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Abstract

This article examines the overall strength, the qualitative pattern, and the evolution over time of gender segregation in higher education across eight European countries. Although previous studies have focused primarily on the divide between humanistic and scientific fields, this work indicates that this divide accounts for no more than half of the association between gender and college major. The degree of gender imbalance is highly variable within scientific fields as well as within humanistic fields. We can make sense of these findings once we posit the existence of a second, equally important gender divide that can be described as the care–technical divide. Accordingly, this work develops a topological model to show that these two dimensions together account for more than 90 percent of gender segregation in the countries under study. Moreover, this model can be used to show the noticeable degree of cross-national stability in both the qualitative pattern and the overall strength of gender segregation. The empirical analyses also point to a generalized stagnation of integration of college majors in recent decades. Taken together, these results indicate that gender segregation has stabilized to an almost identical level and displays a similar qualitative pattern in several countries. This suggests that cultural forces underlying gender segregation are highly resilient, not least because they are sustained by a number of structural developments in educational and occupational institutions.

Keywords

sex segregation, higher education, fields of study, gender segregation, persistence

The issue of gender segregation in higher education is receiving increasing attention in sociological research, not the least because it is a key to understanding gender inequality in the labor market. For instance, it has been estimated that the choice of fields of study explains between 15 percent and 25 percent of the gender income gap among college graduates (Brown and Corcoran 1997; Bobbitt-Zeher 2007). Throughout the second half of the 20th century, Western countries experienced an impressive growth of female participation in secondary and tertiary education. This trend has been paralleled by an increase of female participation in the labor market. However, we are still a long way from gender parity in the occupational arena, and segregation at school is among the prominent causes of lingering inequality (Jacobs 1996; Smyth and Steinmetz 2008). Educational institutions still work as engines of gender inequality.

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Empirical research in the field indicates at least three well-established findings. First, gender differences in higher education are patterned along a humanistic–scientific divide. Indeed, the sociological debate has focused to a considerable extent on female underrepresentation in scientific fields. However, it is not clear whether this divide tells the whole story about gender segregation in higher education. The statistical analyses that are presented in this work indicate that this divide accounts for no more than half of the association between gender and college major. Moreover, these analyses show that the degree of gender imbalance is highly variable within scientific fields as well as within humanistic fields. I will argue that we can make sense of these findings once we posit the existence of a second, equally important gender divide in higher education that can be described as the "care–technical divide." Accordingly, I will draw from the literature on the micromechanisms underlying gender segregation to develop a topological model that shows that these two dimensions, that is to say the humanistic–scientific and the care–technical divide, together account for more than 90 percent of the association between gender and academic specialty. This is the first contribution of this article.[1]

Another well-established finding of empirical research is that gender segregation is a universal feature of higher education institutions. In particular, some large-scale comparisons have established that the underrepresentation of women in scientific fields can be observed worldwide (Ramirez and Wotipka 2001; Smyth 2001). At the same time, previous studies have documented that significant differences between nations exist in the degree of female under- or overrepresentation in specific academic specialties. The balance between cross-national similarities and differences in gender segregation across fields remains an open question. Charles and Bradley (2002) stress an important distinction in this regard between the overall level and the detailed pattern of association between gender and fields of study. The former refers to the intensity of the association between these two variables, whereas the latter refers to its qualitative structure. We may detect similar overall levels of gender segregation in two countries that differ greatly in their patterns of gender segregation, and vice versa. Charles and Bradley (2002, 2009) introduced this distinction to claim that both the levels and the qualitative contours of gender segregation reveal substantial cross-national variability. The topological model developed in this work offers a parsimonious description of the qualitative pattern of gender segregation. Hence, it becomes possible to reassess their findings concerning cross-national differences in this qualitative feature of gender segregation. At the same time, the so-called *unidiff* loglinear model is a proper tool to detect variations across countries in the overall level of gender segregation (Gerber and Schaefer 2004). The second contribution of this work concerns the noticeable degree of stability in both the overall strength and the qualitative pattern of gender segregation across eight European countries (Spain, Italy, Austria, Germany, the Netherlands, Czech Republic, Norway, and Finland) selected to represent a wide variety of arrangements of educational, labor market, and welfare institutions.

The third contribution of this work concerns variations across time. Previous studies have found that some desegregation occurred in the course of the 20th century in several Western nations, and there is evidence that this trend has contributed to weakening occupational segregation to some extent (Smyth 2002; England and Li 2006). However, although some scholars claim that desegregation in higher education is a long-term trend that occurred "slowly but surely" throughout the 20th century (Ramirez and Wotipka 2001), others find indications of a remarkable slowdown of this trend in the 1980s and 1990s, at least for the United States (Jacob 1995; Bradley 2000; England and Li 2006). If this is the case, there is little reason to be optimistic that further educational expansion will result in large reductions of gender inequality in the labor market. The empirical analyses presented in this article point to a generalized stagnation of integration of college majors in the last three decades.

Taken together, the results presented in this work suggest that gender segregation in higher education is highly resistant to change. Its noticeable degree of temporal and spatial stability, as well as the detailed examination of its qualitative pattern, indicates that cultural forces underlying gender segregation are highly resilient, not least because they are sustained by a number of structural developments in educational and occupational institutions, as discussed in the next two sections.

THEORETICAL FRAMEWORKS

Culturalist Perspectives

The standard sociological explanation for gender segregation in education refers to beliefs about the "natural" abilities and inclinations of males and females that still meet widespread acceptance in contemporary societies (Charles and Bradley 2002). Children and adolescents are continuously bombarded with deeply embedded expectations about what constitutes suitable gender-specific behavior according to parents, teachers, counselors, and peers. In daily routines children are induced to express beliefs, aspirations, and goals consistent with the prevailing gender categorizations, including sex-stereotyped educational preferences that will eventually shape their choice of college major (Marini et al. 1996). As part of the ongoing process of "doing gender," students must learn to manage their behavior according to the dominant normative conceptions of femininity and masculinity. Hence, women read more often than men in their spare time, and they learn to appreciate more topics and activities mobilizing empathic and aesthetic skills rather than "masculine" qualities, such as rigor and formal reasoning (Ridgeway and Smith-Lovin 1999). Such cultural pressures provide a well-known explanation for the existence of a humanistic–scientific divide in education between males and females.

However, a bulk of the literature on gender issues also stresses that sex stereotypes emphasize the nurturing role of women and their supposed natural predisposition to care activities (Charles 2005; Reskin 1993). Empirical studies often report these observations to make sense of female concentration in nursing or social work degree programs that prepare students for typical care occupations (Bradley 2000; Jacobs 1995). However, given the pervasiveness of sex categorizations, it may be expected that female students develop a more general preference for "fields characterized by functional or symbolic proximity to the traditional domestic role" (Charles and Bradley 2002:102). Then, we could anticipate a female preference also for fields like psychology or medicine that give access quite often to jobs characterized by their symbolic affinity with traditional caring roles, given their specific orientation toward the well-being and personal development of customers. From this perspective, when a girl chooses a scientific field like medicine, her preference looks less culturally subversive than it may seem at first glance. More generally, this argument leads to the expectation that those scientific fields associated with occupations emphasizing this care orientation should display a more balanced gender composition.

Let us take this reasoning one step further. One could suspect that gender stereotypes also affect educational decisions in a more subtle and indirect way; that is, they may shape attitudes toward second-best options in the occupational plans of upper-secondary graduates. For instance, a girl may develop an interest in history in high school, and she may choose to pursue a history degree because she aspires to become a historian. However, getting this kind of job is not an easy task; therefore, several history graduates may end up teaching in secondary education. A similar point can be made for graduates of other humanistic disciplines but also for a few scientific disciplines like mathematics and biology. Unlike fields like engineering or computing, some fields do not have a well-defined career path, and only a minority of their graduates gain access to jobs that closely match their education (Teichler 2007). Hence, students who enroll in these fields have to consider teaching as a second-best option, but who is more likely to find it acceptable? On one side, given the symbolic proximity of teaching to traditional caring roles, we can predict that girls are more prepared to consider this job as an acceptable compromise. On the other side, boys may regard it as a typical female, low-status occupation, and their ambitions will be directed toward more "masculine" (and better-paid) jobs.

In short, some fields of study prepare students for standard care jobs (e.g., social work), others give access more often to occupations that preserve a symbolic affinity with care jobs (e.g., medicine), and yet others can lead to a care job like teaching as a second-best option. In all of these cases, gender stereotypes about caring roles could be at work, albeit with varying intensity. This can be an important point if we consider that the "achievement barrier," which hindered female access to scientific fields in the past, has largely vanished in recent cohorts.[2] This trend may open room for some desegregation, but the previous argument implies that not all scientific fields of study are equally appealing to girls: Those with stronger direct or indirect connections to occupations that fit better into traditional gender stereotypes should score higher in their educational preferences.

Moreover, females' opportunities to gain access to these occupations are probably better given that the same gender stereotypes operate on the side of prospective employers and colleagues. For instance, in workplace cultures, engineering is perceived as a more "gender authentic" choice for men than for women (Faulkner 2007). Furthermore, service sector expansion increases the demand for jobs involving emotional labor, the ability to communicate, and other soft skills that are female-labeled (Charles and Grusky 2004). Postindustrialization favors the emergence of pink-collar occupational ghettos, where skilled and unskilled care work plays a major role. In short, structural developments sustain cultural stereotypes about gender in the creation of female-labeled "care niches" in education and in the labor market.

It must be recognized that other culturalist explanations have been proposed to account for gender segregation in higher education. In particular, hidden forms of social control are often identified as a complementary mechanism. Jacobs (1995) claims that sex-typed socialization is insufficient, by itself, to keep men and women on separate educational and occupational paths. Internalized preferences are effective to the extent that they are sustained by external pressures, such as subtle forms of discrimination and social control that channel women into female-dominated fields of study and jobs.

Unfortunately, it is not easy to document the existence and efficacy of these social control practices, at least with quantitative techniques. However, external pressures on field of study choice may work indirectly through educational decisions made at earlier stages, when students are particularly vulnerable to parental influences. This observation applies to curricular choice in high schools of some Anglo-Saxon countries or, in the case of several stratified European educational systems, to the choice of secondary school branch. For instance, parents may be persuaded that humanistic or teacher-training programs fit their daughters better; therefore, parents will press their daughters to focus on these subject areas (Entwisle, Alexander, and Steffel 1994). In turn, students who enroll in these tracks are more likely to develop a taste for humanities, pedagogy, or psychology that can affect their later educational decisions. Then, there is one more reason to expect that women should be more attracted to humanistic and care-oriented fields and that, on similar grounds, men should prefer scientific and technical fields.

A final point on culturalist approaches is that they do not entail unequivocal predictions about cross-national and cross-cohort differences in gender segregation in education. For instance, it can be argued that sociological neo-institutionalism incorporates several elements of the previous accounts, as far as they are referred to the early stages of modernization and globalization. However, this theory anticipates a progressive weakening of traditional forms of social control and discrimination, in the context of a delegitimation of ascribed inequalities in contemporary societies. If this is true, a long-term trend toward desegregation must be expected. Moreover, drawing on this theory, it can be predicted that countries with a more institutionalized tradition of gender parity and of female empowerment display lower levels of gender segregation (Ramirez and Wotipka 2001). A comparison between Scandinavian and Mediterranean nations should be rather telling in this regard, because the latter have inherited a strong Catholic tradition that promotes a familist ideology and encourages a traditional division of work (Esping-Andersen 1998).

Against this background, Charles and Bradley (2002:575) argue that sex segregation in education is highly resilient because the gender stereotypes that sustain it are highly resistant to change. Such stereotypes are easily reconciled with an "equal but different" view that finds widespread social acceptance (Charles and Grusky 2004). According to this view, formal gender parity does not preclude the existence of "natural" differences of talents and inclinations between males and females. In other words, gender stereotypes are also difficult to contrast because individuals do not perceive them as discriminatory.

Moreover, the literature on labor market segregation (Charles 2005) suggests that postindustrial occupational structures tend to favor the concentration of women in specific occupations, for instance, because of the expansion of sales and care work. Given the connections between education and occupational destination, Charles and Bradley (2002) argue that these pressures favor persistent segregation in higher education. From this point of view, Scandinavian and Mediterranean countries can be conceived as opposite extremes, but this argument gives a reason to expect more gender segregation in the former. Indeed, this expectation matches the well-known finding that Sweden is one of the most gender-segregated economies among Western nations (Chang 2000; Charles 2005).[3] However, I argue in the next section that some rational choice explanations for gender segregation in education lead to the opposite hypothesis about cross-national differences.

Rational Choice Models

Rational choice models challenge culturalist approaches in that they account for gender segregation in education in terms of cost–benefit calculations where gender norms and sex-stereotyped preferences only play a marginal role. Along these lines, economists have suggested that female students prefer fields of study connected to occupations with higher initial earnings and flatter earnings profiles that minimize the costs of labor force interruption (Polachek 1981). However, when Jacobs (1995:21) reviewed empirical studies testing this hypothesis, he concluded that "the evidence on earnings trajectories has been devastating to this earnings-profile explanation" (see also England et al. 1988).

The comparative advantage hypothesis offers an alternative explanation within the framework of rational choice theory (Jonsson 1999; van de Werfhorst, Sullivan, and Cheung Sin 2003). As already mentioned, absolute differentials between male and female students in mathematical and scientific achievement have considerably narrowed in recent decades. However, relative differentials in academic achievement may still play some role: Even if gender differentials in scientific subjects are small, it is still the case that girls outperform boys in humanistic disciplines. Therefore, it would be rational for them to enroll in humanistic degree programs to maximize the probability of success of their investment in education.[4] However, is this argument a real rational choice explanation? This is doubtful for at least two reasons: (a) Today, girls have good chances to succeed in scientific disciplines; (b) scientific degrees are generally more rewarding in the labor market (Bobbit-Zeher 2007).

A more plausible rational choice explanation refers to anticipated family obligations (Becker 1991). The argument here is that women prefer fields that offer better opportunities to combine family and work duties. For instance, part-time jobs, as well as some occupations in the public sector (e.g., teaching), may attenuate family–work conflicts. Hence, some fields (e.g., teacher education) may be preferred by female students because they give access to female-friendly jobs. However, we could easily mention some highly feminized occupations that do not fit well into this argument (e.g., nurse, social worker). Moreover, it is unclear why women who plan to graduate from university should anticipate a traditional division of domestic work: If they do so because of internalized norms and beliefs about gender roles, we come back to the culturalist approaches discussed in the previous section.

At any rate, this hypothesis leads to the expectation that countries offering better opportunities to conciliate family and work obligations, for instance, by favoring access to childcare services, should exhibit lower gender segregation. Mediterranean and Scandinavian nations may again be described as opposite extremes, with countries of continental Europe in between them, with respect to welfare state support of women's employment. As far as trends over time are concerned, this explanation does not lead to unequivocal predictions. However, the tremendous development of nursery schools in all countries under analysis should work in the direction of a downward trend of segregation.

Summary

On the whole, this theoretical discussion points to three main conclusions. First, although several competing hypotheses have been proposed, culturalist approaches focusing on sex-stereotyped expectations about curricular choice, possibly sustained by direct forms of social control, offer the most compelling explanation for gender segregation in higher education. To be sure, this is not to say that field of study choice is not driven by some evaluation of opportunities and constraints associated with the investment in education. However, rationality is culturally embedded in social practices and beliefs shaping students' preferences, which, in turn, enter their utility function.

A second point is that drawing on this theoretical framework, I would expect to find not only a scientific–humanistic divide in higher education but also a care–technical divide. Both are grounded in social stereotypes about "natural" differences between males and females. However, they must be distinguished because not all humanistic fields display the same care orientation and because not all scientific fields display the same technical orientation. For instance, although teacher training programs are not less humanistic than philosophy programs, the former are more care-oriented; although biology is as scientific as computing, there are reasons to expect that the latter will be more masculinized, because of its technical orientation; a scientific field like medicine often leads to care-oriented jobs in the health sector. It can be noted that the scientific–humanistic divide is grounded in the curriculum content of degree programs, whereas the care–technical divide relates more to their subsequent career applications. Hence, the implicit assumption is that choice of field of study is driven by both decision criteria.

A third point is that different explanations lead to different expectations about variations in gender segregation across time and space. It should be recognized, however, that their implications are not always unequivocal. Therefore, it is difficult to formulate straightforward hypotheses in these respects. Having said this, it seems reasonably clear that neo-institutionalist theory predicts a long-term trend toward desegregation, whereas the "separate but equal" perspective anticipates that this trend has come to a halt in recent decades. As for cross-national comparisons, different explanations for gender segregation entail different hypotheses, but in all cases we are led to contrast Mediterranean countries (Spain and Italy) with Nordic countries (Norway and Finland, but also the Netherlands to some extent), whereas countries of continental Europe (Austria, Germany, Czech Republic) should lie in between them, with respect to the strength of gender segregation. In the next section, I present the data used to assess these hypotheses.

THE REFLEX SURVEY AND THE EULFS

The data for the comparative analyses presented in this work are drawn from the Reflex survey that was carried out in 2005. Its target population includes graduates who completed their studies in the academic year 1999–2000. Only graduates of 5A programs of the UNESCO classification of education, also known as ISCED, were interviewed (bachelors and masters, or equivalent). Hence, short vocationally oriented programs (category 5B) were not considered in the Reflex survey. The UNESCO classification is operationalized in such a way that in the eight European countries under analysis, almost the whole sector of higher education is allocated to category 5A. For instance, 5A programs comprise German and Austrian "universities of applied sciences" (*Fachhochschulen*) together with the traditional university courses, whereas all forms of apprenticeship are assigned to category 5B and are thus excluded from the Reflex data. This seems very reasonable given that in both these countries, apprenticeship courses are best described as postsecondary vocational education rather than as an integral part of the system of higher education.

Data collection was based mainly on mail questionnaires, but about one third of the respondents (28.5 percent) completed Web questionnaires. As this mixture of methods may affect the results, our multivariate models adjust for the effects of data collection mode as well as for sampling design effects.[5] The selection of respondents was based on a multistage stratified sampling. The number of strata could vary from country to country, but most often a simple classification of higher education sectors (e.g., universities vs. vocational colleges), college major, and area of residence was used to identify stratification variables. When the Reflex estimates for gender, age, country of birth, civil status, field of study, and employment status are compared with estimates drawn from corresponding subsamples of the European Labor Force Survey (EULFS), the results are very encouraging (output available from the author upon request).

A major strength of Reflex is the availability of very detailed and truly standardized information on the degree programs completed by the respondents from the eight European countries. More precisely, field of study is available at the 3-digit level of disaggregation of the UNESCO classification. Because of sample size constraints, analyses are performed using a more aggregated classification, but the important advantage is that thanks to the high level of detail of the original data, we can be confident that these aggregate categories have the same meaning everywhere. This is an obvious, although frequently violated, prerequisite for comparative analyses of this kind, where comparability of the same field across nations is often little more than nominal.

The following 14-category classification was devised: (a) education; (b) art and humanities; (c) social and behavioral sciences (mostly psychology and sociology); (d) business and administration; (e) law; (f) life sciences; (g) physics and chemistry; (h) mathematics and statistics; (i) computing; (l) engineering; (m) architecture; (n) agriculture, veterinary, and environmental science; (o) nursing and social work; and (p) medicine. This is a slightly modified version of the 2-digit UNESCO schema for fields of study, with some aggregations attributable to sample size constraints. Although this 14-category classification is fairly detailed, different fields of study assigned to the same category may still display significant heterogeneity with regard to their gender balance. However, a higher level of detail would come at the expense of the stability of model estimates. For the same reason, Reflex countries with very low sample sizes (<1,500) were not included. Hence, the empirical analyses involve the following eight European countries: Austria (1,649 cases), Germany (1,638), Italy (2,975), Spain (3,721), the Netherlands (3,192), Norway (2,116), Finland (2,531), and Czech Republic (6,599).

A limitation of the Reflex data is that they do not include university dropouts. Hence, the analyses must be confined to the outcomes of educational careers. This means that, as in previous large-scale comparative studies, I cannot disentangle to what extent these outcomes can be attributed to enrollment decisions or to gender differentials in completion rates. Besides, the arguments outlined in section 2 suggest that both dynamics are at work and that they operate in a similar direction.

When it comes to the analysis of trends over time, Reflex cannot be used because it is restricted to a recent graduation cohort. Therefore, I use the 2005 EULFS, a large cumulative data set comprising household surveys conducted by the national statistical offices of EU member countries. This survey covers the resident population living in private households, and it is based on face-to-face interviews. Among the eight countries under examination, detailed information on field of study is available only for four (Italy, Germany, the Netherlands, and Norway), and the sample size is big enough for analysis of subsamples of tertiary graduates. Hence, cross-time comparisons will be limited to these countries.

MODELS

Statistical Models for the Analysis of Gender Segregation

This section illustrates the modeling strategy used to address the issue of variations across time and space in gender segregation. First of all, contrary to several previous analyses that used the dissimilarity index or related measures, I rely on loglinear techniques (Grusky and Charles 1994). Their main advantage is that they measure the association between gender and college major net of cross-country (or cross-cohort) variations in the marginal distributions of these two variables. For instance, the assessment of similarities and differences between nations with regard to gender segregation is not affected by the share of each field of study in different countries or by the share of females among tertiary graduates, if we use loglinear techniques (Charles and Grusky 2004, ch.2).

To test different hypotheses, I compare a sequence of loglinear models. The null association model (formalized in Equation 1) postulates that gender and field of study are unrelated in each of the eight countries under examination. It is an unrealistic model expressing the substantive hypothesis that gender segregation is absent in all countries. This model is used only as a benchmark to assess the fit of more realistic models. In the formula below, G denotes gender, F denotes field of study, and C denotes country (or cohort). The formula shows that the null association model takes into account cross-country (or cross-cohort) variations in the share of females among tertiary graduates, as well as in the share of different fields of study, but it postulates no association between gender and field of study.

$$\ln F_{gfc} = \lambda + \lambda_g^G + \lambda_f^F + \lambda_c^C + \lambda_{gc}^{GC} + \lambda_{fc}^{FC} \quad (1)$$

In contrast, the constant association model (formalized in Equation 2) incorporates the gender by field of study interaction term; that is, it posits the existence of gender segregation. However, this term does not vary across nations (or cohorts). In other words, this second model postulates that gender segregation is stable over space and time.

$$\ln F_{gfc} = \lambda + \lambda_g^G + \lambda_f^F + \lambda_c^C + \lambda_{gf}^{GF} + \lambda_{gc}^{GC} + \lambda_{fc}^{FC} \quad (2)$$

If the three-way interaction between gender, field of study, and country (or cohort) is added, we come up with the saturated model, in which gender segregation varies freely between countries or cohorts. This model allows for variations over time and space but lacks parsimony. For instance, if we compare eight countries using the above-described 14-category classification of fields of study, the saturated model incorporates $(G-1)^*(F-1)^*(C-1) = 91$ additional parameters. Therefore, a simple comparison between models 2 and 3 would provide a poor test of the existence of significant variations in gender segregation. We need a simpler, constrained specification of cross-country (or cross-cohort) differences. Moreover, the inspection of 91 parameters is not easily manageable, and their overall substantive interpretation is not straightforward.

The log-multiplicative layer-effect model (also known as unidiff) represents an appealing alternative (3). It decomposes each log-odds ratio as the product of a common pattern Ψ of association between gender and field of study, therefore using $(G-1)^*(F-1)$ degrees of freedom, and of $(C-1)$ country-specific parameters β. This means that unidiff requires only 13 + 7 = 20 additional parameters relative to Model 2 (of course, the same reasoning applies in the case of cohort comparisons). Hence, unidiff provides a more parsimonious specification of cross-national differences than the saturated model. This virtue arises from the core assumption underlying this model, namely that the qualitative pattern of gender segregation is stable across nations. Hence, in the following analyses it can be captured by the 13 Ψ parameters, so that one parameter per country is enough to detect variations in the overall strength of gender segregation.

$$\ln F_{gfc} = \lambda + \lambda_g^G + \lambda_f^F + \lambda_c^C + \lambda_{gf}^{GF} + \lambda_{gc}^{GC} + \lambda_{fc}^{FC} + \lambda_{gf}^{GF*}\varphi_c^C \quad (3)$$

Unidiff is a well-established model in social mobility research, and it has been used recently for the analysis of gender segregation in higher education (Xie 1992; Gerber and Schaefer 2004). However, it should be recognized that parsimony, its main strength, is achieved at the cost of a strong assumption that cannot be taken for granted: the cross-national (or cross-cohort) stability of the qualitative pattern of gender segregation. Unidiff works well insofar as we are interested in a global assessment of the overall level of gender segregation in each country. Topological models can be used instead to address potential variations in its qualitative pattern. This family of loglinear models divides the bivariate table between gender and field of study into a number of regions of net association between these two variables, according to a theoretical model of the generative mechanisms of gender segregation in higher education. After having described this basic qualitative pattern, I assess its potential cross-national (or cross-cohort) variations instead of assuming that such variations are absent, as unidiff does. It thus becomes possible to quantify the amount of commonality in the structural pattern of association between gender and field of study.

Topological Model for the Study of Gender Segregation in Higher Education

The topological model is defined by four matrices incorporating two distinct gender divides in higher education (see the appendix for more details). The first two matrices express, respectively, the female preference for humanistic disciplines and the male preference for scientific disciplines. Although the conceptual distinction between these two broad areas of study is seldom discussed in the literature, it is not completely uncontroversial. This issue is particularly relevant when it comes to assigning each of the 14 categories of field of study to the scientific or to the humanistic area. Several criteria could be invoked for this purpose, but for the issues at hand the important ones are those related to the supposed mechanisms behind gender segregation in education. In section 2, it was argued that social stereotypes oppose female qualities like empathy and sensitivity to male qualities like rigor and detached reasoning. This suggests that women are more attracted to disciplines that (in their view) emphasize a more emotional and sympathetic relationship with their object of study, whereas men should be more inclined to prefer disciplines dominated by deductive reasoning and by a high degree of formalization. In short, the main criterion for the distinction between humanistic and scientific fields is the cultural opposition between disciplines emphasizing the role of psychological feeling and empathy in understanding and disciplines ruled more by law-governed reasoning.[6]

Table 1. Matrices Defining the Topological Model for the Association between Gender and Field of Study

	Humanistic–Scientific Divide		Care–Technical Divide	
Field of Study	Humanistic	Scientific	Care	Technical
Teacher training education	1	0	2	0
Humanities	1	0	1	0
Social sciences	1	0	1	0
Economics	0	0	0	0
Law	0	0	0	0
Biology	0	1	1	0
Physics	0	1	0	0
Mathematics	0	1	1	0
Computing	0	1	0	1
Engineering	0	1	0	1
Architecture	0	0	0	1
Agriculture/veterinary	0	1	0	0
Social work	0	0	2	0
Medicine	0	1	2	0

If we draw on this criterion, in most cases it is fairly clear where to assign a given discipline, but one should avoid arbitrary decisions for the few ambiguous cases. Instead, it may be simply acknowledged that some disciplines (e.g., law) are neutral with regard to the above distinction (see the appendix). Hence, two separate matrices will be used (Table 1)[7]—one identifying scientific fields and the other humanistic fields—but a few fields are not assigned to either of the two. In substantive terms, this means that for some college majors, the humanistic–scientific divide does not give compelling reasons to expect a prevalence of either male or female students. However, this does not necessarily imply that in these cases the topological model predicts a balanced gender composition: Much depends on the second gender divide, to which we now turn.

The third and the fourth matrices refer to the care–technical divide (Table1). In the previous theoretical discussion, I traced the implications for educational and occupational preferences of gendered socialization practices emphasizing the nurturing role of women as well as manual and technical expertise in the case of men. In the context of the 14-category classification used here, technical fields comprise engineering, computing, and architecture, which put particular emphasis on applied technical expertise as their constitutive element.

A more critical issue is arriving at an appropriate definition of *care-oriented field*. However, the arguments developed previously indicate a rather straightforward solution: Care fields are those that prepare students for care jobs, and a growing sociological literature has extensively examined such occupations and identified their key elements. According to an authoritative review of this literature by England (2005), care jobs can be characterized by two defining features: face-to-face interaction with customers and job tasks directly oriented toward their well-being and personal development. For example, the first criterion differentiates a psychologist from a manager, whereas the second differentiates a social worker from a front-office secretary. Hence, according to this definition, occupations as different as doctor, nurse, psychologist, social worker, and teacher can all be characterized as care jobs. Not surprisingly, they all display a rather high or increasing share of female workers. Moreover, although these jobs are heterogeneous in many other respects, they all fit nicely into the notion of functional or symbolic proximity to traditional female domestic roles.

The above definition of care occupations can be used to generate a dummy variable that marks care jobs among Isco 88 occupational titles.[8] (provided in the online supplementary material available at http://soe.sagepub.com). Then, one can examine which educational fields are more likely to give access to care jobs: According to the previous hypotheses, female students should be particularly inclined to enroll in these care-oriented fields. In other words, the identification of care-oriented fields is based on information on the prevailing occupational destinations of graduates: Some fields lead to care jobs more often than others. More generally, it becomes apparent that the care–technical divide relates more to the subsequent career applications of degree programs.[9]

The appendix illustrates the detailed procedure used to arrive at a threefold distinction between (a) care fields (e.g., teacher training education, social work); (b) fields open to care jobs (e.g., humanities, social sciences, but also biology and mathematics); and (c) fields unrelated to care jobs (e.g., economics, engineering). The second category consists of majors that, although not explicitly designed to prepare students for care jobs, give access to them quite frequently, most often via teaching (e.g., biology) or welfare state employment (e.g., psychology). This specification operationalizes the theoretical argument developed earlier about second-best job options in the choice of college major.

The overall logic of this topological model should be clear: Female students develop a preference for humanistic disciplines and for fields of study that display direct or indirect connections with care jobs, whereas male students are more inclined toward scientific subjects and tend to avoid care-oriented fields in favor of technical fields. According to this topological model, the gender compositions of different fields result from these two principles: The highest share of women should be found in faculties that combine a humanistic curriculum with an explicit care profile (e.g., education); and humanistic faculties characterized by more indirect connections with care jobs, mostly related to teaching as a second-best job option (e.g., philosophy), should be less feminized and even less so in the case of scientific faculties that are only potentially related to teaching (e.g., mathematics), whereas scientific fields with a strong technical curriculum should be a male monopoly.

I show in the next section that this model fits the data well. Still, its main contribution probably lies elsewhere, namely in the effort to arrive at explicit operational criteria to test hypotheses about mechanisms behind gender segregation. These criteria cannot be always unequivocal, but this kind of problem perhaps best illustrates the need to improve the clarity of culturalist explanations.

RESULTS

Stability of Gender Segregation across Nations

Let us start with a preliminary assessment of gender segregation in higher education based on logistic regression. This analysis will provide a direct, intuitive understanding of the main patterns of gender segregation that will be modeled then by means of loglinear techniques. I estimate a multinomial logistic regression that describes the influence of gender on the choice of field of study. Males and economics are used as reference categories for gender and field of study, respectively. Therefore, we can examine the effect of being female on the chances of graduating from one of the remaining 13 fields. The stronger this effect is for a given field, the more feminized is this field.[10] The same model is estimated separately for each country.

The x-axis in Figure 1 refers to different fields of study. The y-axis plots the logit parameters for the effect of gender on the chances of graduating from each of these fields (relative to economics). If a field is highly feminized, this effect is strong and the field is located on the top part of each graph. For instance, the value 2.5 for teacher education programs in Italy indicates a strong overrepresentation of women among graduates from this field. Conversely, masculinized fields are located on the bottom part of each graph. Finally, if a field has a value close to zero, it is as feminized as economics (reference category), which displays a rather balanced gender composition. For instance, law, architecture, and agriculture may be characterized as gender-balanced fields.

It can be seen that in all countries women are overrepresented in humanistic fields, whereas the share of men is higher in scientific fields. However, the degree of feminization also varies considerably within these two broad subject areas. For instance, an ordering between teacher education, humanities, and social sciences in terms of women's prevalence is apparent almost everywhere. Social work is highly feminized in all countries, but its position vis-à-vis teacher education and humanities is somewhat varying. Similarly, in the scientific area we can detect an ordering among medicine, biology, mathematics, physics, computing, and engineering: The overrepresentation of men mostly involves the latter

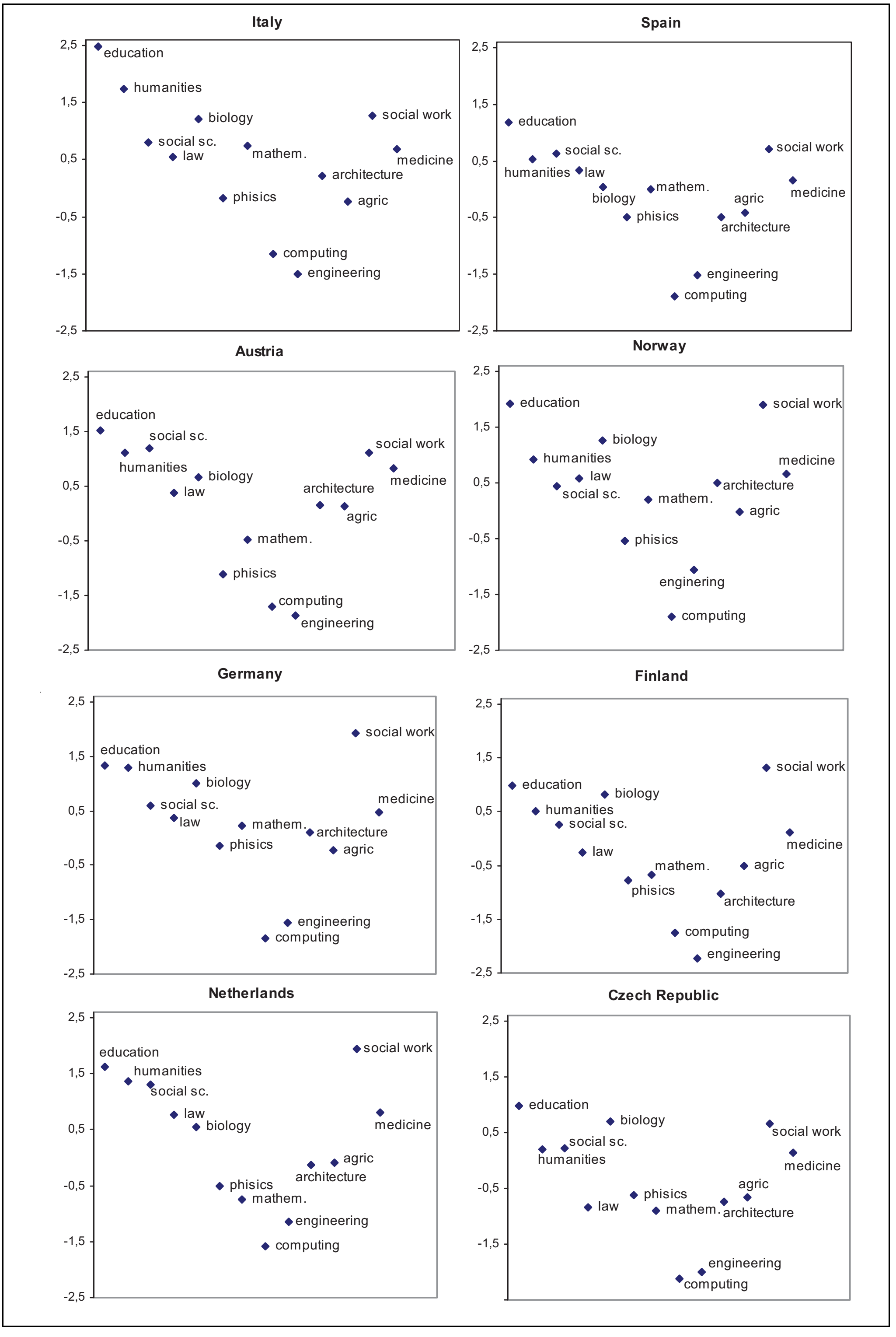

Figure 1. Gender segregation in eight European countries: the effect of being female on field of study choice (Reflex, 2005, N = 24,421; logit estimates).

Table 2. Fit of Different Loglinear Models Incorporating the Two Gender Divides in Higher Education (Reflex, 2005, *N* = 24,421)

Model	Misclassified Cases, %	Deviance	Deviance Reduction, %	*df*
Model 1: no sex segregation by field of study (conditional independence model)	17.8	4,909.5	—	104
Model 2: humanistic–scientific divide only	12.2	2,476.6	−49.6	102
Model 3: Model 2 + care–technical divide	4.8	424.7	−91.3	100
Model 4: Model 3 + interaction between country and humanistic–scientific divide	4.4	383.0	−92.1	86
Model 5: Model 3 + interaction between country and care–technical divide	4.2	360.5	−92.7	86
Model 6: Model 3 + interaction between country and both gender divides	3.9	327.7	−93.3	72

Note: Deviance reduction: the comparison is always with Model 1; *df* = degrees of freedom.

fields, but not the former. In short, there are some first indications that the humanistic–scientific divide does not tell the whole story about gender segregation, because the degree of gender unbalance varies substantially within both humanistic and scientific fields.

Moreover, it can be seen at a first glance that the graphs for different countries look rather similar, as indicated by their recurrent V-shaped form. In other words, this preliminary analysis gives some first clues that women are under- or overrepresented in approximately the same fields across different European countries. Hence, there are substantial cross-national similarities in the qualitative pattern of gender segregation.

Furthermore, the vertical dispersion of points on the y-axis is also remarkably similar across countries, although somewhat lower for Spain and the Czech Republic. Vertical dispersion relates to the overall strength of gender segregation (an analogue of the kappa index used to summarize the strength of class voting). This suggests that the overall level of gender segregation is largely stable among the eight nations under examination. In other words, the "distances" between fields with respect to their degree of feminization are rather similar across countries. In sum, this analysis offers preliminary evidence that both the structural pattern and the overall intensity of sex segregation across fields display noticeable cross-national constancy.

However, a more formalized test is in order. Figure 2 plots the kappa indices of the unidiff model that summarizes the overall level of gender segregation in each country. The higher these values are, the stronger gender segregation is. As can be seen, the kappa indices observed in different countries are highly similar, although we find again some indication that sex segregation is somewhat lower in Spain and in the Czech Republic. Thus, the unidiff model confirms our previous conclusion that the level of segregation is remarkably stable cross-nationally. The online materials reporting the fit statistics for different loglinear models lend further support to this conclusion.

However, unidiff is poorly informative of potential variations in the qualitative pattern of sex segregation (see section describing the topological model). The previous logistic regression analysis showed that countries look rather similar also in this respect, but I now reassess this conclusion more systematically. Table 2 reports the fit indices of a sequence of loglinear models, designed to analyze this qualitative feature of gender segregation. The first model is only a benchmark: It denies the existence of sex segregation by field of study and, not surprisingly, does not fit the data.

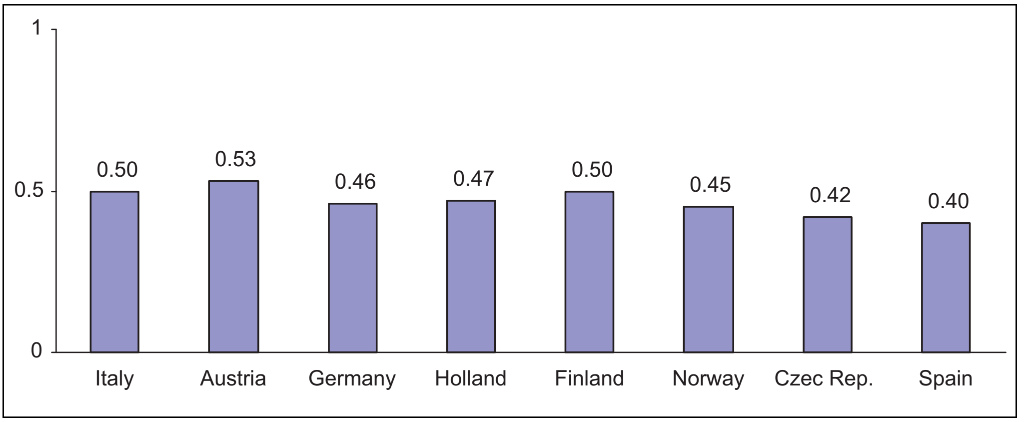

Figure 2. Level of gender segregation in eight European countries (kappa indices of the unidiff model).

Model 2 incorporates the humanistic–scientific divide in higher education. In other words, this model states that women prefer humanistic fields and men prefer scientific fields. It misclassifies 12.2 percent cases, and we can see from the third column that this model accounts for 49.6 percent of gender segregation in the eight nations under examination. This result can be taken as evidence of the importance of the humanistic–scientific divide. However, we are still left with half of the association between gender and field of study not accounted for by this divide. This means that gender segregation cannot be reduced to the humanistic–scientific divide.

Accordingly, the next model allows for the existence of a second gender divide that operates within humanistic and scientific fields. In line with theoretical arguments elaborated earlier, we now incorporate the care–technical divide. As can be seen, Model 3 misclassifies only 4.8 percent cases and accounts for 91.3 percent of the observed sex segregation. Put differently, this parsimonious model captures nine-tenths of the association between gender and field of study. Hence, there is clear support for the hypothesis that gender segregation in higher education is organized around two divides, rather than just one.[11]

Model 3 does not allow for cross-national differences in the importance of these two divides. In other words, it postulates that the qualitative pattern of gender segregation is constant across countries. I have shown that this model displays a good fit, but what happens if we incorporate cross-national variations? Models 4 to 6 provide evidence on this point, because they allow for differences between countries in the importance of the two gender divides. It can be seen that these alternative (and less parsimonious) specifications lead to marginal improvements of fit relative to Model 3. This conclusion applies both to the percentage of misclassified cases and to the deviance reductions of different models. This indicates that the qualitative pattern of gender segregation displays an overriding cross-national stability, at least in recent cohorts. To be sure, country peculiarities do exist, but they appear to be of limited importance. They can be interpreted as "idiosyncratic deviations" from a largely common pattern. In sum, not only the overall strength but also the qualitative structure of sex segregation in higher education displays a noticeable degree of stability across nations. In the next section, we assess whether the same conclusion holds for cross-cohort differences.[12]

Stability of Gender Segregation across Cohorts

As anticipated in the section describing models, the analysis of trends over time is based on the EUFLS and is limited to four countries (Italy, Germany, the Netherlands, and Norway). Unfortunately, this data source provides information on fields of study only at the 2-digit level of detail of the UNESCO classification. Therefore, I must resort to a 12-category classification that merges social sciences, economics and law together. Moreover, I cannot separate medicine from social work, nursing, and similar, highly feminized care-oriented fields.[13] Three enrollment

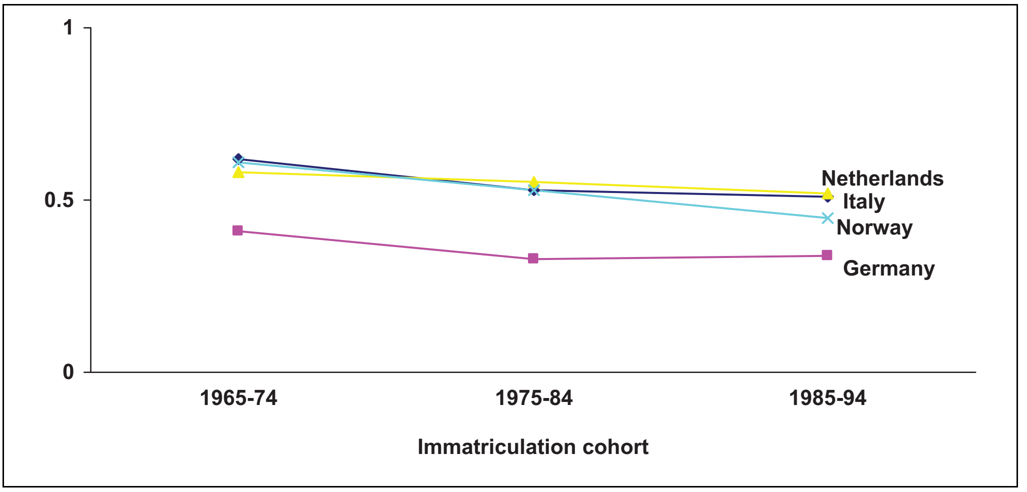

Figure 3. Level of gender segregation across three cohorts (kappa indices of the unidiff model).

cohorts of graduates will be compared (1965–1974, 1975–1984, and 1985–1994).

The level of sex segregation in each cohort is expressed in Figure 3 by the kappa indices of the unidiff model. If these values decline across cohorts, there is evidence of diminished segregation. The fit statistics for the unidiff model, as well as for competing loglinear models, are reported in the online materials. They point to an overriding temporal stability of gender segregation in all four countries. Here I will rely simply on the kappa indices to convey the broad picture and I will add only few more detailed comments on the specific deviations from temporal stability.[14]

As can be seen, a slight decline is apparent in Italy between the first and the second cohorts, whereas no change occurs between the last two. A more detailed analysis indicates that the initial variation is entirely due to desegregation in only two fields (biology and medicine), whereas for the other fields no trend is apparent. In Germany and the Netherlands, the kappa indices draw an almost flat line. Only in the case of Norway do the kappa indices point to some reduction of gender segregation. However, these changes are highly localized too, as they involve only two fields: natural sciences and engineering. Taken together, these results suggest that if a long-term trend toward desegregation exists, it has slowed down considerably in recent decades. This result might be contrasted with the dramatic changes in family arrangements and in female labor market participation as well as in gender inequalities in educational attainment that occurred during the same period.

A limitation of the models presented so far is that they do not disentangle university courses from vocational colleges and similar programs. As already mentioned, this kind of differentiation may be highly consequential for gender segregation, because the growing diversification in the supply of higher education institutions may favor sex-typing of some new occupationally specific courses (e.g., social work). To address this issue, I rely on a national data set, the 2004 German microcensus. I consider trends for both university courses and the more practically oriented Fachhochschulen. The latter display a high degree of gender segregation, mostly because of the large share of engineering courses monopolized by male students. Moreover, the number of Fachhochschulen has increased considerably in recent decades. Hence, Germany represents an interesting national test case for the claim that there is a relationship between diversification and sex segregation.

We can rely on a detailed classification of fields of study (27 categories) and on a large analytic sample (133,606 observations). Figure 4 plots the usual kappa indices of separate unidiff models estimated for universities and for Fachhochschulen. These values summarize the overall strength of segregation in each of the three birth cohorts (1949–1958, 1959–1968, and 1969–1978) that enrolled in higher education between

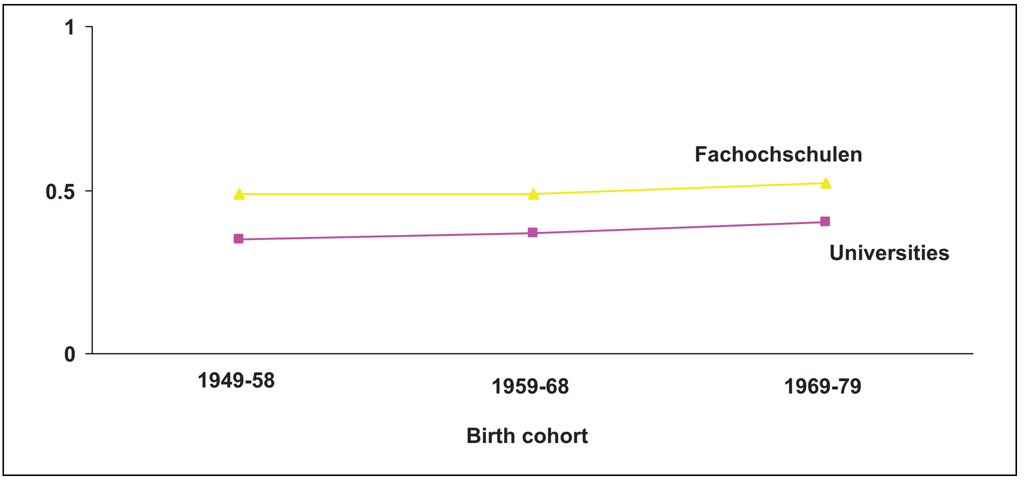

Figure 4. Level of gender segregation across three German cohorts, by sector of higher education (kappa indices).

the late 1960s and the late 1990s. The results are clear: We detect stability of sex segregation in both sectors of higher education. As expected, Fachhochschulen display somewhat higher sex segregation than universities, but the two lines in Figure 4 remain parallel across the three cohorts. If anything, this analysis, based on a very detailed classification of fields of study and on a large sample size, provides evidence of slight growth of segregation.

Before moving to the conclusions, I briefly comment on the agreement between estimates from different data sources. If the unidiff estimates based on the Reflex data (Figure 2) are compared with the corresponding estimates for the same countries based on the EULFS (Figure 3, third cohort), they look generally rather similar. This is reassuring given that the same model, when applied to different data sources and to heterogeneous classifications of fields of study, gives reasonably comparable estimates. However, for Germany we detect a discrepancy of about 0.1 between the two values. The suspect is that the EULFS value underestimates sex segregation, because it relies on a more aggregate classification. Indeed, this suspicion is confirmed if we turn to the German microcensus estimate for the whole sample (i.e., universities plus Fachhochschulen), which is based on a very detailed classification: Its value is almost identical (0.45) to that obtained with the Reflex data. Hence, these comparisons illustrate how the level of detail of the classification of academic fields can affect the substantive conclusions. This suggests the importance of compositional effects arising from the use of aggregate classifications, as is discussed in the concluding remarks.

DISCUSSION

The analyses presented in this work indicate that gender segregation in higher education has declined surprisingly little in recent decades and that it displays a largely similar level and qualitative pattern in several countries. This basic invariance closely matches the invariance of gender segregation in the labor market. In both respects, there are significant cross-national and historical variations, but they are best described as variations on the same underlying theme. Indeed, the stability in higher education documented in this work is precisely what would be expected given that occupational segregation declines very slowly and displays a high degree of similarity across countries (Chang 2000; Charles 2005).

However, the finding that the pattern of sex segregation among graduates is basically the same across nations characterized by different welfare regimes, labor markets, and educational institutions is quite novel. It deserves particular attention in the light of the previous results of comparative studies on sex segregation (cf. Smyth 2001; Charles and Bradley 2009).[15] To be sure, a few similarities between nations have been already mentioned in earlier analyses, together with some significant variations, but the effort here has been to quantify the amount of cross-national similarity. The topological model developed in this work indicates that more than 90 percent of the association between gender and fields of study is constant across the eight countries under examination. Hence, the balance between similarities and differences clearly favors the former.

The partial disagreement with previous studies is in many respects not surprising. A first explanation is that the present analysis used margin-free measures of the association between gender and field of study. Hence, contrary to Smyth (2001) and Ramirez and Wotipka (2001), the analyses presented here do not rely on standard segregation indices (e.g., the dissimilarity index), which lack the important prerequisite of margin insensitivity: They are not independent of variations both in women's overall participation in higher education and in the size of fields of study in different nations (or cohorts). Therefore, it is not surprising, although it is to some extent misleading, that both these studies report substantial cross-national variation in sex segregation. This is why I instead followed the loglinear modeling approach (Charles and Grusky 2004).

However, it should be stressed that the "added value" of this approach is critically dependent upon the level of detail of the data. If a rather aggregate classification of academic fields is used, it will conceal substantial variation of gender segregation within each category. Then, measures of sex segregation based on loglinear models are not really margin-free, because they are affected by the share of different subfields assigned to the same aggregate category. This share, of course, can vary both historically and cross-nationally. For instance, let us go back to Figure 1, which shows that computing is considerably more masculized than mathematics and biology in all countries under examination. At the same time, the share of computing graduates changes from country to country (e.g., it is almost three times higher in Norway than in Italy, according to Reflex estimates). This means that if we create an aggregate category consisting of these three faculties, its degree of gender segregation will be heavily affected by the different shares of computing graduates in different countries. We are thus reintroducing a hidden form of margin sensitivity in the analyses.

Unfortunately, this is but one example of the misleading aggregations of subfields made by the UNESCO classification, which was often used in previous comparative studies. The problem is that this classification often is available only in its most aggregated 1-digit version, with two important consequences. First, there is a serious risk of overstating cross-national differences in gender segregation given these compositional effects.[16] Second, this limitation is more than a methodological issue: It also entails substantive implications for wider gender inequalities in the labor market. For instance, because computing is not only more masculized but also more financially rewarding than biology or mathematics (Teichler 2007), the aggregation of these fields systematically obscures some forms of gender segregation that are highly consequential for the gender wage gap. More generally, in the context of the growing differentiation of higher education, much gender segregation may occur at a micro level (e.g., home economics vs. business economics).

Here one can appreciate the virtues of topological modeling. Because the 4-matrix model presented in this work was developed according to explicit definitions and operational criteria, it can be easily applied to more detailed classifications of fields of study. For instance, drawing on the arguments and definitions given in the sections describing theoretical frameworks and models, we can argue that psychology is more care-oriented than political sciences. Then, although they have been assigned to the same category, the former should be more feminized. Similar arguments may be derived for several other subfields of the 14-category classification used here. In short, the topological model is open to further testing and refinement with more disaggregated classifications. To summarize, I argue that the data, measures, and models used in this work are less affected by cross-national variations in the size of different fields and sub-fields. This may explain why our analyses point to the conclusion that gender segregation is largely invariant across countries.

Although results concerning cross-national similarities await confirmation and explanation by future comparative research, this work has replicated and extended findings of previous studies with regard to the invariance over time of gender segregation. Previous trend analyses focused mainly on the United States or on other Anglo-Saxon countries (Jacobs 1995; England and Li 2006), but there is less work on continental Europe, with the exception of two large-scale analyses and a few case studies (Bradley 2000; Smyth 2001). Now there is further evidence for four European countries (Italy, Germany, the Netherlands, and Norway) that gender integration of college majors stalled during the 1980s and 1990s.

Although some hypotheses to account for this stagnation were discussed in the section on theoretical frameworks, they have not been directly tested so far, and this article is no exception. As already mentioned, an important limitation of this work is that its data source is a graduate survey that contains no information about students who left school before graduation. However, if we are to assess the relative value of different explanations of gender segregation and of its persistence over time, we need longitudinal data that consider the whole educational trajectory of male and female students across different cohorts.

With this important caveat in mind, I draw two theoretical implications from the above analyses. On the one hand, they pose a challenge to neo-institutionalist theories. Although these theories may still be relevant to make sense of declining gender inequalities in educational attainment, when we turn to horizontal inequalities related to fields of study choice, we find rather limited support for the claim that gender differentials are declining to any significant extent. On the other hand, the above results lend support to theoretical approaches emphasizing the persistence of gender stereotypes in contemporary societies and the pressures related to postindustrial employment structures. Even though traditional forms of socialization may decline over time to some extent, gender essentialist ideologies are highly resilient, not the least because they are reinforced by the structural developments of service economies. These are characterized by an increasing share of jobs that are functionally or symbolically similar to women's traditional domestic roles. In the section on theoretical frameworks, it was argued that these jobs include several skilled occupations that are now reserved for college graduates. This explains why a gender divide associated with care work operates in higher education, even in contemporary societies formally promoting gender parity. Indeed, the analyses presented in this work confirm the existence of this gender divide. The humanistic–scientific divide, which has been the main focus of previous research, accounts for no more than 50 percent of the association between gender and field of study. The degree of gender imbalance varies considerably within both scientific and humanistic fields because a care–technical divide intersects the humanistic–scientific divide. Gender differentiation in higher education is patterned along two distinct but equally important divides in recent cohorts of graduates.

These results illustrate the pervasiveness of gender stereotypes and their strenuous resistance to change. Postindustrial employment structures sustain and reinforce these cultural dynamics rather than counteract them (Charles and Bradley 2009). Hence, these empirical results tend to deemphasize the opposition between culturalist and rational choice approaches: the influence of gender categorizations is so resistant to change because it operates not only through the internalization of sex stereotypes but also through the evaluation of opportunities and constraints. For instance, the overrepresentation of female graduates in care-oriented fields reflects both their intrinsic occupational preferences and the increasing job opportunities created in service economies. Thus, it comes as no surprise that Nordic countries are as sex-segregated as Mediterranean countries: A more progressive culture of gender parity can be counteracted by stronger labor market pressures toward segregation. For similar reasons, a possible weakening of traditional forms of socialization and social control does not necessarily translate into less gender segregation in higher education if the transformations of education and economic systems work in the opposite direction.

APPENDIX

This appendix provides some additional information about the topological model developed in this work. Table 1 in the main text shows its four defining matrices. As discussed in the results section, the humanistic–scientific divide is described by two matrices instead of just one because some disciplines, like law and economics, cannot be unambiguously regarded as either humanistic or scientific. For instance, economics programs offer not only highly formalized courses in micro- and macro-economics but also courses that place more emphasis on soft skills (e.g., marketing, public relations, personnel administration). A similar point can be made for architecture: Its curriculum typically consists of a mixture of technical courses and of artistic or other humanistic subjects. Social work, nursing, physiotherapy, and similar programs perhaps tend more toward the humanistic side, but a closer look indicates that the load of medical, legal, and methodological courses is far from negligible. These examples show that the allocation of fields to the two gender divides cannot be uncontroversial, not the least because the 14-category classification of fields of study merges some disciplines characterized by rather different curricula and because the same discipline can offer a wide range of programs. Moreover, the humanistic or scientific orientation of a field may change from country to country, at least to some extent, but detailed and harmonized data on the curricula offered by different fields of study in different countries are not available. At any rate, I have carried out several sensitivity analyses concerning the key findings reported in the discussion section. For instance, I have checked that the results do not change if we assign economics to the scientific field or architecture to the humanistic field.

The care–technical divide, as defined in the discussion of theoretical frameworks, is less strictly concerned with curricular content and deals more with the occupational prospects of graduates from different fields. Technical disciplines (computing, engineering, architecture) put a particular emphasis on the acquisition of applied expertise for the corresponding professions. Care-oriented faculties also have a practical, vocational profile, but they prepare students for care jobs. Hence, they have been identified according to their prevailing occupational destinations. The Reflex data contain detailed information about jobs held by graduates of different educational programs. Occupations are coded according to the 3-digit level of detail of the Isco 88 classification. Drawing on the definition of *skilled care jobs* given in the discussion of models, job titles have been dichotomized (care vs. non-care jobs; provided in the online supplementary material available at http://soe.sagepub.com).

Then, the absolute probability of entering care jobs for graduates of different fields was calculated. I inspected the bivariate tables of fields of study by care/noncare jobs, but I also followed a more refined approach by running a binomial logistic regression to obtain parameter estimates of the net association between each field of study and access to care jobs, controlling for gender, age, area of residence, parental education, and achievement in upper secondary education. In principle, controlling for gender might be particularly critical because results are then independent of the gender composition of each field. However, the basic ranking between fields does not change much compared with bivariate tables. In particular, education, social work, and medicine are much more likely than all other fields to give access to care occupations, as defined above. On the contrary, some fields almost completely "protect" from this kind of jobs: technical faculties, but also law, economics, and physics. The remaining fields lie in between these two extremes because they display some connection with care work, mostly via teaching. Not surprisingly, this three-fold hierarchy looks very similar across the eight countries under examination. The output of the bivariate tables and of the logistic regression is available upon request from the author. It may be objected that this procedure to identify care-oriented fields relies on data on the occupational destinations of graduates in a given year to infer information about educational decisions that were made around 10 years before (Reflex respondents were interviewed in 2005, 5 years after graduation). However, this is unlikely to be a serious concern once we realize that connections between fields of study and care jobs are unlikely to change in the short run. For instance, there is little doubt that medicine or social work courses also mostly led to care jobs in 1995.

NOTES

1. This work was prepared in the context of the project on Social Selectivity in Higher Education coordinated by W. Mueller (Mannheim Center for European Social Research, Mannheim University).
2. However, gender stereotypes may bias in a downward direction female students' assessments of their own competencies in science and mathematics, with significant implications for their career-relevant aspirations (Correll 2001).
3. Another pressure against desegregation relates to the advent of mass higher education. When social barriers hindered female participation in higher education, the few women who managed to gain access were highly selected with regard to their social background, academic achievement, and (unconventional) gender-role attitudes. In a sense, they were elite students. However, when higher education opened its doors to women, female students with more traditional identities and views also enrolled, and they were likely to make more stereotyped school choices.
4. The opposite reasoning would push boys toward scientific subjects, particularly if we consider that their distribution of math scores displays higher variability, so more of them are in its right tail, from which math-intensive fields recruit.
5. The multinomial logistic models discussed in the next section control for method of data collection and relax the assumption of independence between respondents from the same university. The assumption of the independence of irrelevant alternatives made in these models is not rejected according to the Hausman test.
6. To be sure, sociology is but one example of disciplines combining both approaches. More generally, the distinction underlying this criterion is obviously a matter of degree. At any rate, what needs to be stressed here is that enrollment decisions are affected by students' perceptions (or even fantasies) of the content of different disciplines, rather than by their real content in itself.

7. Given that gender is a dichotomous variable, the four defining matrices can be collapsed into four vectors (1 = yes, 0 = no; for the care divide, see subsequent discussion).
8. Because this work deals with segregation in higher education, we focus on skilled care jobs (e.g., family helpers are ignored). Needless to say, the above definition, as any definition, is not clear-cut. For instance, should we consider all teachers, including those in higher education, as care workers? I have excluded university professors, but given their low share, this decision is inconsequential.
9. This raises an obvious issue: to what extent is the choice of a field of study informed by expectations about future occupational outcomes? Some students may take a shortsighted view and simply opt for their preferred subject with little consideration for labor market prospects. However, there is evidence that by the age at which they choose their college major, most students already have some plans and expectations about their future jobs, although their aspirations are not always realistic (Teichler 2007). However inaccurate it may be, there is also some informal knowledge about "strong" and "weak" faculties (e.g., engineering vs. history).
10. Control variables include age in years, country of birth, parental education, area of residence, and method of data collection. Some details about these variables are as follows. (a) Parental schooling has three categories: lower secondary or less, upper secondary, and tertiary education. (b) Area of residence is a dummy variable that refers to socioeconomically deprived areas of four countries: southern Italy, eastern Germany, the southwestern regions of Spain (plus Cantabria), and the southeastern area of Finland; this variable is absent for the other four, more homogeneous countries. (c) The method of data collection has two options: web or mail questionnaire. Results concerning these control variables go in the expected directions, but they are not reported because they hold little relevance for the issues at hand.
11. I have fitted an additional model that incorporates only the care–technical divide. Its deviance is 631.1, compared with 424.7 for Model 3, which incorporates both gender divides with only two more degrees of freedom. Model 3 is clearly superior also according to the percentage of misclassified cases.
12. It would be interesting to carry out separate analyses for the different sectors of higher education. For instance, one may wonder whether Austrian or German universities display the same levels and patterns of gender segregation as the universities of applied sciences (Fachhochschulen). Unfortunately, a larger sample size is needed to answer this kind of question. The only way to avoid overdispersion is to carry out a separate analysis that excludes graduates from Fachhochschulen and similar institutions, in order to check whether this affects the above conclusions. However, this is not the case: The results closely echo those presented here.
13. For this reason, I cannot fully retest the topological model described in the previous sections on the EULFS data. However, some experiments in this direction are quite encouraging. In particular, I was able to fit only three out of the four matrices of the topological model, and only for Italy, Germany, and the Netherlands. This simplified specification still gives good results: The model accounts, respectively, for 85.3 percent, 88.9 percent, and 86.5 percent of the association between gender and field of study in these countries. The percentages of misclassified cases are remarkably low: 4.6 percent, 3.5 percent, and 4.4 percent, respectively.
14. These comments are based on the inspection of the significant standardized residuals of the constant association model.
15. This finding may have a simple explanation, of course; namely, that my sample of European countries is too restricted. At any rate, there is little doubt that these results cannot be generalized outside Western nations. However, it is worth mentioning that the data set analyzed here includes the least gender-segregated nation (Spain) of the larger sample of Western countries available to Charles and Bradley (2002:582) as well as the second most segregated nation (Germany) according to their estimates.
16. For instance, Charles and Bradley (2002) mention as evidence of substantial international variability in gender segregation the fact that men are massively overrepresented among computer science and math graduates in Sweden, whereas near gender parity prevails in Italy. However, Figure 1 shows that computer science is strongly masculinized in Italy as in all other countries, in line with previous analyses of the Italian case. Unfortunately, Charles and Bradley (2002) were forced to merge math, biology, and computing. In a more recent article on 44 countries, Charles and Bradley (2009:942) conclude that "international variability is striking even if we consider only engineering, the most sex-segregated field." Indeed, they detect marked cross-national differences in the overall amount of sex segregation. This may be partly due to the fact that they cover also less-developed countries and partly to the recourse to an aggregate four-category classification.

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