of transformation that today it is inscribed in the legal conception of the education system itself: "*Schools, secondary schools, colleges and higher education are responsible for transmitting knowledge and working methods. They help promote coeducation and equality between men and women, particularly with regard to orientation…*"[1] [Article L121-1 of the French Educational Code].

During the 1990s, it was considered that progress towards education equality had been insufficient, and a new series of reforms were enacted. Equal opportunities lay at the heart of all these educational reforms, and the fight against inequalities – whether geographical, social, cultural or gendered – became a priority.

In a previous paper (Jaoul-Grammare, 2016), we assessed whether the reforms had allowed a democratization of higher studies with regard to five vectors of inequality – age, gender, cultural origin, geographical origin, and social origin. We showed that despite a reduction in some inequalities, access to various areas of higher education remained characterized by inequality, especially with regards to gender. We argued that this was important for economic as well as ethical reasons, since gender inequalities entail inefficient human capital accumulation and thereby slow down economic growth (Morrison et al., 2007; Amin et al., 2015).

Extending our previous work, we focus here on gender inequalities. The objective is to answer the following question: Have the various reforms led to a decrease in gender inequality in French higher education, and thereby to efficiencies in human capital accumulation and a climate more favourable to economic growth?

We frame our analysis with regards to three dimensions of gender inequality: access to prestigious courses; access to traditionally "male" academic courses, and access to higher diplomas. The baseline is indeed unpromising: for 2015 we observe that only 27% of girls entered engineering schools, and only 25% embarked on scientific academic courses (MEN, 2015).

The paper is organised in three parts: we first recall the long history of gender educational reforms in France (I). Then we present the data and the methodology used (II). In the last part (III) we discuss the results.

[1] "Les écoles, les collèges, les lycées et les établissements d'enseignement supérieur sont chargés de transmettre et de faire acquérir connaissances et méthodes de travail. Ils contribuent à favoriser la mixité et l'égalité entre les hommes et les femmes, notamment en matière d'orientation."

1. Gender equality reform in French education: a very long story

1.1. Economic advantages of decreasing inequalities

Many works have dealt with the relationship between economic growth and gender inequality. In 1973, Becker and Lewis showed in their Quality-Quantity model that when household income increases, parents prefer to have fewer children but to give them more education. This implies a decrease in the fertility rate and an increase in women's labour force participation. So economic growth enables a decrease of gender inequalities.

Becker (1960) also showed that an income increase implies a decrease in the fertility rate because of the increase in the opportunity cost of children; this results in women's incomes increasing more rapidly than men's, so we observe a decrease in gendered income inequality.

In a theoretical model, Galor and Weil (1996) highlighted the existence of a retroactive loop between economic growth and decreases in gender inequality, identifying three mechanisms at work. First, there is a relationship between the per capita wealth and the ratio of women's to men's wages, such that an increase in the per capita wealth implies an increase in the ratio of women's to men's wages because capital is more compatible with women's labour than with men's. Second, fertility depends on the ratio of women's to men's wages: an increase in women's income implies a more significant increase in the cost of children than in the total income: this implies a decrease in fertility. Third, a decrease in fertility implies a decrease in population growth, which implies an increase in per capita wealth. From these three mechanisms a virtuous circle emerges between economic growth and the reduction of inequality.

Most theoretical models agree that economic growth is favourable to decreasing inequality, but inequalities can also be harmful to economic growth (OECD, 2011). Gender inequality can affect economic growth through human capital accumulation, and through the assignment of production factors (Morrison et al. 2007). Indeed, if there is unequal investment in human capital between men and women, this will result in inefficient human capital accumulation and lower economic growth. This is all the more important since women's returns from education are higher than those of men. There is a similar result if there are barriers in the labour market which stop women accessing certain sectors of activity: production factors are not efficiently assigned and economic performance slows.

According to Dollar and Gatti (1999), an increase in education gender inequality implies a decrease in economic performance. Lagerlöf (1999) developed a model in which he assumes that the aim of parents is to maximize the future income of their children. If there are gender inequalities in education, it will be optimal for parents to invest in their boys, because girls can marry an educated boy whereas a boy can only marry an uneducated girl. This

reproduction of gender inequalities in education implies high fertility, and so weak investment in each child.

At the empirical level, many authors have analysed the influence of inequalities on economic performance. While most of them show a negative impact of inequalities on economic performance, some papers argue in favour of inequality. Barro and Lee (1996) found that girls' primary and secondary education had a negative impact on economic growth. Seguino (2000) showed that a decrease in the education gender gap combined with an unchanged wages gender gap, provides a source of cheap qualified workers who can improve national economic growth.

However, Schober and Winter-Ebmer (2011) called these results into question, agreeing instead with most of works on this topic: using Barro and Lee's database (1994), Brummet (2008) underlined that gender inequalities in education have a negative impact on economic growth. Using panel data regressions, Kalsen and Lamanna (2008) showed that gender inequalities in education and employment have a negative impact on economic growth. And Amin et al. (2015) confirm that greater gender inequality is strongly associated with lower economic growth.

So, the fight against gender inequality seems essential for efficient human capital accumulation and thereby for economic growth. Yet even though gender inequalities seem more sensitive to economic events than to political reforms (Jaoul-Grammare, 2014), many reforms have been adopted in order to reduce them.

1.2. The reforms

Although Condorcet had proposed opening primary schools to all children and alluded to girls' education as early as 1792, girls in France remained confined to domestic chores. Successive governments during the XIXth century strove to develop female education. In 1850, the Falloux law obliged municipalities of more than 800 inhabitants to have a girls' primary school. This threshold was reduced to 500 inhabitants by the Duruy law (1867). In order handle this new organisation of the educational system, in 1879 the Bert law obliged every department to create a girls' teacher training college, and the next year public secondary schools and public high schools for girls were created (the Sée law, 1880). Two years later, the Ferry laws were the first laws which did not enact differences between girls and boys: education became free, compulsory and secular for all children. However, there were already differences between boys' and girls' schools, which had different educational programs. At the end of the 1880s, municipalities of more than 500 inhabitants were obliged to have a girls' primary school or to replace it with a coeducational school (the Goblet law, 1886).

The First World War increased the demand for female education. On the one hand, more and more economic activities and masculine jobs were opened to women; on the other,

the war emphasized the availability to girls of higher studies. This movement was galvanized by the award of the Nobel Prize in Chemistry to Marie Curie in 1911, and the creation of the feminine baccalaureate in 1919.[2] The Bérard order (1924) unified boys' and girls' schooling programs and allowed girls to take the baccalaureate under the same conditions as boys. In 1930, schooling programs, schooling timetables and diplomas became the same for both, although teaching remained separate.

The 1950s and 1960s showed an important move towards coeducation, seeing its legalization in high schools (Berthoin reform, 1959) and secondary schools (Fouchet Reform, 1963); and with the Haby law (1975) coeducation was finally implemented at all levels of the French education system during the 1970s.

From the 1980s, the importance of gender equality became legally recognised, and the principle of coeducation appeared in many laws. In 1984 and 1989, there were agreements to diversify girls' choice of courses. The orientation law of 1989 indicated that primary schools, secondary schools, high schools and higher education should contribute to gender equality. At the beginning of the 2000s, an interministerial agreement proposed to promote women's access to the labour market (2000), and the term *coeducation* was registered in the orientation law (2005).

Following an interministerial decree, from 2006 to 2011 gender equality became an objective in its own right in many economic and political areas. From 2013 to 2018, six departments (Education; Women's rights; Labour, employment and professional training; Higher education and Research; Environment and rural affairs; School success) signed an interministerial agreement to promote gender equality in the educational system. However, despite a wealth of regulations in favour of gender equality in schooling, "*coeducation remains an incomplete goal*" (Report of the General Inspection of the Education Department [GIED], 2013, p. 9).

Taking this as a starting point, the aim of this paper is to determine whether the various recent reforms have really led to a decrease in gender inequality in French higher education. With this in mind, we study the influence of gender inequality on girls' attainment for two years: 1998 and 2010.

2. Did the recent reforms lead to a decrease in gender inequality?

The data used in this paper are drawn from the CEREQ[3] general databases "Generation 98" and "Generation 2010". They consist in longitudinal investigations with

[2] However, we must wait until 1968 to find as many girls as boys passing the Baccalaureate.

[3] CEREQ (Centre d'Etudes et de Recherche sur les Qualifications) is a French public institution which depends on the French Ministry of National Education, the Ministry of Economy, Industry and Employment and the Ministry of Labor, Social Relations, Family, Solidarity and Towns. It gives advice on educational policies and is expert in the production of statistical series at regional and national levels, as well quantitative research on

regard to the first years of working life, for young people who left the educational system in 1998 and 2010 respectively. The investigation provides indicators on schooling and labor market insertion. The database lists 55,000 individuals for 1998, and 33,000 for 2010. From these databases, we have selected persons with a training level equal to or higher than IV+.[4] We analyse the evolution of gender inequality between these two years. For this, we focus on access to prestigious courses, access to "male" academic courses, and access to higher diplomas.

2.1. Database and descriptive statistics

Access to prestigious courses is analysed via course choice after baccalaureate. There are six choices: *University*; *IUT* (diploma awarded after 2 years of technical studies, depending on university); *BTS* (diploma awarded after 2 years of technical studies, depending on secondary school); *CPGE* (post-secondary preparatory school);[5] Health and social training (*HST*); and Medical studies (*PCEM*). We have not considered business and engineering schools,[6] since they represent less than 1% of the sample of individuals. For this topic, all individuals in our samples are considered: that is to say, 28,827 individuals for 1998, and 14,611 for 2010.

The share of girls in higher education increased by two points between 1998 and 2010 (Table 1). The course choices which saw the highest increases are the post-secondary preparatory school (from 46.8% to 53.3%) and medical studies (from 60.9% to 76%).

Table 1. Share of individuals according to gender and course choice after baccalaureate

	1998		**2010**	
	Female	**Male**	**Female**	**Male**
BTS	45.9	54.1	45.1	54.9
CPGE	46.8	53.2	53.3	46.7
HST	89.8	10.2	86.7	13.3
IUT	37.4	62.6	36.5	63.5
Medical studies	60.9	39.1	76.0	24.0
University	63.1	36.9	66.1	33.9
Total	**54.8**	**45.2**	**56.8**	**43.2**

education, insertion and employment. Among the statistics produced by the CEREQ is the study entitled "Generation".

[4] Level 4 = Baccalaureate; Level 4+ = 1 year after baccalaureate; Level 3 = 2 years after baccalaureate; Level 2 = Both 3 and 4 years after baccalaureate; Level 1 = 5 years and more after baccalaureate.

[5] Elite schools (les grandes écoles) offer five-year courses including two years of initial preparation in preparatory classes (Classes Préparatoires aux Grandes Ecoles, CPGE). They are famous for their competitive selection entry exams.

[6] Engineering and business schools where students go just after the baccalaureate, and not after a higher degree.

Access to "male" academic courses is measured by students who chose university after the baccalaureate. The analysis is based on 15,895 individuals for 1998 and 8,131 for 2010. We consider eight academic courses: Chemistry, Law/Economics/Management, Humanities, Mathematics/Physical science, Mechanics/Electronics/Engineering, Health studies, Biology, and Sports.

If we look at the "male" specialties,[7] that is to say Mechanics/Electronics/Engineering, Mathematics/Physics, and Sports (Table 2) we observe that the share of girls remained stable for the first two, and slightly increased for the last (from 30% to 34.9%).

Table 2. Share of individuals according to gender and academic courses

	1998		2010	
	Female	**Male**	**Female**	**Male**
Chemistry	46.9	53.1	45.7	54.3
Law/Economics/Management	60.0	40.0	56.9	43.1
Humanities	70.9	29.1	68.0	32.0
Mechanics/Electronics/Engineering	17.9	82.1	17.8	82.2
Mathematics/Physical science	33.3	66.7	34.0	66,0
Sports	30.0	70.0	34.9	65.1
Health studies	61,6	38.4	80.6	19.4
Biology	53.0	47.0	55.2	44.8

Access to higher diplomas is measured by individuals who have at least a master's degree, numbering 6,072 for 1998 and 5,669 for 2010. We consider four higher levels of diploma: Master, PhD, Engineering degree, and Business Schools Master degree. The share of individuals according to gender and higher diplomas (Table 3) showed improvement, especially for those who had a PhD (from 47.4% to 63.6%) and an Engineering degree (from 23.2% to 31.2%).

Table 3. Share of individuals according to gender and higher diplomas (master's level)

	1998		2010	
	Female	**Male**	**Female**	**Male**
PhD	47,4	52,6	63,6	36,4
Business School Master's degree	51,7	48,3	51,0	49,0
Engineering degree	23,2	76,8	31,2	68,8
Master's degree	53,0	47,0	61,4	38,6
Total	45,5	54,5	55,8	44,2

[7] So-called "masculine" specialties are those whose intake comprises less than a third girls. Conversely, the "feminine" specialties comprise more than two-thirds. Between these two thresholds, specialties are considered "mixed" (Couppié & Epiphane, 2002).

In order to measure the real evolution of gender inequalities, we estimate a multinomial logistic regression.

2.2. Methodology

Problems of inequality are conceptually intractable, and it sometimes happens that results allow for different conclusions, depending on the populations to which evaluation methods are applied (Selz & Vallet, 2006): for instance, when odds-ratios are applied to the whole population, inequalities of access to diploma according to their origin seem to have decreased, but if we reduce the sample to a given degree, inequalities remain stable (Blossfeld & Shavit, 1993).

In order to study the evolution of gender inequality on course choice in higher education, on university sector chosen, and on access to prestigious courses, we estimated a multinomial logistic regression for each year (1998 and 2010). This is the generalization of the binary regression to a dependent variable Y which can take k values Y = 0, 1, … , k – 1. The objective is to analyze the effect of many variables of X on the choice of Y. The estimation of the model depends on the choice of a reference situation for Y, Y = 0.

The model is written as follows: $Ln\left(\frac{P(Y=i/X)}{P(Y=0/X)}\right) = \alpha_i + b_i(X) = \alpha_i + \beta_{ij}X_j$

This is equivalent to choosing Y = 0 as the reference and estimating k – 1 logistic binary regressions.

As $\sum_i P(Y=i) = 1$, the model becomes:

$$P(Y=0/X) = \frac{1}{1+exp[\alpha_1+b_1(X)]+\cdots+exp[\alpha_{k-1}+b_{k-1}(X)]} = \frac{1}{1+\sum_{i=1}^{k-1} exp[\alpha_i+b_i(X)]}$$

$$P(Y=j/X) = \frac{exp[\alpha_j+b_j(X)]}{1+\sum_{i=1}^{k-1} exp[\alpha_i+b_i(X)]}\text{, j=1,…, k-1}$$

Finally: $(Y=j/X) = \frac{exp[\alpha_j+b_j(X)]}{\sum_{i=0}^{k-1} exp[\alpha_i+b_i(X)]}$, j=0,…, k-1 and $\alpha_0 = \beta_{0l} = 0$

We estimate three models in which the dependent variable is respectively: post-baccalaureate course choice, academic course, and higher diploma. For the dependent variables, the reference is university, biology, and Business School Master's degree. We then evaluate the effect of gender on the various course choices.

3. Results

We present the odd-ratios for the three models. All coefficients are significant at 1% level except those where we cite "NS" (non-significant).

Concerning post-baccalaureate course choices (Table 4), we note a slight improvement in female access to prestigious courses (CPGE) with a decrease of the odds ratio from 1.9 to 1.7. On the contrary, technical studies saw an increase in gender inequality.

Table 4. Odds-ratios men vs women for post-baccalaureate course choices

	1998	2010
BTS	2.3	2.8
CPGE	1.9	1.7
IUT	3.2	3.8
FSS	*NS*	*NS*
PCEM	*NS*	1.8

* Read as: in 1998, a man was 1.9 times more likely to enter post-secondary preparatory school than university.

Concerning academic courses (Table 5), gender inequalities decreased in Sports, Health studies, and Chemistry. However, "male" academic courses saw an increase in gender inequality: in 1998 a man was 5.9 times more likely to access Mechanics/Electronics/Engineering academic courses than biology and 9.0 times more likely in 2010. For Mathematics and Physics, the odds-ratio increased from 2 to 2.5.

Table 5. Odds-ratios men vs women for academic courses

	1998	2010
Chemistry	1.3	1.1
Law-Economics-Management	0.7	1.2
Mechanics/Electronics/Engineering	5.9	9.0
Maths, Physical science	2.0	2.5
Sports	3.6	3.1
Health studies	0.6	0.4
Humanities	NS	NS

* Read as: in 1998, a man was twice as likely to access Mathematics and physical sciences academic courses than biology.

The last estimated model (Table 6) shows that gender inequality remained stable for PhDs and saw a decrease for the engineering degree; however, access to this diploma remains highly gender-related: men are 2.4 times more likely to have an engineering degree than a business school master's degree.

Table 6. Odds-ratios men vs women for higher diplomas

	1998	2010
PhD	1.7	1.7
Engineering degree	3.1	2.4
M2	NS	NS

* Read as: in 1998, a man was 1.7 times more likely to have a PhD than a business school degree.

In conclusion, it seems that coeducation does not entail greater gender equality. Success and failure in schooling, like success and failure in terms of occupational integration, remain gender related. More than just an educational phenomenon, this is a societal problem. Indeed, even if transformations in society have enabled girls to develop their abilities within the education system, social attitudes have changed much more slowly, resulting in rigidity of the labour market. The choice of orientation continues to follow stereotypes (Duru-Bellat, 2004; MEN, 2012) and both girls and boys still make their education choices based on what society assigns them as areas of competence: thus, having achieved excellence in mathematics, only 6 girls out of 10, vs. 8 boys out of 10, will choose a scientific sector. Thus, inadequate initial orientation means that girls have greater difficulties in labour market integration (Couppié & Epiphane, 2002).

Conclusion

The aim of this paper was to evaluate the efficacy of recent political reforms in reducing inequality. For the years 1998 and 2010 we estimated three models in order to measure the evolution of the impact of gender differences on three schooling choices: post-baccalaureate course choice and especially access to prestigious courses, academic course choice in particular access to "male" sectors, and access to higher diplomas.

Our results show that in spite of a reduction of inequality, access to prestigious courses and access to higher diplomas (especially engineering degrees) remain affected by gender inequality. We also show that inequality of access to "male" academic courses increased between 1998 and 2010. The intakes to the academic courses *Mechanics* and *Mathematics/physical sciences* remain highly gender-related.

We agree with the conclusions of the Education Department (2013) that "*the weight and the complexity of both internal and external factors which affect gender relationships […] are so important that policies have been unsuccessful for many decades*" (GIED, p. 22). As a consequence, "*School success and school failure, professional success and professional failure, remain gender-related phenomena*" (GIED, p. 26).

French human capital accumulation therefore does not appear to be fully efficient, and we can therefore conclude that an improvement in gender equality could have favourable results on economic growth based on better talent assignment – especially for the talents of women.

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