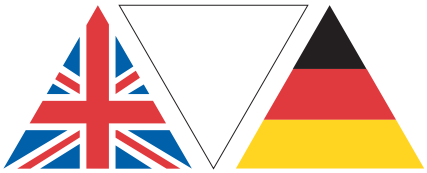

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The contribution of degree subject to the gender wage gap among graduates

Stephen Machin and Patrick A. Puhani

2004

The contribution of degree subject to the gender wage gap among graduates:

A comparison of Britain, France and Germany

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Acknowledgements

We are grateful to the Anglo-German Foundation and the Institute for the Study of Labor (IZA), Bonn, for supporting this project. We thank Holger Breiholz, Dragana Djurdjevic, Jean-Marie Jungblut, Markus Frölich, Vanessa Higgins, Michael Lechner, Paul Lüttinger, Sandra McNally, Ruth Miquel, Walter Müller, David Pevalin, David Rose, Lesley Sanders, Katarina Thomson, Barbara Wende, Thomas Wende, Rudolf Winter-Ebmer, Heike Wirth, Bernhard Schimpl-Neimanns, Markus Zwick and seminar participants of the Population Economics Group of the German Economic Association for helpful comments. Thanks also go to Georgios Tassoukis from IZA, Bonn, for sending us output files from the German Labour Force Survey. Michael Huber and Felix Brill provided excellent research assistance; any errors remaining are our own.

1 Introduction and Executive summary

It is a fact that women earn less than men. However, there is little consensus as to why this should be the case. In this project we focus on university graduates and show that degree subject is relevant to the gender wage gap. We draw on person-level data from Britain, France and Germany, and observe wages and degree subject for a large number of graduates. Wages differ by degree subject and women on average study different degree subjects from men. A stylised picture would characterise men as predominant in engineering and related fields, whereas women are predominant in education and language studies. This is true in all three major European economies. Because men concentrate more on financially rewarding subjects than women, degree subject can explain a significant share of the gender wage gap among graduates in all investigated countries. The importance of degree subject to the explained gap in wages ranges from 13–36% in our preferred specifications.

The findings that we report show that the subject studied in higher education matters for future labour market outcomes. At a given point in time in all three countries, a sizable portion of the wage differences between male and female graduates can be explained by degree subject. The cross-country pattern is less consistent when looking at changes through time. In Britain it seems that women have made much more headway than in France or Germany into studying degrees that pay off more in the labour market. Thus there has been a narrowing of the wage gap between male and female graduates in Britain, part of which can be attributed to convergence in male/female degree subjects, which has not occurred in the other two countries.

The findings of this project should be of interest to a number of parties. These include academics from various social science disciplines with an interest in gender, education and the labour market. The results should also be of interest to policymakers concerned with gender equity and how gender-specific disparities originate. Finally, employers whose labour demand over time has been increasingly shifting towards graduates, together with workers' representatives, may well be interested in the way in which different degree subjects are rewarded in the labour market, and how this contributes to different wages for men and women.

The structure of the remainder of the report is as follows: Chapter 2 discusses and summarises the large amount of data work carried out in the project, and presents descriptive statistics to motivate the analysis that follows. Chapter 3 presents the estimation results and Chapter 4 concludes.

2 Data and descriptives

A large part of the project consisted of the processing of five large person-level data sets for three countries over several years. Therefore, out of necessity, a considerable part of this report discusses data sources and definitions. Our analyses are based on two sets of data. First, we try to make use of recent comparable cross-sectional data sets for all three countries – Britain, France and Germany. Second, we seek to gather evidence over time for as long as we can for each country.

As to the cross–sectional evidence, the most recent year of available data on the required variables for all countries are the labour force surveys of the year 2000. We use the UK Labour Force Survey for Britain [BLFS] (Northern Ireland is excluded from the analysis). For France, we use the *Enquête de l'Emploi* (French Labour Force Survey [FLFS]), and for Germany the *Mikrozensus* (German Labour Force Survey, GLFS).[1] These surveys all carry very detailed information on degree subject studied. The number of degree types for which there are positive observations for both men and women in the age group 25–64 are 127, 76 and 73 for Britain, France and Germany, respectively. We use these numbers in our specifications with 'detailed degree subject'. However, we also generate 13 different broader degree subject types that are comparable across countries.

Table 1
Shares of degree subject by gender and country (year 2000)

	GLFS men [%]	GLFS women [%]	FLFS men [%]	FLFS women [%]	BLFS men [%]	BLFS women [%]
1 Medical and related	7.3	10.1	5.0	6.1	5.7	11.3
2 Agricultural and related	2.8	3.1	6.8	2.4	0.9	0.5
3 Natural sciences	6.9	4.7	12.6	11.5	14.5	9.1
4 Mathematical & computing	5.7	3.2	8.5	4.7	10.2	4.9
5 Engineering and technology	32.6	7.3	18.0	2.9	17.6	1.6
6 Architecture and related	3.3	2.0	1.1	0.7	3.9	1.4
7 Social sciences	13.1	15.1	14.4	20.6	11.6	17.1
8 Business and financial	11.3	9.8	16.1	13.7	16.3	12.0
9 Librarianship and information	0.4	1.2	3.1	3.5	0.5	1.4
10 Languages	1.6	5.3	4.7	20.2	3.9	10.7
11 Humanities	2.3	2.1	4.0	6.0	4.9	6.1
12 Arts	2.1	3.3	1.7	2.7	3.5	6.7
13 Education	10.7	32.8	4.1	5.0	6.6	17.3
# observations	17,125	9,244	3,034	3,483	4,573	3,795

[1] The GLFS now only records degree subject every four years, and the 2004 wave is not available yet. In addition, the last wave of the FLFS made available to us is 2000.

Table 1 displays these 13 degree types with sample means by gender for all three countries. As can be seen from the table, choice of degree subject clearly varies with gender in Britain, France and Germany. In addition, men and women specialise in similar degree types in all three countries. Spearman rank correlations of subjects of degree chosen by men and women *within* countries are 0.49, 0.46 and 0.73 in Britain, France and Germany, respectively. These rank correlations are mostly higher *between* countries for a given gender than *within* a country between genders: for men, Spearman rank correlations are 0.81, 0.87 and 0.74 between Britain and France, Britain and Germany, and France and Germany, respectively; for women, they are 0.76, 0.86 and 0.59 for the same pairs of countries, respectively. A stylised picture would describe men to be over-represented mostly in *Engineering/Technology*, whereas women are over-represented mostly in either *Education* (Britain and Germany) or *Languages* (France). Overall the table makes it very clear that gender gaps in degree subject exist, and that they are similar across countries.

Table 2
Gender shares, wages and degree subject (year 2000)

	GLFS men [%]	GLFS women [%]	GLFS net hourly income [€]	FLFS net hourly wage [€]	BLFS gross hourly wage [€]
1 Medical and related	7.3	10.1	16.9	15.5	20.1
2 Agricultural and related	2.8	3.1	12.3	15.1	14.9
3 Natural sciences	6.9	4.7	14.6	15.8	18.9
4 Mathematical and computing	5.7	3.2	14.9	17.6	21.4
5 Engineering and technology	32.6	7.3	14.2	15.9	21.6
6 Architecture and related	3.3	2.0	13.0	13.1	18.4
7 Social sciences	13.1	15.1	14.1	13.1	19.1
8 Business and financial	11.3	9.8	15.0	13.7	21.5
9 Librarianship and information	0.4	1.2	10.7	13.0	15.5
10 Languages	1.6	5.3	12.6	17.7	16.7
11 Humanities	2.3	2.1	11.6	14.7	15.7
12 Arts	2.1	3.3	11.8	14.8	14.9
13 Education	10.7	32.8	13.5	15.7	15.7
# observations	17,125	9,244	26,369	6,517	8,368

The final three columns of Table 2 display averages of our hourly wage measures in the three year 2000 labour force surveys by degree subject, together with sample shares of degree subject by gender for Germany as an example. Unfortunately, there are some differences in the measurement of labour productivity in the labour force surveys of the three countries. Ideally, we would like to observe hourly gross wages as the measure for labour productivity. This information is given in the BLFS. In the FLFS, only hourly wages net of social security are observed. In the GLFS, net hourly wages are given in intervals. The fact that taxes in Germany may depend on the income of the spouse makes it difficult to compare absolute magnitudes in hourly wages or gender wage gaps across our three countries. Nevertheless, Table 2 shows that in each country average hourly wages differ considerably by degree subject. Taking up the stylised result from Table 1 that men are over-represented in *Engineering/Technology*, whereas women are over-represented in

Education (Britain and Germany) or *Languages* (France), Table 2 demonstrates that, except for *Languages* in France, men are over-represented in the higher-earning of these two types of degree subject.

Spearman rank correlation coefficients show a positive correlation between hourly wage measures by degree subject across countries. The rank correlations are 0.29, 0.85 and 0.22 for Britain and France, Britain and Germany, and France and Germany, respectively. However, only the rank correlation between Britain and Germany is significantly different from zero. Wages in France seem to be ranked somewhat differently by degree subject than in Britain or Germany, at least in this raw form – i.e. unadjusted for labour market and socio-economic characteristics.

The analyses in Chapter 3 will decompose the graduate gender wage gap into a component explained by observed characteristics and an unexplained component. The observed characteristics we consider are *age*, *industry*, *region*, *part-time work*, *work in the public sector*, and *occupation*. The detailed information given in the year 2000 labour force surveys of the three countries allows harmonising of these characteristics so that almost all variables are defined in the same way across countries. A difficulty arises with *occupation*, where classifications differ significantly across countries. As sociologists have spent considerable effort in classifying occupations in terms of social classes, we use the social class codes that are either given directly in the data sets (as the *soclasm* variable in the British case) or implementable through programs as suggested in Schimpl-Neimanns (2003), Erikson and Goldthorpe (1992) and Brauns et al (2000). The classifications are based on (a selection of) the tasks a job entails, the position in the job hierarchy and the independence of the worker in the job. For France and Germany, we adapt the programs by Brauns et al (2000) to the 2000 waves of the labour force surveys to implement the Erikson et al (1979) occupation/social class categories.[2]

As one aim of this study is to investigate how changes in the structures of degree subject have influenced changes in the graduate gender wage gap, we aim to use person-level data for time periods as long as possible for all three countries. In Britain, the BLFS just started to collect data on wages for a subsample of the survey in 1993, so the BLFS is not best suited to investigate longer-term changes for Britain. Hence, we use the General Household Survey (GHS) instead, which allows analysis of the relation between the graduate gender weekly earnings gap and degree subject from 1980 to 1996 (after 1996 the degree subject variable has no longer been collected). The GHS does not allow measuring of *hourly* wages consistently across the observation period, so we consider *weekly* earnings of full-time workers. In addition, the many changes that the GHS underwent during the observation period do not allow the continuing classification of degree subject into the 13 types displayed in Table 1. Instead, the most detailed classification that can be consistently defined consists of four categories – namely, *Arts*, *Science/Engineering/Technology*, *Social Sciences* and *Rest/Combined Degrees*.

In the FLFS, degree subject was first introduced in 1990. However, only a subsample (mainly but not exclusively the incoming rotation group) were asked the new question and, from our investigation of the data and talks with the Statistical Office of France (*INSEE*), we are sceptical about the representativeness of the 1990 (and perhaps also the

[2] We thank Jean-Marie Jungblut and Walter Müller from MZES, University of Mannheim, for providing us with these programs.

1991) wave in terms of degree subject. Consequently, we investigate the period 1992–2000 for the impact of degree subject on the gender wage gap over time in France. Between 1994 and 1995, there was a significant change in the coding of the degree subject variable in the FLFS, which makes the definition of the 13 degree categories as in Table 1 unfeasible. Consequently, we have to resort to a coarser coding for the analysis across time. Nine categories can be defined consistently; these are: *Medical/Social Services and Related*, *Agricultural and Related*, *Science*, *Mathematics/Computing*, *Engineering/Technology*, *Architecture/Building/Planning*, *Social Sciences/Business*, *Language Studies* and, finally, *Humanities/Arts/Education*.

For Germany, we can use person-level data back to 1970. Although the *Mikrozensus* has been carried out since 1957, these old waves of data are not available (either because the micro data have been destroyed in the past or because they are not yet made available to science). What is available is a 1% sample of the 1970 West German census as well as scientific use files of the 1989, 1991, 1993, 1995, 1996 and 2000 waves of the GLFS (1998 is also available, but does not contain degree subject). In addition, the 1985 wave was for the first time made available for scientific research for this project.[3] Fortunately, there are great similarities in the designs of the 1970 census and the subsequent GLFSs. Hence, we are able to define as many as 54 different types of degree subject consistently across the 30-year period (1970–2000). A slight problem arises with the outcome variable (hourly wage). As already mentioned, income is measured in intervals. In the 1970 census, we measure labour income of natives; in the GLFS, we measure total income. Hence, to insure comparability across time, we only included natives and people stating labour as their main income source in the GLFS samples. An additional problem is that hours worked are given only in four broad intervals in the 1970 census. Consequently we cannot calculate hourly wages, unless we estimate labour income and hours by some midpoint of the intervals. Alternatively, we can estimate monthly income adjusted for dummy variables for hours worked, as surveyed in the 1970 census, in order to obtain a consistently defined hours-adjusted earnings measure for the whole period 1970–2000.

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[3] Data access in Germany is very difficult compared to Britain. Although the 1% sample of the 1970 census (*Volkszählung*) can be used for scientific analysis, one has to travel to the *ZUMA* institute in Mannheim to work on it (in other words, the data are not allowed to leave *ZUMA*). To work on the 1985 wave of the GLFS, one of the authors, Patrick Puhani, had to travel to the Federal Statistical Office of Germany in Wiesbaden, as these data must not leave the research centres of Germany's statistical offices. Perhaps because Patrick Puhani has apparently been the first person to work on the 1985 wave, it was an unpleasant experience trying to access these data. We applied to use the data in September 2003 and were only able to work on them in May 2004! It then took more than one month until the bureaucracy of the Federal Statistical Office allowed the result files – produced on 13th May 2004 – to be sent to Patrick Puhani: this was on 16th June 2004. The reason for this dismal state of affairs was German regulations rather than the people whom we contacted for data access. Indeed, we thank the research centre (*Forschungsdatenzentrum*) of the Federal Statistical Office for their moral support while going through a bureaucratic process which is not conducive to scientific research.

What is more, the scientific use files of the GLFS are not allowed to leave Germany. Without the help of IZA, Bonn, where we could run our computer programs, this project would not have been possible. In Britain, the world is completely different: we could download all the required data within very few days. One thing we learned from this project is that, although many people in Germany work at improving data access for science at the moment, Germany is still far from a system were science is provided in an uncomplicated way with basic person-level data, as is the case in Britain, for example.

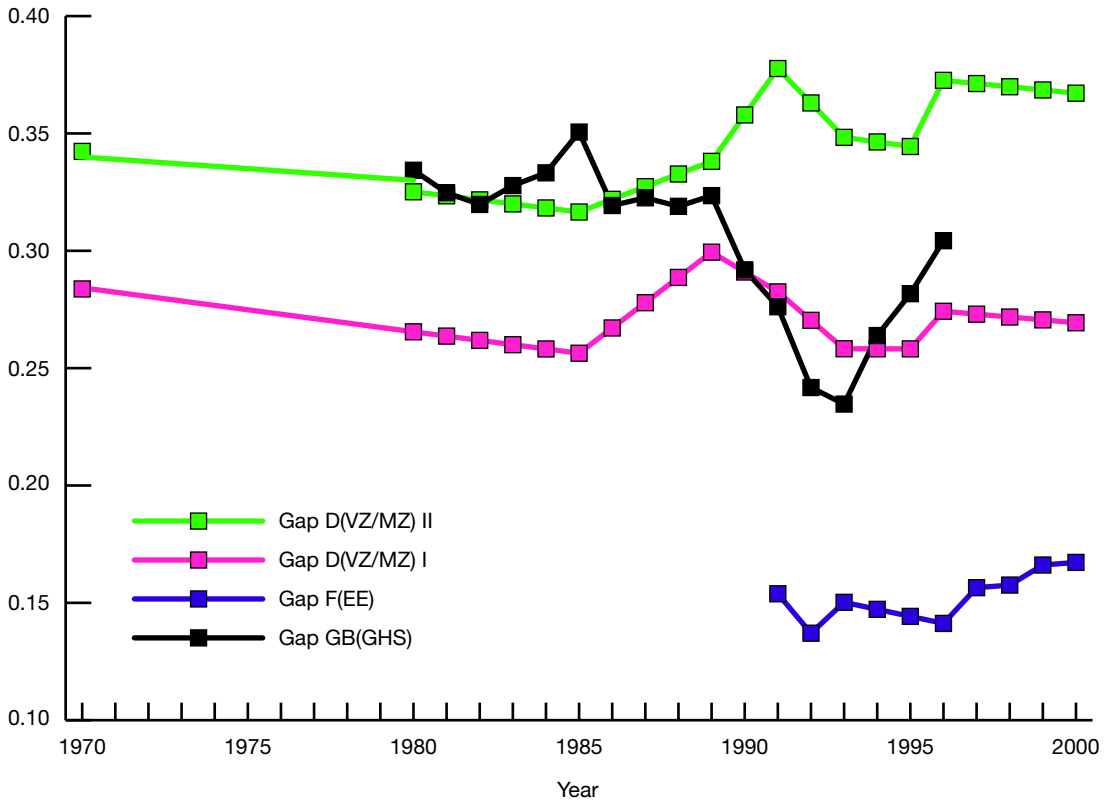

Figure 1
Gender wage/earnings gaps among graduates

Figure 1 displays the gender wage gaps (measured as explained earlier) for the time periods 1980–1996 for Britain (due to small sample size, we merged three years of GHS data and allocated the enlarged data set to the middle year, with the exception of 1980 and 1996), 1992–2000 for France and 1970–2000 for Western Germany. For Western Germany two series are displayed: Series I shows the gender wage gap measured at midpoints of earnings/hours intervals, whereas Series II measures the gender earnings gap adjusted by regression on dummy variables indicating hours-worked intervals.[4] (While we display both series, we prefer Series II because changes in the interval sizes across time make the often used method of choosing interval midpoints less consistent over time than an adjustment by dummy variables for hours worked.)

As exhibited in Figure 1, there is some sampling variation in the graduate gender wage gap as measured in our data. This is especially true for Britain (GHS), where the sample size is the smallest. However, the data show a declining trend in the gender wage gap for the period 1980–1996. Western Germany (our preferred Series II) between 1970 and 2000, and France between 1992 and 2000, actually display slight increases in the graduate gender wage gap. It is important to bear in mind that this is the gender gap among graduates and, as such, is a subset of the overall working population.

[4] Technically, Series II is the unexplained component of the gender earnings gap from a Blinder–Oaxaca (Blinder, 1973; Oaxaca, 1973) decomposition with only the hours-worked dummies as explanatory variables.

3 Empirical results

In this section of the report we investigate the role of degree subject, first in explaining the gender wage gap among graduates at a specific point in time (2000) and, second, in terms of accounting for changes in graduate gender gaps through time and across cohorts.

Degree subject and the gender wage gap in the year 2000 across countries

We start our analysis with the year 2000 labour force surveys which allow the most harmonised comparison across the three countries. We carry out the widely applied Blinder–Oaxaca (Blinder, 1973; Oaxaca, 1973) decomposition of the graduate gender gap. This decomposition is defined as follows:

$$\Delta \equiv \ln w_m - \ln w_f = \underbrace{(x_m - x_f)\beta_m}_{\text{explained gap}} + \underbrace{(\beta_m - \beta_f)x_f}_{\text{unexplained gap}} \quad (1)$$

where $\ln w_m$ and x_f refer to sample means of log wages and observed labour market characteristics of men and women, respectively. The first term on the right-hand side – i.e. the 'explained gap' – is the part of the gender wage gap due to observed differences in the *X*-variables between men and women. The second part, the 'unexplained gap', is a residual that arises due to differences in the returns to the *X*-variables between men and women. If these returns are estimated by ordinary least squares (OLS) regression, the decomposition holds by definition. Sometimes, the unexplained gap is interpreted as the part of the gap due to discrimination against women. However, the interpretation of the unexplained gap depends on whether all relevant differences between men and women are observed in the *X*-variables. Therefore, one has to be cautious in the interpretation of the explained and unexplained gaps.

The question is which variables can legitimately be included among the *X*-variables. Human capital variables like *age* (as a proxy for *experience*) and *education* (here we just consider graduates) are key determinants of labour market success. In our 'Specification 1', we include only *age* and its square as explanatory variables, and investigate how the explained gap changes if we refine our human capital measurement by adding *degree subject* to this specification. 'Specification 2' extends the set of *X*-variables by the inclusion of *industry*, *region*, *part-time* and *public sector*. These variables may measure preferences associated with compensating differentials in the labour market. The same is true for *occupation*, which we append to the list of variables in 'Specification 3'. If one likes to think of the Blinder–Oaxaca decomposition as determining the discriminatory component of the labour market, no variables should be included among the *X*s that are themselves outcomes of discrimination. *Occupation* is particularly controversial in this respect. To a lesser extent, one might also challenge the additional variables included in Specification 2. However, we believe that the preference component dominates in *industry*, *region*, *part-time* and *public sector,* and Specification 2 is therefore our preferred one.

Table 3
Human capital wage regressions and degree subject (year 2000)

	GLFS gap = 0.25			FLFS gap = 0.17			BLFS gap = 0.24		
	Without degree subject (DS)	With less detailed DS	With detailed DS	Without DS	With less detailed DS	With detailed DS	Without DS	With less detailed DS	With detailed DS
Specification 1 (Age, Age^2)									
$[\beta_m - \beta_f]x_f$	0.22	0.21	0.20	0.12	0.08	0.06	0.22	0.16	0.15
(s.e.)*	(0.01)	(0.01)	(0.08)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$[x_m - x_f]\beta_m$	0.03	0.04	0.05	0.05	0.09	0.11	0.02	0.07	0.09
(s.e.)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Percentage of GE**	13	18	21	27	51	66	9	31	38
AIGE by DS***	0.00	0.01	0.02	0.00	0.04	0.07	0.00	0.05	0.07
(s.e.)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)

*Standard error **Gap explained ***Absolute increase in gap explained by degree subject

Tables 3–5 display the decomposition results for the three specifications, respectively. All results are based on the year 2000 labour force surveys of the three countries. The gender wage gaps, although somewhat differently measured, are in a comparable range across countries with 0.24, 0.17 and for Britain, France and Germany, respectively. The percentage of the graduate gender wage gap explained by age alone is rather small, ranging from 9% in Britain to 27% in France. However, adding degree subject to the specification significantly increases the gap explained. We distinguish between 13 degree categories defined consistently across countries (columns headed 'less detailed degree subject [DS]' in the tables) and degree categories defined as detailed as possible (columns headed 'detailed DS' in the tables). As mentioned in Chapter 2, the latter include 127, 76 and 73 types of degree for Britain, France and Germany, respectively.

Table 3 demonstrates that inclusion of the 13 degree categories already raises the explained shares of the gap from between 9 and 27 to between 18 and 51 percentage points. Inclusion of detailed degree subject raises this share even more to between 21% and 66%. The standard errors on the 'absolute increase in gap explained by degree subject (AIGE by DS)' show that these increases are statistically significant.

Table 4 shows that similar results hold in our preferred Specification 2, where the set of explanatory variables is enlarged by *industry*, *region*, *part-time* and *public sector* dummies. Inclusion of these variables generally raises the explained part of the gap. An exception is Germany, where the high positive coefficient on part-time work (most likely due to the German tax regime), combined with a higher share of females in part-time work, technically leads to a reduction in the explained gap. Adding degree subject to these specifications raises the explained gap again, yet by a smaller amount than in Specification 1. In the models with detailed degree subjects, the explained gap increases from between 9% and 54% to between 14% and 70%. In all three countries, the 'AIGE by DS' is statistically significant, although in Britain only at the 10% level. Note that, if one includes only less detailed degree subjects, the 'AIGE by DS' becomes statistically insignificant in both Britain and Germany. This demonstrates the specificity of human

Table 4
Extended wage regressions and degree subject without occupation (year 2000)

	GLFS gap = 0.25			FLFS gap = 0.17			BLFS gap = 0.24		
	Without degree subject (DS)	With less detailed DS	With detailed DS	Without DS	With less detailed DS	With detailed DS	Without DS	With less detailed DS	With detailed DS
Specification 2 (Age, Age^2, Industry, Region, Part-time, Public sector)									
$[\beta_m - \beta_f]x_f$	0.23	0.22	0.22	0.09	0.07	0.05	0.11	0.10	0.09
(s.e.)	(0.01)	(0.01)	(0.07)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$[x_m - x_f]\beta_m$	0.02	0.03	0.04	0.08	0.10	0.12	0.13	0.14	0.15
(s.e.)*	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Percentage of GE**	9	11	14	45	60	70	54	59	62
AIGE by DS***	0.00	0.01	0.02	0.00	0.03	0.04	0.00	0.01	0.02
(s.e.)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)

*Standard error **Gap explained ***Absolute increase in gap explained by degree subject ***Standard error

capital investment at the high end of the labour market, as well as how choices of human capital investments differ between men and women at a very detailed level.

If one also adds *occupation* to the set of *X*-variables, the explained part of the gap increases substantially in France, somewhat in Germany, and falls slightly in Britain. As one might expect, inclusion of *occupation* decreases the incremental explanatory power of degree subject for the gender wage gap further. Indeed, the 'AIGE by DS' is now statistically insignificant in Britain and only significant at the 10% level in Germany. When less detailed categories of degree subject are included, the increase in the gap explained remains significant only in the French data. However, occupation may well be an outcome of degree subject choice, and we therefore do not put much emphasis on the results in Table 5, which may give a biased impression of the labour market outcomes of degree

Table 5
Extended wage regressions and degree subject with occupation (year 2000)

	GLFS gap = 0.25			FLFS gap = 0.17			BLFS gap = 0.24		
	Without degree subject (DS)	With less detailed DS	With detailed DS	Without DS	With less detailed DS	With detailed DS	Without DS	With less detailed DS	With detailed DS
Specification 3 (Age, Age^2, Industry, Region, Part-time, Public sector, Occupation)									
$[\beta_m - \beta_f]x_f$	0.22	0.22	0.21	0.05	0.03	0.02	0.11	0.11	0.10
(s.e.)	(0.01)	(0.01)	(0.07)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
$[x_m - x_f]\beta_m$	0.03	0.03	0.04	0.12	0.14	0.15	0.12	0.13	0.14
(s.e.)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Percentage of GE*	11	11	15	73	82	88	53	55	59
AIGE by DS**	0.00	0.00	0.01	0.00	0.01	0.03	0.00	0.01	0.01
(s.e.)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)

*Gap explained **Absolute increase in gap explained by degree subject

subject choice. Instead, Table 5 suggests that part of the effect of degree subject on the graduate gender wage gap works through the effect of degree subject on occupation.

Returns to degree subject and differences in degree subject by gender across time

Having established the significant impact of degree subject on the gender wage gap, we now investigate the impact of changes in the structures of degree subject on the development of the graduate gender wage gap over time. To this end, we estimate wage regressions separately for men and women from the data described in Chapter 2 in order to carry out decompositions as in equation (1). Figure 2 displays the explained part of the graduate gender wage gaps for all three countries for our preferred Specification 2. On a rough scale, the absolute size of the explained gap is similar across countries. In Britain and Germany, it falls over time, whereas it is roughly constant for France. However, if one plots the absolute increase in the gap explained by degree subject' (cf. Figure 3), there is a clear trend decline for Britain and France, but not for Western Germany: in Germany there is a slow decline from 1970 to 1996, but the increase in the gap explained by degree subject' jumps up from 1996 to 2000.

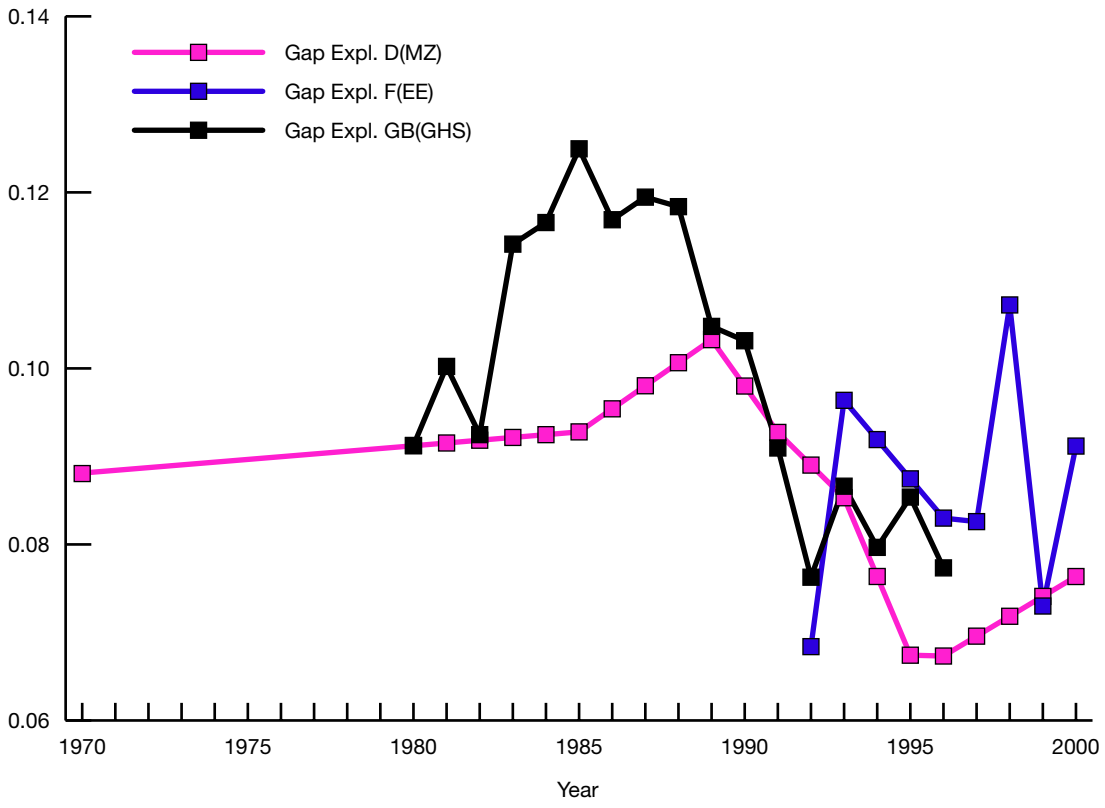

Figure 2
Gap explained in log points (including degree subject) (Specification 2)

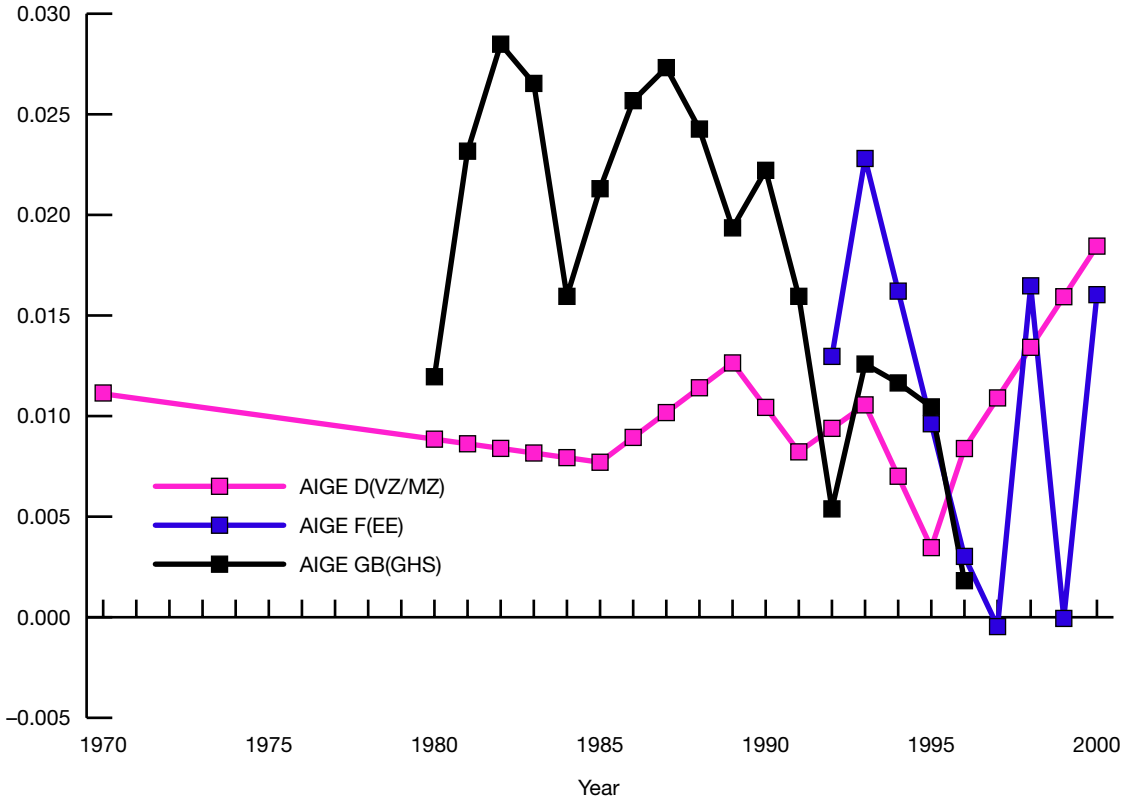

Figure 3
Absolute increase in gap explained (AIGE) due to degree subject (Specification 2)

Figures 4–9 show the development of the male degree subject coefficients and the differences in the degree subject shares between men and women for the three countries across time. For Western Germany, the observation period is longest (1970–2000). Although Figure 4 displays some movements of the estimated returns to degree subject across time, there is no massive change in the ranking across degree types: *Medicine* is clearly at the top, both in 1970 and 2000, and *Arts and Humanities* are at the bottom. In both years, *Engineering/Technology* carries a higher estimated return than *Education*, the latter subject being the 'female' and the former the 'male' degree subject as shown in the stylised results of Chapter 2 for the year 2000. Figure 5 displays differences in female–male degree subject shares for Western Germany from 1970–2000. The stylised picture that women are more inclined to study *Education* whereas men are more inclined to study *Engineering/Technology* is a prevailing feature across all three decades. Indeed, the relative predominance of males in *Engineering/Technology* even increased in the 1970s (probably related to the introduction of the polytechnics/*Fachhochschulen*, which might have benefited men, but might also explain the slight fall in the relative return to a *Engineering/Technology* degree after 1970). Although women have caught up and even overtaken men in their choice of *Social Sciences* as a degree subject, the relative return of *Social Sciences* to *Engineering/ Technology* has fallen according to Figure 4.

For Britain, we observe degree subject for the second longest time period, but can only define four coarse groups for 1980–1996. As for Germany, the ranking of degree subject remains largely unchanged over time, except that the category *Rest/Combined* (which includes medicine) in 1996 shares the top rank with *Social Sciences*, which was second in

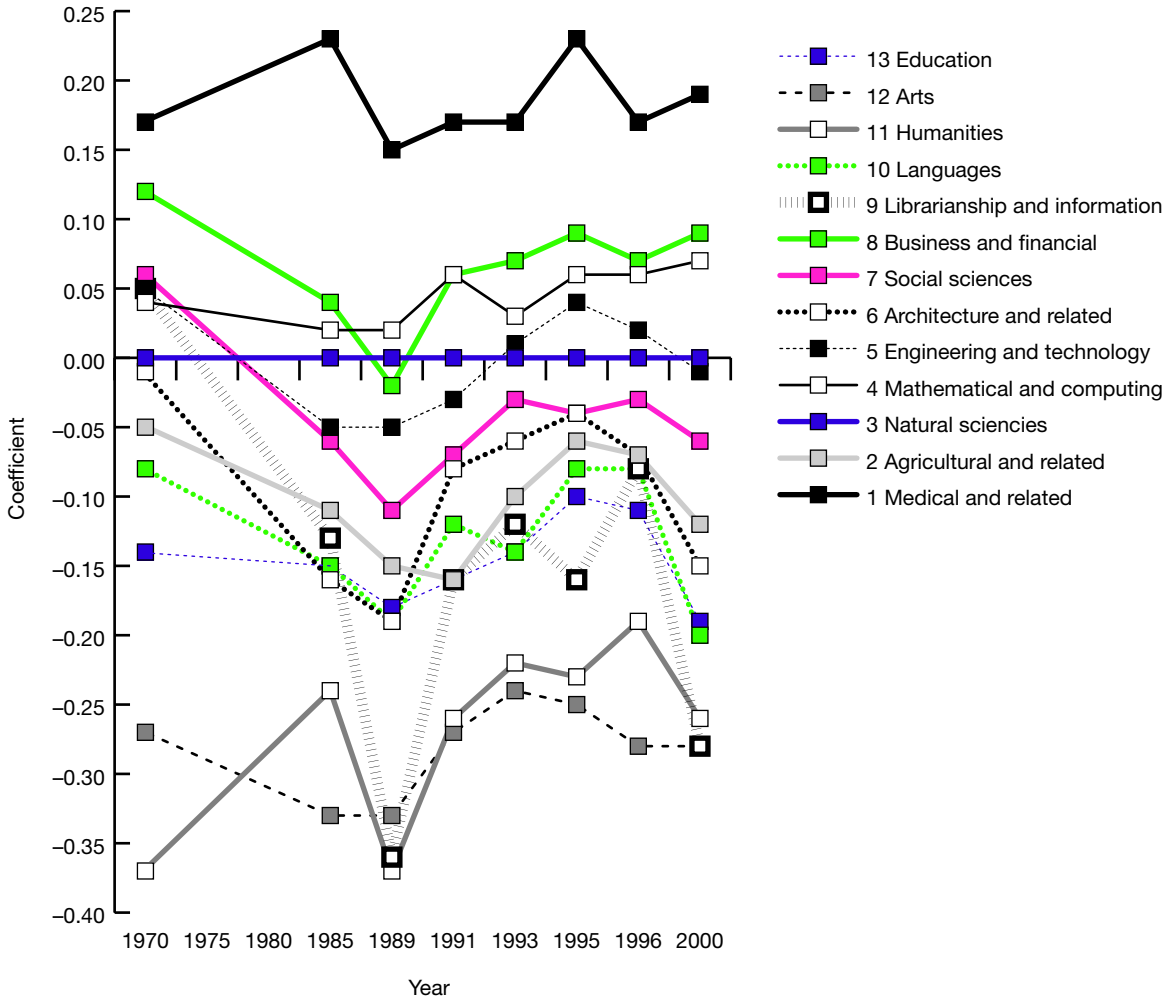

Figure 4
Male wage coefficients for selected degree subjects (Western Germany, Census, GLFS)

1980 (cf. Figure 6 on page 14). *Science/Engineering/Technology* has the third largest estimated return, whereas *Arts* is clearly at the bottom.[5]

An interesting contrast between Britain and Germany emerges by comparing the development of the differences in female–male degree subject shares in the two countries (cf. Figures 5 and 7). In Britain, the inequality in degree subject choice between men and women clearly decreased in 1980–1996 (Figure 7 on page 14), whereas this did not happen in Western Germany during an even longer period, 1970–2000 (Figure 5). Unlike in Germany, British women increased their choice of *Engineering/Technology* compared with to men, and reduced their relative choice of less lucrative *Arts* degrees. However, what is common to both Britain and Germany is the increasing relative inclination of women to study *Social Sciences.*

[5] The considerable variation in the relative return to *Arts* is somewhat of a puzzle to us. We have checked the coding and could not find a mistake, unless there was a change in the definition of degrees that is not contained in the data documentation of the GHS.

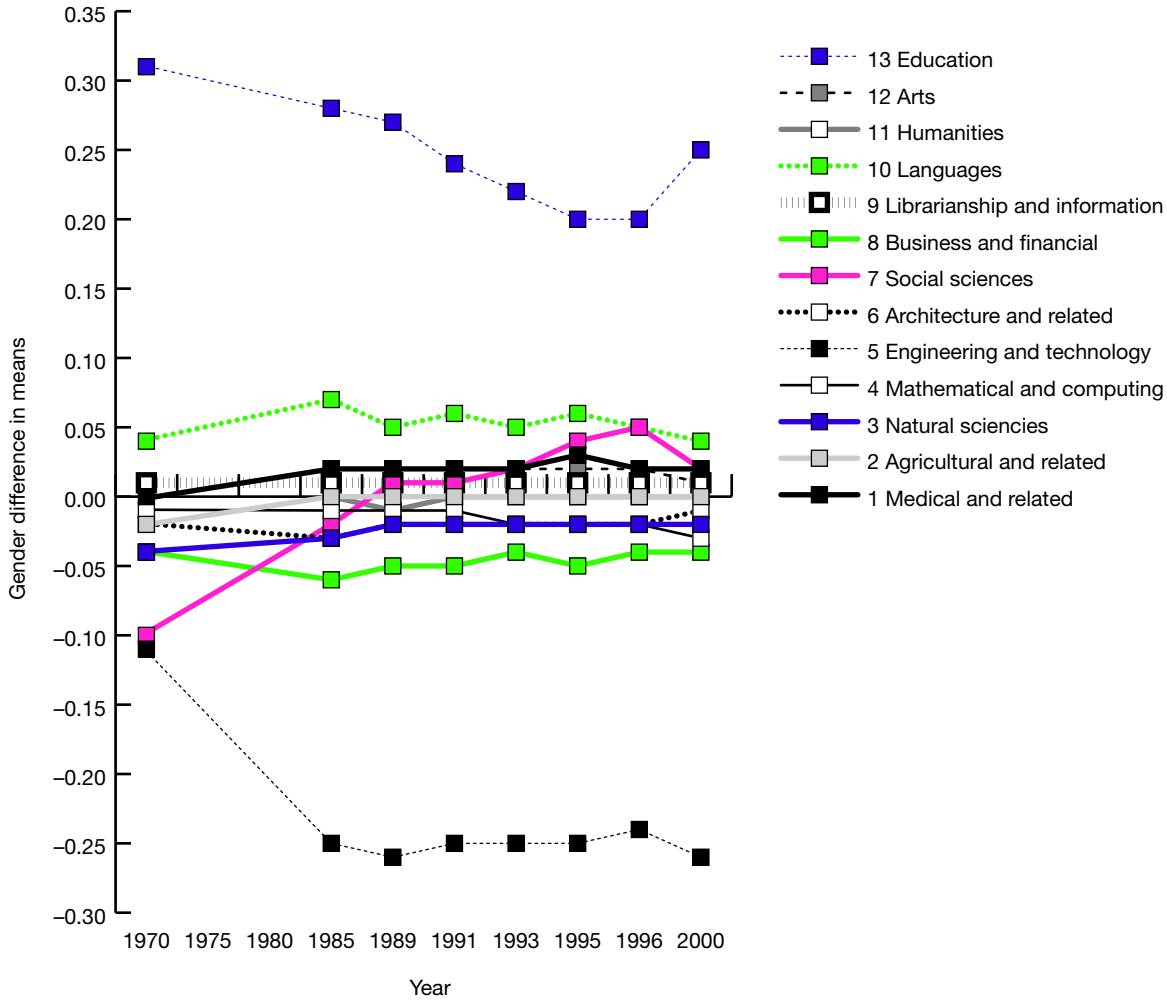

Figure 5
Difference in female–male degree subject shares (Western Germany, Census, GLFS)

As to France, we observe degree subject for a comparatively short time period. Figure 8 on page 15 displays the male wage coefficients.[6] Similarly to Germany and Britain, technical subjects like *Mathematics/Computing* and *Engineering/Technology* carry a relatively high return compared to *Languages* and *Humanities/Arts/Education* for almost all of the observation period 1992–2000. Figure 9 on page 15 shows that women have a higher propensity to study *Languages* relative to men throughout the observation period, whereas the reverse is true for the more rewarding *Engineering/Technology* degrees. However, as in Britain, the inequality in degree subject studied narrowed in France after 1993, even during this short observation period. Also, France is similar to Germany and Britain in that women have overtaken men in their inclination to study *Social Sciences*.

[6] As the coefficients change somewhat erratically over time, we have not displayed the coefficients of *Agricultural Studies* and *Architecture* here. These groups are comparatively unimportant in terms of size.

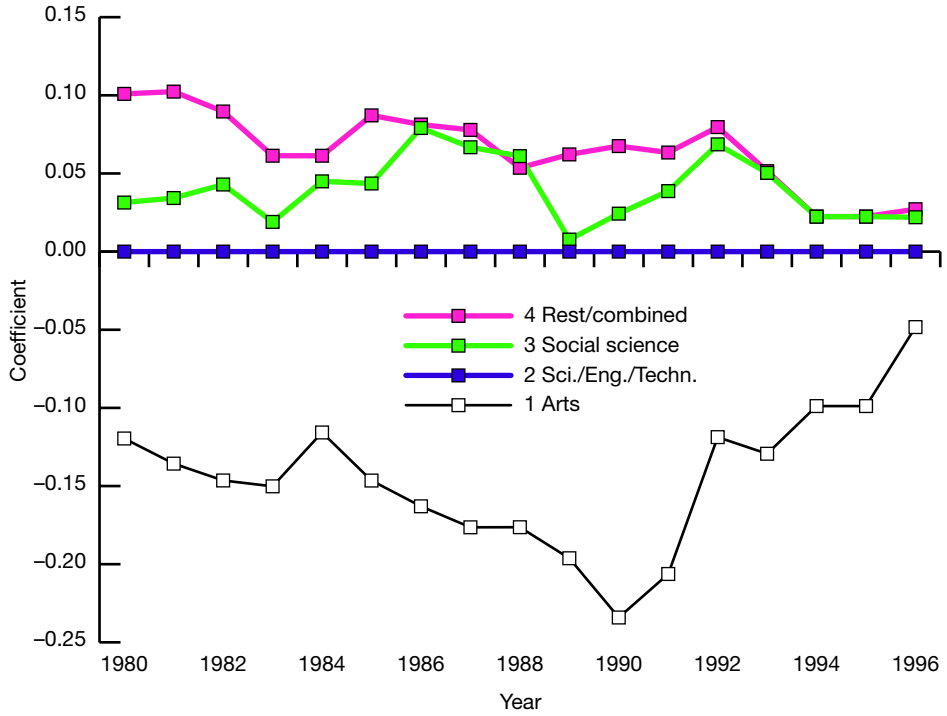

Figure 6
Male earnings coefficients for degree subjects (Britain, GHS)

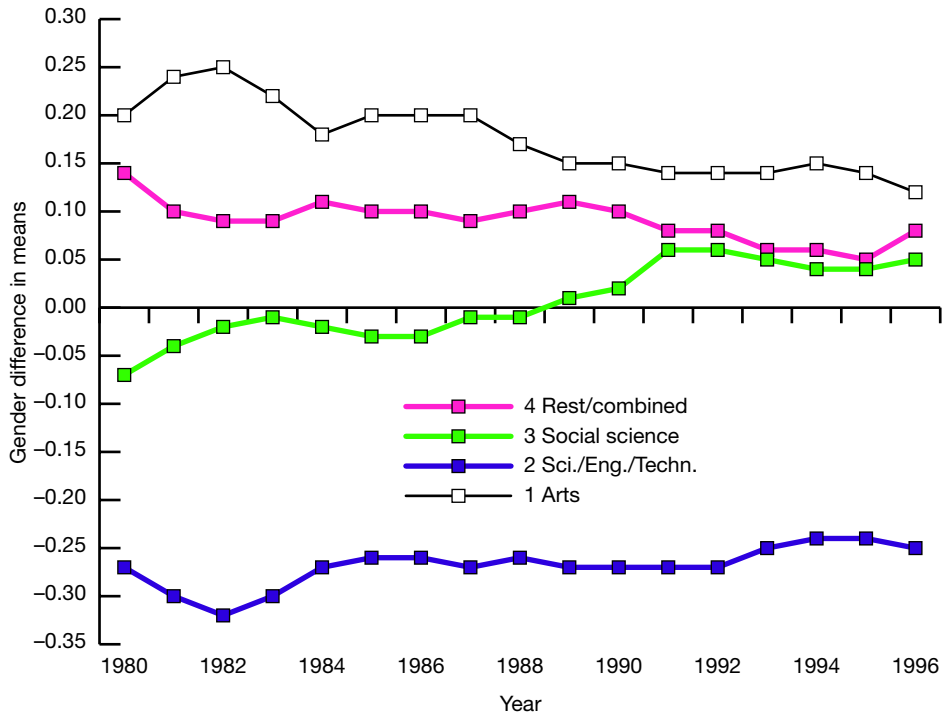

Figure 7
Difference in female–male degree subject shares (Britain, GHS)

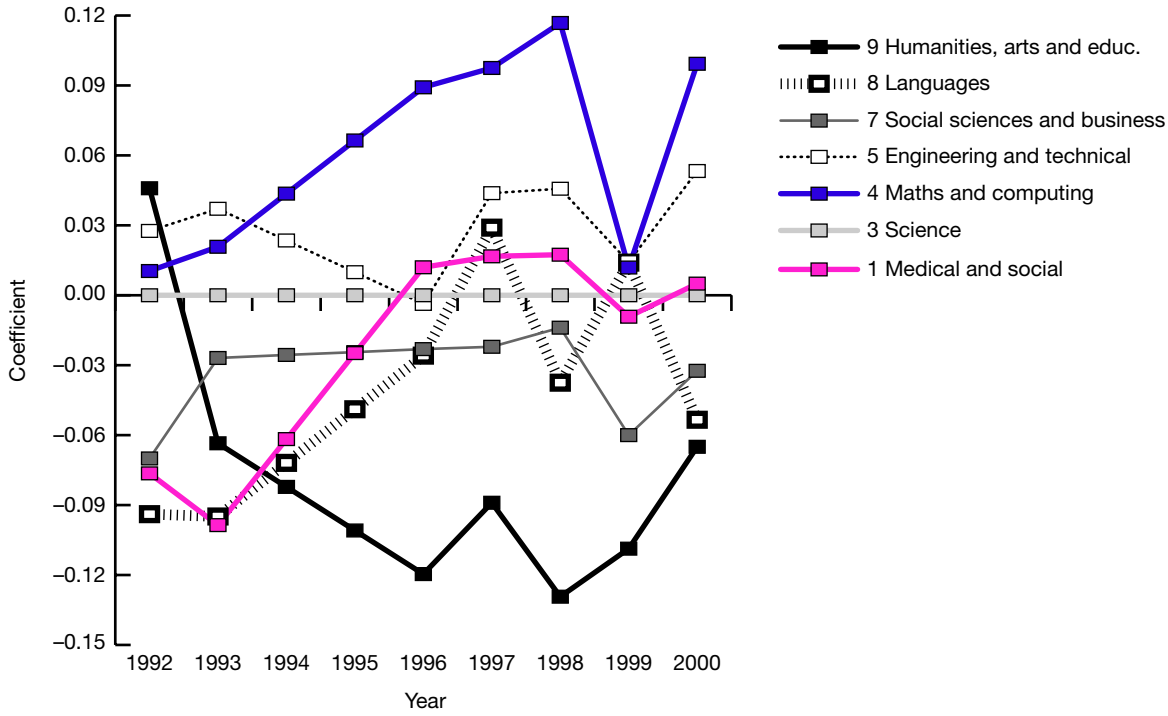

Figure 8
Male wage coefficients for degree subjects (France, FLFS)

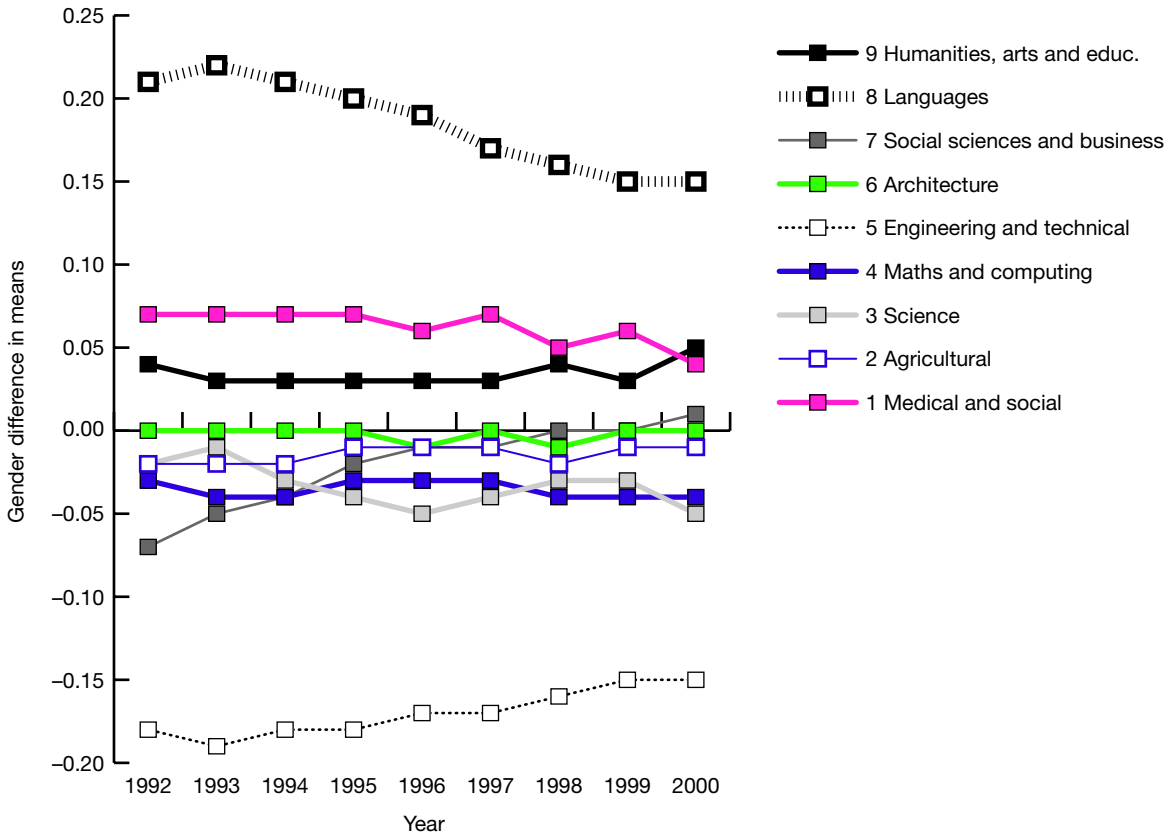

Figure 9
Difference in female–male degree subject shares (France, FLFS)

Decomposition of the change in the graduate gender gap across time

In order to summarise the results just discussed, we decompose the change in the graduate gender wage gap along the lines of Wellington (1993) and Lee and Miller (2004). The change in the gender wage gap can be decomposed as follows:

$$\Delta_1 - \Delta_0 = \beta_{m1}[\Delta x_1 - \Delta x_0] + [\beta_{m1} - \beta_{m0}]\Delta x_0 + [\Delta\beta_1 - \Delta\beta_0]x_{f0} + \Delta\beta_1[x_{f1} - x_{f0}] \quad (2)$$

where 0 and 1 indicate the beginning and the end of the observation period, respectively. Sample means by gender are indicated by x_f for females, for example, and Δ refers to a gender difference. The first two terms on the right-hand side are identical to the decomposition applied by Blau and Kahn (1997) (derived from Juhn et al1991), and refer to the changes in the wage gap due to changes in the differences between male and female characteristics and to changes in labour market returns to these characteristics, respectively. The other two terms refer to (changes in) the differences between males and females in the returns to labour market characteristics. These differences may arise either due to discrimination of women in the labour market or they may result from differences in unobserved labour market characteristics and their prices. The latter is the interpretation of the Juhn et al (1991) approach implemented in Blau and Kahn (1997). In the following interpretation, we will therefore refer to the last two terms of the decomposition of the change in the graduate gender wage gap as residual terms and focus on the first two terms instead.

Table 6 shows the decomposition results for Britain, France and Western Germany for our preferred Specification 2.[7] As already discussed in relation to Figure 1, the gender wage gap among graduates has only fallen in Britain. In France and Germany, it has increased.[8]

Table 6
Decomposition of the change in the gender wage/earnings gap across time (Specification 2)

	Britain (GHS) Change in gap 1981–1995: –4%			France (FLFS) Change in gap 1992–2000: 3%			Germany (GLFS) Change in gap 1970–2000: 10%		
	Without DS*	With DS	Difference	Without DS	With DS	Difference	Without DS	With DS	Difference
$\beta_{m1}[\Delta x_1 - \Delta x_0]$	2	1	–1	2	2	0	3	3	0
$[\beta_{m1} - \beta_{m0}]\Delta x_0$	–2	–2	0	0	1	0	3	4	1
$[\Delta\beta_1 - \Delta\beta_0]x_{f0}$	–5	–6	0	1	0	–1	–1	–4	–3
$\Delta\beta_1[x_{f1} - x_{f0}]$	1	3	2	0	1	0	5	6	2

*degree subject

[7] For Britain, we consider the period 1981–1995 in order to be able to increase sample size by pooling the data of the respective year with those of the two adjacent ones.

[8] Note that the seemingly large increase in Germany refers to the gap in labour earnings unadjusted for hours and therefore does not correspond directly to Figure 1, where the hours-adjusted earnings gap is displayed. However, this does not matter for our measurement of the impact of degree subject on the decomposition.

In all countries, changes in the differences in observed characteristics contribute to an increase in the gender wage gap. This may at first seem surprising in the light of Blau and Kahn's (1997) results on women 'swimming upstream' (meaning that, in a world of increasing labour market differentials where *ceteris paribus* would work to the detriment of women, women have improved their observed labour market characteristics by enough to even narrow the gender gap despite the increase in labour market differentials). However, considering Blau and Kahn's (1997) results in Table 2 (all workers) and Table 4 (high-skilled workers) of their paper, it emerges that the improvement of women's characteristics is mostly due to higher levels of experience obtained. As we do not measure actual experience, but proxy it by age, it is not surprising that our results differ. Indeed, we would expect this effect to show in changes in the differences between male and female returns to labour market characteristics. In fact, the third terms of our decompositions in Table 6 contribute to a fall in the gender wage gap, at least for Britain and Germany.

In order to summarise how far changes in the structures of degree subject have contributed to a falling graduate gender wage gap (note that this may occur even if the gender wage gap is rising as a whole), we compare the decompositions of the changes in the gap in the models with and without degree subject. The columns of Table 6 headed 'difference' subtract the decomposition components of the model with degree subject from those of the model without degree subject. If this difference is negative for the first terms, for example, it means that changes in the degree subject structures contributed to a fall in the graduate gender wage gap, as is the case for Britain. According to our calculations, this contribution amounts to about a quarter of the total fall in the graduate gender wage gap. For France and Western Germany, the estimated contributions are zero. These results roughly reflect the changes in the differences in female–male degree subject shares as displayed in Figures 5, 7 and 9.

Decomposition of the change in the graduate gender gap across cohorts

Although we have spent significant effort in harmonising variable definitions across time in the GHS, FLFS and GLFS, changes in the definitions of variables and designs of the surveys over time cast some residual doubt on whether our estimates derive from true changes in the economy or from changes in survey design. Therefore, we go back to the year 2000 labour force surveys and compare the graduate gender gap and female–male differences in degree subject across different birth cohorts. In Table 7 we display the decompositions of the gender wage gap between two sets of cohorts – namely, persons born between 1940 and 1954 on the one hand, and those born between 1960 and1974 on the other. For Britain, we observe a large drop (by approximately 16 percentage points) in the graduate gender wage gap between the older and younger cohorts. However, this is not true for France, where the gap is constant, or for Germany, where it even increases by 4%.[9] As in Table 6, the decompositions in Table 7 show no 'swimming

[9] Unlike in Table 6, the wage gap for Germany in Table 7 refers to hourly wages, not earnings, as hours are measured not in intervals but to the hour in the GLFS 2000.

Table 7
Decomposition of the change in the gender wage gap across study cohorts (Specification 2)

	Britain (BLFS) Change in gap 1960/74–1980/94: –16%			France (FLFS) Change in gap 1960/74–1980/94: 0%			Germany (GLFS) Change in gap 1960/74–1980/94: 4%		
	Without DS*	With DS	Difference	Without DS	With DS	Difference	Without DS	With DS	Difference
$\beta_{m1}[\Delta x_1 - \Delta x_0]$	4	2	–2	3	2	–1	7	8	1
$[\beta_{m1} - \beta_{m0}]\Delta x_0$	–1	0	1	–3	1	4	6	6	0
$[\Delta\beta_1 - \Delta\beta_0]x_{f0}$	32	29	–3	14	9	–6	–28	–32	–4
$\Delta\beta_1[x_{f1} - x_{f0}]$	–50	–46	4	–14	–12	2	19	22	3

*degree subject

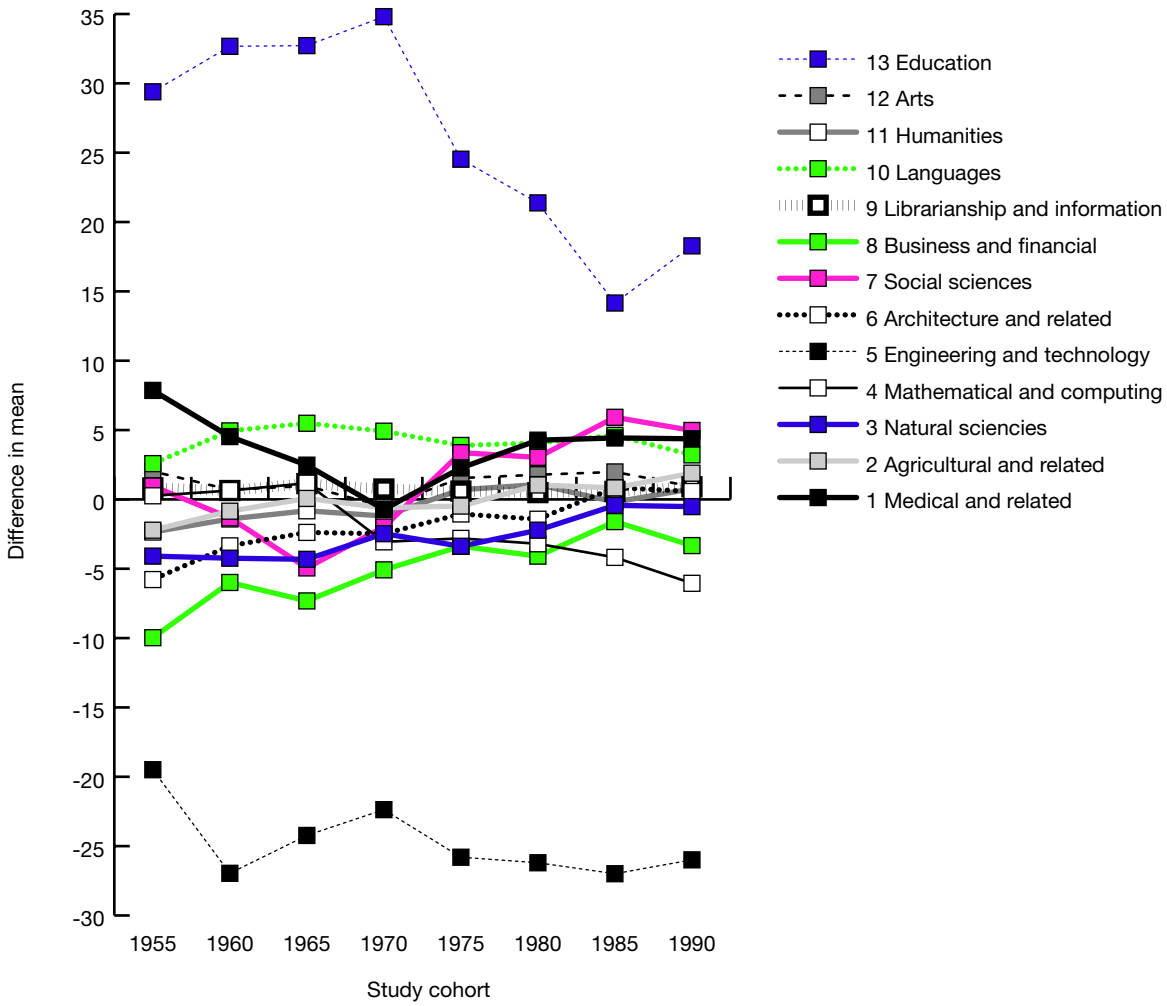

Figure 10
Difference in female–male degree subject shares by study cohort (Western Germany, GLFS)

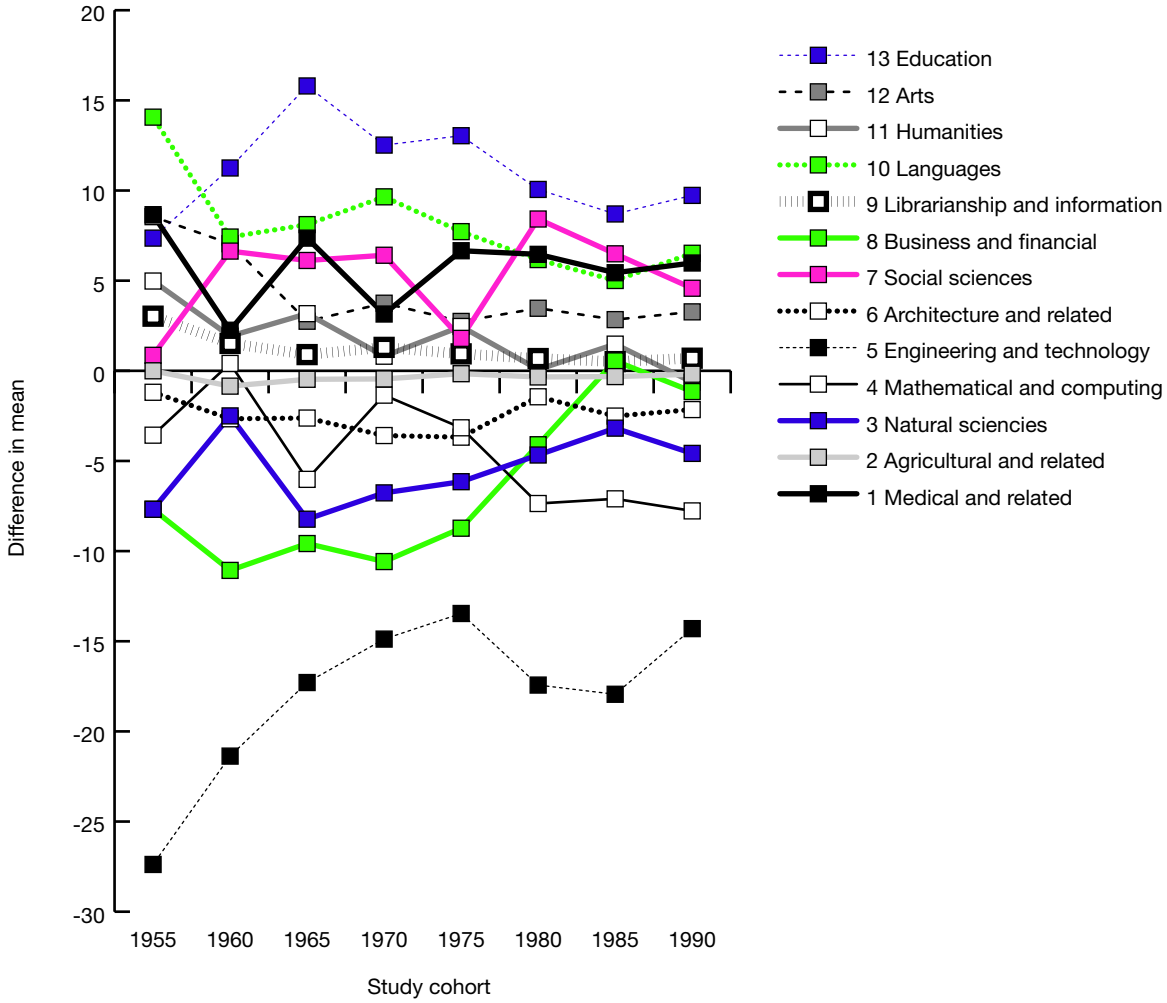

Figure 11
Difference in female–male degree subject shares by study cohort (Britain, BLFS)

upstream' effect for women. In addition, the difference in the components between the models with and without degree subject paint a similar picture as in Table 6: in Britain, younger women and men chose degree subjects associated with a narrower gender gap than older women (cf. the first component of the decomposition in the column headed 'difference'). The contribution of degree subject to the difference in the gender wage gap across cohorts is estimated to be around one-eighth. For France we also observe that younger women have caught up in terms of degree subject in relation to men, but to a lesser extent than in Britain. In Germany, the size of the effect is the same as in France, but in the opposite direction: here differences in degree subject by gender across cohorts are in fact more disadvantageous to women in the younger cohorts.

Figures 10–12 illustrate differences in female–male degree subject shares by 'study cohort' for Western Germany, Britain and France, respectively. As we observe only year of birth, a 'study cohort' is defined by year of birth plus 20. In addition, to achieve a large enough sample size, we combine five years together into one cohort. To give an example, the 'study cohort' 1960 are people born between 1940 and 1944 who were entering university roughly during the years 1960–1964. As in the previous graphs, considering changes in cross-sections over time, there is a clear contrast between Britain and Germany in the

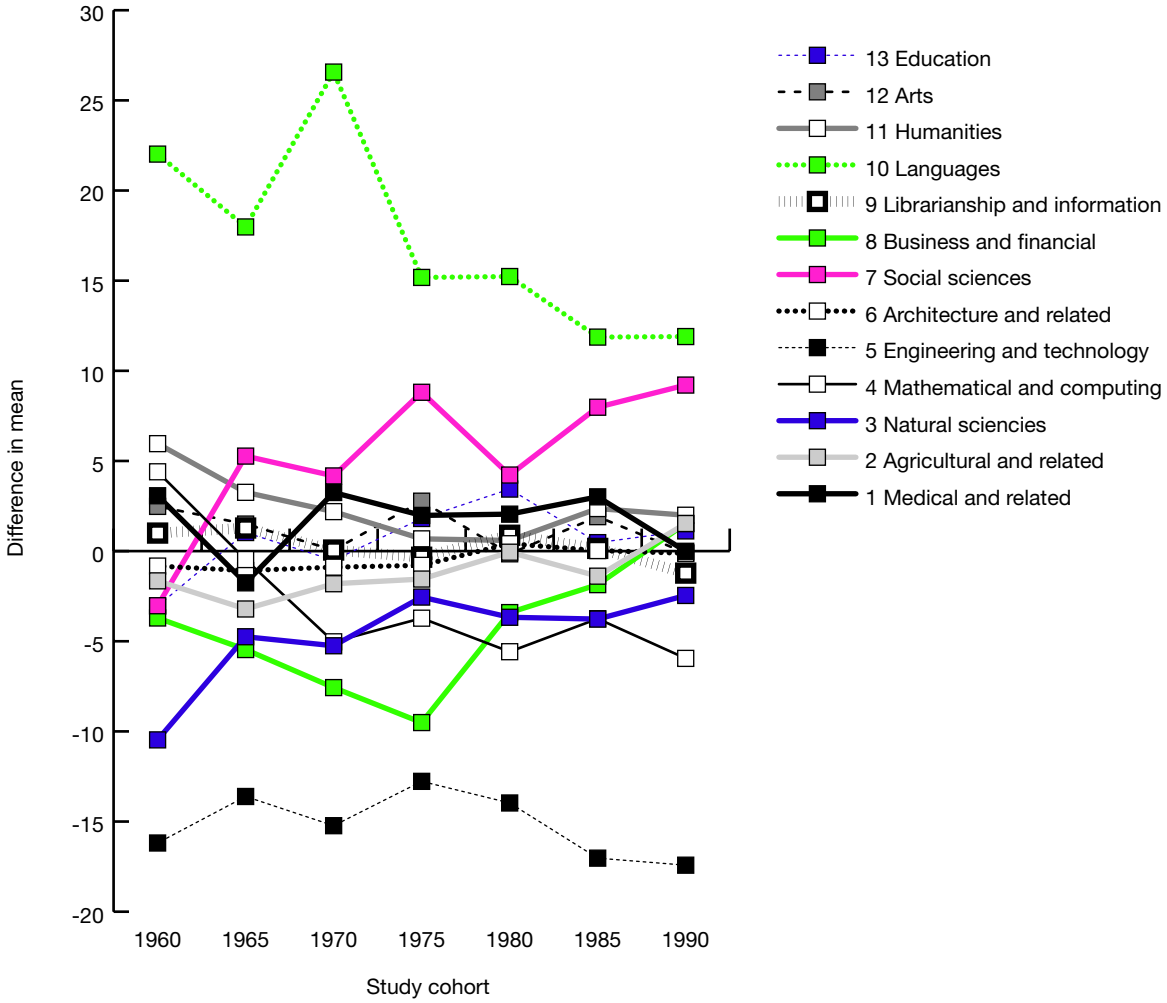

Figure 12
Difference in female–male degree subject shares by study cohort (France, FLFS)

sense that women did not catch up with men in their choice of *Engineering/Technology* as a degree subject.

The following chapter summarises our results with an outlook for further research into the questions addressed in this project.

4 Conclusions and outlook

In this research project we have investigated the impact of degree subject on the gender wage gap among graduates. We have started by establishing that, at a specific point in time, degree subject explains a significant part of the graduate gender wage gap. We have also analysed the contribution of degree subject to changes over time in the graduate gender wage gap in Britain, France and Germany.

The decline in the gender wage gap among graduates during the last few decades seems to be a phenomenon experienced by the Anglo-Saxon countries (here we considered Britain 1980–1996), but not by the continental European economies of France (1992–2000) and Western Germany (1970–2000). Moreover, we cannot speak of a general phenomenon in Western Europe (here represented by Britain, France and Western Germany) in the form of women moving increasingly into more highly rewarding degree subjects. This only holds for Britain and to a minor extent for France, not – according to our results – for Germany. As to returns to different degree subjects over time, we find some but no massive changes (France may be an exception, but this might also be due to sampling error). Given that in contrast to Germany, British women have been able to narrow the graduate gender wage gap by moving into more lucrative degree subjects, our results provide an empirical foundation for a policy informing women about the importance of (financially) rewarding degree subjects for their career advancement as well as for building institutions that facilitate women's choices of degree subjects with a high return.

In further research we want to investigate what drives the differences in the changes of degree subject choices between men and women across countries. In particular, the contrasting experiences of women in Britain versus Germany raise the question of the sources of these differences. One reason could be that students finish university in Britain at a much earlier age than in Germany, which is particularly advantageous for women as it allows them to enter working live at a time when they do not yet face a conflict between work and family life: the median ages at first degree are 21 and 25 years in Britain and Germany, respectively (own calculations based on the year 2000 labour force surveys of the two countries). However, there may also be other reasons for the different experiences that might lie in both the labour market and the educational institutions of the two countries. Investigating these issues is a highly policy relevant topic for future research.

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