Wage inequality between male and female university graduates: the influence of occupational specialization, female-dominated subjects and occupational segregation

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Abstract

In search of an explanation for the wage inequalities between male and female higher education graduates, this article investigates three different sets of explanations: first, the human capital explanation claiming that women's financial disadvantages on the labour market are the result of their choice of less occupation-specific fields of study; second, the hypothesis of a socio-cultural devaluation of female-dominated subjects as claimed by feminist theories; and finally, the importance of occupational sex segregation for the gender wage gap as a function of the cultural devaluation of female-dominated occupations as well as national labour market institutions, such as the German system of collective bargaining. Based on the 1997 HIS *Absolventenpanel* we estimate the gross monthly income of men and women employed full-time five years after graduation. Results mainly support the assumption of a discrimination of female-dominated fields of study and occupations, which explain 19 and 13 percent respectively of the gender wage gap among higher education graduates. Choosing a field of study with low occupational specificity, however, does not seem to have an influence on the earnings of men or women.

1. Introduction

Contrary to what current discussions about the "internship generation" suggest, previous research has shown that German university graduates, when compared to individuals with lower educations credentials, continue to be relatively successful in entering the labour market, even in times of high unemployment rates and increasing labour market deregulation. In comparison with people holding different educational certificates, university graduates are quick in finding a job, they are employed in better positions, they are less often affected by unemployment, their unemployment spells are shorter, and their average earnings tend to be higher than those of other employees (Müller, W., et al. 2002, Müller, W. / Gangl, M. 2003, OECD 2008). These advantages notwithstanding, however, almost one out of seven university graduates has an inadequate job after graduation, i.e. works in a job which does not correspond to his or her occupational training or has earnings below the average pay level of university graduates. Women and graduates from certain fields of study, such as humanities and linguistics, are particularly affected by inadequate employment (Buchholz, S. / Grunow, D. 2006, Grunow, D. 2006). Thus, compared to other graduates, German humanities graduates tend to go through longer transition periods before attaining a regular working contract, tend to have lower chances of finding high status employment and, most importantly, tend to have lower potential earnings after graduation (Fehse, S. / Kerst, C. 2007). Female university graduates face the same situation as women in general, i.e. they earn considerably less than their male colleagues (Braakmann, N. 2008, OECD 2008: 177).

Regarding *wage inequalities between male and female university graduates*, one can ask whether there is a linkage between these two findings, since fields of study such as the humanities are particularly dominated by female graduates. It could be that it is due to their choice of subjects that women have greater difficulty in finding adequate employment which could be the cause of their lower wages. Possible explanations go in two directions: First, female-dominated subjects such as the humanities could be less occupation-specific, which could lead to lower wages as a result of differences in human capital. Second, however, it could also be that we observe *gender discrimination*, independent of occupational specialization: It could be that individuals face inferior career prospects because they graduated in subjects dominated by women or qualifying for female-dominated occupations. Regarding vocational training, it has already been shown that female-dominated training programmes

tend to result in inferior career prospects and lower wages (Solga, H. / Konietzka, D. 2000, Trappe, H. 2006). A comparable analysis regarding the interplay between choice of subject and gender for university graduates' career is still missing.

The present article offers such an empirical search for the causes of wage inequalities between male and female university graduates. In the following, we start by providing a brief overview of wage inequalities in Germany before going on to present our theoretical assumptions which are then tested empirically. Based on a representative graduate panel (HIS-*Absolventenstudie 1997*) we estimate the logarithmised gross monthly income of men and women in full-time employment five years after graduation. By doing so, we test for the influence of occupational specialization by subject choice, the socio-cultural devaluation of female-dominated subjects as well as the gender-specific occupational segregation in terms of earnings.

2. Wage differences between (highly qualified) men and women

The educational expansion of the 1960s not only led to a rise in the general importance of tertiary education, but also to an exceptional increase in the numbers of female university graduates. Between 1995 and 2005, the share of female workers with university degrees in the total labour force increased by approximately 45 percent, while that of men only rose by 16 percent. The share of women among all working graduates increased from 33.9 percent in 1995 to 39.0 percent in 2005 (Anger, C. / Konegen-Grenier, C. 2008: 5). But despite this remarkable catching-up of female university graduates, they are still disadvantaged on the labour market. Women in Germany on average have a higher occupational prestige (Müller, W., et al. 1998), which has to do with their higher presence in non-manual labour. However, neither their higher educational credentials nor their increased occupational prestige necessarily translate into higher wages and increased job mobility for women (Smyth, E. 2005: 466f.).

In terms of gross monthly income, working-age women have considerably less money at their disposal than men: In 2005, women earned an average of 1864 euros, which is almost 40 percent less than men (3067 euros). This comparison includes persons employed full-time

and part-time, which is why the difference is considerably higher than the often quoted difference in gross hourly wages, which amounted to 24 percent in 2006 (Allmendinger, J., et al. 2008: 23).[1] Wage differences between men and women are even higher between highly qualified workers than between the lower qualified: In 2006, German women who earned a university entrance certificate (*Abitur*) and subsequently completed a vocational training programme earned 38 percent less a year than equally qualified men, while the annual income of women with university degrees was 42 percent lower than that of men with the same qualification (OECD 2008: 177).

One explanation for these wage differences among the highly qualified, apart from factors which apply to women in general, is the *gender-specific choice of academic subjects* (Bradley, K. 2000, Buchholz, S. / Grunow, D. 2006, Charles, M. / Bradley, K. 2002, Grunow, D. 2006, Jacobs, J.A. 1995). In many countries, women tend to choose majors in the humanities, in the social sciences, and in education, while men are generally overrepresented in the natural sciences and in engineering (Charles, M. / Bradley, K. 2002, Machin, S. / Puhani, P.A. 2004, Smyth, E. 2005). This pattern is also true for Germany, where, in 2005, 70 percent of all humanities and lingustics students were female, while their share in the natural sciences was 37 percent, and only 20 percent in engineering (Statistisches Bundesamt 2007: 27).

This type of horizontal segregation leads to wage differences between genders, as has been shown for other countries (Daymont, T.N. / Andrisani, P.J. 1984, Gerhart, B. 1990, Grogger, J. / Eide, E. 1995, Kalmijn, M. / Van der Lippe, T. 1997, Machin, S. / Puhani, P. 2003, Machin, S. / Puhani, P.A. 2004, Napari, S. 2006). In Germany, we also find this kind of relationship: About 74 to 76 percent of the difference in the entry-level salaries of men and women can be explained by gender-specific choice of subject; five or six years after graduation, choice of subject still explains 26 to 33 percent of the gender wage gap (Braakmann, N. 2008: 2). Thus, it is no novelty that female graduates, due to their choice of academic subjects, earn less than their male colleagues. However, this does not answer the question which mechanisms are at the bottom of these wage differences resulting from gender-specific subject choice.

[1] The analysis of gross hourly wages does not consider the fact that men and women have a different likelihood of working part-time or full-time and of interrupting their employment, e.g. for child rearing – which is why the gender wage gap based on hourly wages is lower than the one based on monthly or annual income.

3. Theoretical explanations of wage inequalities between women and men

Our theoretical concern, therefore, is the question which explanations are available for understanding wage differences between male and female university graduates. We consider three possible mechanisms: (1) the degree of occupational specialization, which is linked to a university degree in specific subjects, (2) the devaluation of female-dominated subjects, and (3) gender-specific wages due to occupational segregation. Theoretically, we base the first influence on human capital arguments, while the devaluation of gender-specific subjects and occupations is explained with socio-cultural and institutionalist theories.

3.1 The advantage of occupational specific human capital for wage returns

One of the most prominent theories for explaining wage differences between men and women is human capital theory. Its central assumption is that higher qualification leads to higher productivity and, consequently, to higher wages (Becker, G. 1993). Seen from this perspective, wage differences between men and women are explained by different levels of human capital and, consequently, different levels of labour productivity. Empirically, however, wage differences between men and women can only be attributed in part to differences in human capital (Beblo, M. / Wolf, E. 2003, Becker, R. / Schömann, K. 1999, Bellmann, L. / Gerlach, K. 1984, Braakmann, N. 2008, Diekmann, A., et al. 1993, Kunze, A. 2005, Lauer, C. 2000, Sohr, T. / Stephan, G. 2005, von Kulmitz, L. 2001). Important factors which lead to differences in the human capital of men and women include employment interruptions, job tenure, participation in firm-specific professional development, and differences in prior vocational training. For university graduates, 17 to 18 percent of the gender wage gap are explained by such differences in human capital, since female graduates are more likely to change firms, they tend to have less work experience, are more often employed in marginal jobs or unemployed, and are more often engaged in child rearing activities (Braakmann, N. 2008).

Beyond these “quantitative” differences in human capital, there has been a discussion about the qualitative differences in men’s and women’s human capital. Explaining the gender wage gap, the human capital approach, which differentiates between general and firm-specific human capital (Becker, G.S. 1962), attributes a major influence to women’s lower occupa-

tional specialisation (Polavieja, J.G. 2007). While general human capital is mainly acquired through formal education, firm-specific human capital is, for the most part, built up by on-the-job-training. When describing the German labour market, one usually adds a third form of human capital, namely occupational-specific human capital (Müller, W. / Shavit, Y. 1998), which can be acquired in standardized occupational training programmes for specific occupations. These different forms of human capital differ mainly in terms of the degree of transferability of acquired skills in different work contexts: While general human capital can be used in a variety of different firms and occupations, firm-specific human capital can only be used in the firm where it was acquired (Becker, G.S. 1962). Occupational-specific human capital can finally be used in different firms but is linked to jobs in one specific occupation (Estevez-Abe, M., et al. 2001).

Gender wage differences result from the fact that men and women, when anticipating their gender-specific employment histories, make different investments in their human capital. The assumption is that rational women who expect their careers to be discontinuous due to many changes of firms and occupations as a result of child rearing activities will be reluctant to invest in specific human capital. Instead, they will acquire general human capital which (1) can be used more flexibly in different occupations and firms, and (2) is less devaluated during employment breaks when the skills are not used. Since, according to human capital theory, specific human capital in particular is positively related to income and negatively related to firm changes (Becker, G. 1993), women face disadvantages on the labour market due to their rational investment in general human capital. Since they are more prone to anticipate employment breaks even at the beginning of their university studies, they tend to choose, according to this theory, subjects with less need for specialization, in order to be able to change flexibly between different occupations and firms, which also leads to their later wage penalties, however (Polavieja, J.G. 2007). Men, who assume a continuous working biography, instead tend to choose subjects with a high degree of specialization, precisely because these subjects promise to result in higher wages.

Gender-specific investment in general and specific human capital should have particularly negative effects in those institutional contexts where occupational-specific human capital leads to an advantageous situation on the labour market (Estevez-Abe, M., et al. 2001, Hall, P.A. / Soskice, D. 2001). Germany is usually characterized as a system with a high importance

of occupational specificity, in which occupational specialization in the education system is closely related to a labour market segmented along occupations and industries (Lutz, B. / Sengenberger, W. 1980). Since occupational specialization is of such high importance, lack of specialization should lead to severe wage discrimination. This is why it can be expected that women, who – due to their choice of subjects – tend to acquire a more general training, e.g. in the humanities or the social sciences (Leuze, K. / Strauß, S. 2008), face a higher risk of earning less than higher specialized men. According to this theoretical perspective, wage differences are legitimized by differences in productivity caused by different qualifications. Following from these considerations, we derive the following hypothesis:

H 1: Graduates of subjects with low occupational specialization earn lower wages than graduates from highly specialized subjects. Since it is more rational for women to invest in less specialized subjects, this effect should contribute to their comparatively lower income.

3.2 Devaluation of female-dominated subjects

In contrast to rationalistic human capital approaches, feminist cultural theories argue that gender-specific choice of subjects and their wage compensation on the labour market can be explained by socio-cultural factors. Men and women are socialized to behave in accordance with pre-existing gender roles which influence their educational and occupational choices as well as their career plans (Polavieja, J.G. 2007). Male and female choice of academic subjects is particularly often explained by gender-specific socialization (England, P. 2005, Jacobs, J.A. 1989), which tends to reproduce gender stereotypes of typically male (e.g. analytical thinking in mathematics and natural sciences) or typically female skills (e.g. caring in educational and caring subjects) (Kelly, A. 1985). Moreover, educational sociological research points to the importance of school organisation, peer influence, curricular content, and teaching methods (Dekkers, H. 1996, Dryler, H. 1999, Smyth, E. / Hannan, C. 2002), which also contribute to the reproduction of gender typical behaviour. Charles and Bradley (2002) argue that gender differences in subject choice are constructed and maintained by cultural beliefs of “equal but different” (Charles, M. / Bradley, K. 2002: 575).

Choice of academic subject resulting from gender specific socialisation can lead to wage differences on the labour market when female-dominated fields of study are less appreciated

than male-dominated ones. According to the approach of evaluative discrimination, skills of lower status groups such as women are devaluated (Baron, J.N. / Newmann, A.E. 1989, Baron, J.N. / Newmann, A.E. 1990, Catanzarite, L. 2003). Thus, cultural gender role beliefs involve the idea that reproductive work, which is mainly provided without pay by women in the private sphere based on affection or family obligation, is considered less valuable when provided as paid work (Liebeskind, U. 2004). In this view, female-dominated fields of study are subject to devaluation, and consequently result in lower wages on the labour market.[2]

Subjects such as education or health, which qualify for caring activities related to one individual or are associated with reproductive work and, due to their close relation to motherly family work, are perceived as 'female' (Liebeskind, U. 2004), can be expected to receive lower societal appreciation and, consequently, result in lower wages. Based on this approach, we develop our second hypothesis:

H 2: A high representation of female students in a given field of study leads to its devaluation and, consequently, to lower earnings for graduates of this subject on the labour market.

In other words, this view also assumes differences in male and female human capital; however, it differs from human capital theory in terms of the presumed consequences for wage differences: While human capital theory starts from the assumption of lower productivity (due to lower occupational specialisation), socio-cultural approaches explain women's lower wages by discriminatory processes related to the devaluation of female-dominated subjects.

3.3 Occupational segregation and gender-specific wages

The third explanatory approach is related to occupational gender segregation. It could be the case, after all, that it is not female-dominated subjects which lead to lower wages but that discrimination starts on the labour market where female-dominated occupations are paid less well than male-dominated ones. As to the underlying mechanisms, there are – as with the devaluation of academic subjects – socio-cultural explanations pointing to the devalua-

[2] *Evaluative discrimination* is thus related to processes of devaluation due to horizontal segregation of fields of study. When, however, women and men with the same human capital (meaning academic subjects) are hired for different hierarchical positions and consequently receive different wages, we talk about *allocative discrimination*. Thus, men are ascribed more competence in leadership positions, since the cultural background of gender status beliefs (Ridgeway, C.L. 2001) leads decision-makers to perceive femininity and professional leadership as incongruent (Eagly, A.H. / Karau, S.J. 2002, Gmür, M. 2004, Meng, C. 2002).

tion and discrimination of female-associated activities at the workplace. If activities which are predominantly performed by women are ascribed a lower value, this should be reflected in the wages associated with these activities. This means that it is not only fields of study but also occupations associated with women that are culturally devaluated and consequently less well paid (England, P., et al. 2002: 457). Female-dominated careers fields for university graduates such as teaching or social work, and other occupations associated with reproduction and therefore traditionally associated with women, can be expected to yield lower earnings.

Moreover, from an institutional point of view, certain institutions such as the system of collective bargaining have an important impact on gender inequalities on the labour market. Gross hourly wages differ between each industry and group of employees. Women predominantly work in the area of services and caretaking, while men are overrepresented in the industrial sector (e.g. in technical occupations as well as in the area of natural sciences and engineering). In that context, Ziegler (2005) shows that collective agreements in Germany's highly centralised wage bargaining system are not gender neutral. Collective agreements often envisage lower wages for typically female occupations and higher wages for typically male ones (Ziegler, A. 2005). This indirect discrimination of women in collective agreements is enabled by a variety of mechanisms: the disregard of work activities related to female-dominated occupations, such as physical requirements of nursing staff; the application of different criteria when evaluating male and female-dominated activities; or the discriminating interpretation of criteria which men and women – for societal or physical reasons (e.g. traditional family roles or physical strength) – can achieve to very different degrees (Wirtschafts- und Sozialwissenschaftliche Institut (WSI) 2001).

Similar to collective agreements, performance-related bonuses are more often paid in male-dominated jobs, as are overtime premiums. Empirically, we can say that average wages in Germany for female-dominated occupations are indeed lower than those for other occupations.[3] The cut in wages applies to both sexes; men's wages, however, surpass women's

[3] Wages are not only reduced in female-dominated occupations but also in female-dominated departments of a firm or company. Wage reduction in these departments, however, is higher for women than it is for men (Achatz, J., et al. 2005). After controlling for education and work experience the gender wage gap within these firm departments still amounts to 12 percent (Hinz, T. / Gartner, H. 2005: 33), which suggests that the devaluation of female-dominated activities also takes place within a firm.

within those occupations as well (Lauer, C. 2000). The wage gap in female-dominated occupations, however, is lower than in men-dominated occupations (Brückner, H. 2004). From this third explanatory approach we can finally derive the following hypothesis:

H 3: A high representation of women in a given occupation leads to its socio-cultural and institutional devaluation and, consequently, to lower wages for the university graduates who work in these occupations.

To summarize, we can expect that female-dominated academic subjects as well as female-dominated occupations can lead to wage reductions. Smyth (2005) shows how the early segregation of men and women in different educational tracks leads to a stronger occupational segregation between sexes (see Borghans, L. / Groot, L. 1999). Moreover, Buchmann and Charles (1995) argue that early educational decisions continue to be gender-specific. This leads to the argument that gender segregation is stronger in countries like Germany, which place high importance on occupational specialization and feature strong links between educational and labour market system. The German situation is thus characterized by horizontal segregation of fields of study as well as horizontal segregation of occupations, resulting in double discrimination of women on the labour market.

4. Data and methods

In order to test our hypotheses, we conduct our analysis on the basis of a representative German panel study of the 1997 graduate cohort (*HIS-Abolventenpanel*) which surveys graduates 12 to 18 months after graduation as well as five years after graduation. The population consists of all university graduates who acquired their first degree at a German university. The survey provides detailed information on the course of studies, the field of study, the acquired degree as well as on the process of entering the labour market (for a detailed description of the data set, see Fabian, G. / Minks, K.-H. 2006).

In order to assess gender differences in university graduates' wages, we use OLS-regression to estimate logarithmised gross monthly incomes.[4] Gross monthly income was measured at the time of the first and second interviews, but not for all employment spells since graduation. Our analysis is focused on the time of the second interview, five years after graduation, since the transitional phase between graduation and labour market entrance involving further types of practical training should be finished by that time. We may thus expect an initial degree of consolidation in the respondents' professional development.[5]

In order to avoid the danger that gender-specific employment participation patterns regarding full-time and part-time employment should bias our three theoretical explanations, we confine our analysis to individuals who state that, five years after graduation, they are in (contractual) full-time employment and effectively work at least 35 hours a week. Our results are consequently only valid for a very selective part of the population of university graduates, i.e. those who are employed full-time five years after graduation. This selection excludes more women than men from the analysis, especially women with fewer labour market opportunities and mothers of small children. Our empirical findings on gender-specific wages thus compare men to a specific, privileged sub-group of women employed full-time. We may thus assume that our analysis tends to underestimate the discrimination of women as a general group. Furthermore, we exclude self-employed individuals from the analysis since their wages are determined by mechanisms different from those that impact dependent workers; the mechanisms described above may thus hardly be expected to have sufficient explanatory power. (For a descriptive overview on the central variables, see appendix A).

[4] In the literature on gender-specific wage differences, we often find the estimation of gross hourly wages (Petersen, T. 1989). The advantage is that this strategy directly controls for wage differences due to different working hours. However, the HIS-survey does not include the necessary information to calculate gross hourly income. According to Petersen (1989), gross monthly income is defined by the regular gross hourly wage for the contractual working hours, the hourly income for overtime as well as variable wage fractions. The data do not, however, include any information on the contractual working hours, whether overtime was paid or not and at which rate and whether the monthly income includes other variable wage components.

[5] At the time of the first interview, many university graduates still participate in further practical training phases, such as in the case of medical doctors (*Praktisches Jahr*), teachers and lawyers (*Referendariat*) or journalists (*Volontariat*). As a consequence, due to the training character of their occupations, their starting salary is often considerably lower than after this phase of additional practical training. This is the reason why wage differences between men and women are still comparatively low at that phase of their careers (Büchel, F. 1998, Jensen, U., et al. 2006), which is why we expect the mechanisms discussed to be less relevant at that time.

As explanatory factors of the (logarithmed) gross monthly income we include in the *first model* the respondent's sex (women = 1, men = 0) as well as his or her *field of study*. The graduates' fields of study are subdivided into eight categories which are based on the ISCED classification issued by the UNESCO (UNESCO 1997): humanities, arts, social sciences, law, economics, natural sciences, health, engineering. Despite a more detailed coding of subject areas in the data set, we opted for this rough classification in order to allow for a sufficiently large number of respondents in each subject category. We are aware, however, that the analysis of gender segregation between fields of study is sensitive to the number of subjects entered in the analysis (Smyth, E. 2005). This is why we use the more detailed differentiation between subjects to define female-dominated subjects (see discussion of model 4). Moreover, we expect that the variance of the residuals is correlated within subject groups which would lead the standard deviation to be biased. Therefore we calculate robust standard errors, clustering by subject area.

In the following three models we analyse, separately at first, the influence of specific human capital, female-dominated fields of study and occupational segregation. Since we expect these factors to contribute to the explanation of gender wage inequalities, we expect the explanatory power of the model to increase while the coefficient of gender should decrease. Since we additionally assume that it is not the field of study per se but its occupational specialisation or female connotation which exerts an influence, we also expect the differences between fields of study to decrease. In the *second model* we include the specificity of a person's human capital, operationalised by objective and subjective indicators, as explanatory variables (hypothesis 1).[6]

We operationalise occupational specific human capital objectively by measuring the correspondence in substance between field of study and practised occupation at the time of the first interview. Thus, we determine whether studying a certain subject leads to (horizontally) adequate employment immediately after graduation, a correlation which indicates a de-

[6] Objective indicators have the advantage of being independent of individual respondents' assessment while reflecting an externally constructed criterion. At the same time, however, this is a disadvantage since they heavily depend on the researcher's ability to construct a valid indicator. The subjective operationalisation faces the problem of potential bias due to the respondents' modesty and effects of social desirability. At the same time, they are considered more powerful since they are able to reflect differences within an occupation as well as over time, independent of individual researchers (Dekker, R., et al. 2002, Kivinen, O. / Nurmi, J. 2003).

gree's high occupational specificity. For this purpose, we designed a matching-matrix[7] which attributes specific occupations to the various fields of study and enters the result as a dummy variable (1=occupation matching the field of study).

The subjective operationalisation of the acquisition of specific human capital during university studies is measured by the question: "Would you say that your current employment matches your university qualification?" Based on the detailed classification of fields of study, we calculate the weighted percentage of graduates who declare at the time of the first interview to be "certainly" employed adequately "regarding their professional qualification (field of study)". Areas of study with a higher percentage are supposed to transmit more occupational specific human capital (see also table in appendix C).[8]

In our third and forth model we assess, separately at first, the influence of female-dominated subjects and gender-specific occupational segregation (hypotheses 2 and 3). As to the operationalisation of female-dominated subjects, we measured the share of female graduates in each subject area on the basis of the HIS graduate panel.[9]

Based on the detailed classification of subjects, we calculated the weighted mean female participation in a given field of study (in percent) and matched it to the respondents' fields of study. In order to operationalise female-dominated occupations, we first calculated the weighted mean share of women in each occupational category of the classification of the

[7] On the basis of the classification of occupations in 1992, we first identified all occupations which require a university degree. In a next step, the occupations were related to at least one, sometimes several fields of study (such as e.g. in the case of the occupation of a researcher) which can be considered typical entrance certificates for these occupations. The resulting matrix between subject areas and occupations was validated intersubjectively between the two authors as well as by a comparison with other matching matrices (vgl. Müller, W. / Shavit, Y. 1998). For an overview on the matching between field of study and occupations based on the classification of occupations (KldB) from 1992, see appendix B.

[8] The operationalisation of occupational specificity is a general challenge for educational research. In comparative research on vocational training, researchers often count the number of vocational training programmes which prepare for a specific occupation. If this number is high in a certain country, it is assumed to have a high degree of occupational specificity. However, this operationalisation bypasses an analysis of factual curricula and subjective evaluations of their applicability. While the first is often not feasible for economic reasons, the latter is often not possible due to a lack of data. In this study, we were not able to analyse the study and examinations regulations of different degree programs in order to assess their occupational specificity in qualitative fashion. Instead, we considered the matching between field of study and occupation right after graduation as a proxy for specific human capital, even if we are aware that this is more the result of occupational specificity than specific human capital per se.

[9] By following this approach, we do not, however, measure actual job duties but assume that a high share of women in an area makes the subject appear female. To be sure, this operationalisation may be criticized for not being able to differentiate between evaluative discrimination and mere crowding effects.

Federal Statistics Agency (KldB92) (3-digit classification) and merged it with the graduates' occupations. This analysis was done on the basis of the German microcensus (wave 2002), including only employed individuals aged 25 to 65. Female-dominated subjects or occupations have a share of women of more than 60 percent, male dominated subjects or occupations of less than 40 percent and integrated subjects or occupations are characterized by a share of women between 40 and 60 percent (Smyth, E. 2005). (For an overview, see table in appendix C). All categories were included as dummy variables in the model (reference category: male dominated subject or occupation). In the *fifth model* we included all three main effects simultaneously in order to explain gender wage differences.

The sixth model includes additional control variables which previous research identified as having an influence on gender wage differences. These control variables may be divided into three groups. First, we included various socio-demographic characteristics, especially educational family background (at least one parent with '*Abitur*'), family status (married or not) as well as the presence of children of different ages in the household. Second, we included different characteristics of the respondents' educational biography, which are mainly meant to capture "quantitative" human capital differences: an accomplished apprenticeship, age at graduation (under 24, 24 to 29 years, 30 years and older) as well as the type of university degree attained ('*Fachhochschule*', i.e. polytechnic, university *Diplom*, *Magister*, *Staatsexamen*). Finally, we included various variables capturing the respondent's previous labour market experience and current employment situation: length of unemployment and work experience (both in months) since graduation, employment in East Germany, labour market position five years after graduation (employment in a profession or in management, in order to control for allocative discrimination), firm size (large firm with over 500 employees) as well as employment in the public sector.[10]

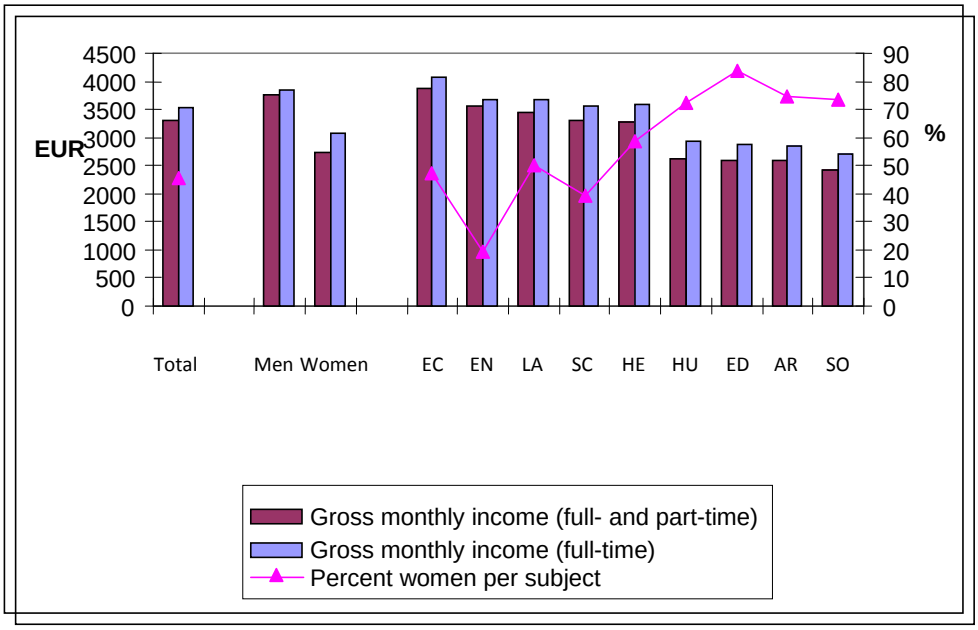
In the following we calculate the *sixth model for men and women separately* in order to trace the gender-specific influence of control variables, such as family status and the presence of children on earnings. The sixth model is also the basis for the following Oaxaca-Blinder decomposition. In the following section, we now present the results of our empirical analysis.

[10] Due to our data we were not able to measure wage differences within firms or firm departments.

5. Empirical results

When analysing the monthly income of male and female graduates descriptively, one can see that five years after graduation, women earn considerably less than their male counterparts. The average woman working full-time makes 3074 euros a month, i.e. 20 percent less than the average man whose gross income is 3838 euros (see graph 1). If both full-time and part-time employees are included in the analysis, the wage difference increases to 28 percent. Apart from gender differences we also find important differences in mean income between graduates of different fields of study. Graduates of economics earn the highest incomes, followed by graduates of engineering, law, natural sciences and health. Graduates in humanities, education and social sciences are at the bottom of the wage hierarchy. At first glance, these descriptive results suggest that graduates of fields with a higher degree of specialisation such as law or engineering receive higher wages than graduates in humanities and social sciences, which provide a more general training. However, the share of women in each field of study points into a different direction. Comparing mean income and the share of female students in a given field of study suggests that degree programmes with a high percentage of female graduates yield lower wages on the labour market. The mere descriptive comparison of subject areas thus does not allow for identifying the causes of the gender wage differences.

Graph 1: Mean monthly gross income five years after graduation, by sex, subject and mean share of women in a field of study



Source: HIS-Absolventenpanel (graduate cohort 1997), weighted means, own calculations
EC: Economics, EN: Engineering, LA: Law, SC: Sciences, HE: Health, HU: Humanities, ED: Education Sciences, AR: Arts, SO: Social Sciences

In a next step we estimated the logarithmed gross monthly income five years after graduation, using OLS regressions; the estimations include both men and women in order to be able to assess the gender wage gap. Model 1 of the multivariate analysis (see table 1) generally confirms the descriptive results: women earn significantly less than men, even when controlling for subject areas. At the same time, we observe a positive effect of graduating in a natural science or engineering subject compared to humanities on wage, independent of a person's gender. We do not, however, find significant differences between fields of study such as humanities, social sciences and education.

The inclusion of subjective and objective indicators for occupational specificity in the model tests whether the gender wage gap can be explained by the fact that women are more likely to invest in general human capital, whereas men tend to invest in specific human capital (model 2). However, the results show no difference between graduates who found a job which matches their field of study immediately after graduation. Moreover, degree pro-

grammes which, according to the respondents, provide students with many occupational skills have no influence on gender-specific wages. Including the variables on specific human capital does not change either the influence of gender or the general explanatory power of the model. Our model thus does not show any influence of a subject's occupational specificity on gender specific wages. We cannot be entirely sure, however, whether the lack of influence is due to the aforementioned difficulties regarding operationalisation (close relation to the labour market, no classification of curricular content) or whether occupational specific human capital is really not important for university graduates' wages on the German labour market.

Table 1: OLS regression estimating logarithmised gross monthly income

	Model 1		Model 2		Model 3		Model 4	
Women (RC: Men)	-0.227**	(0.027)	-0.224**	(0.026)	-0.185**	(0.016)	-0.186**	(0.024)
Field of study (RC: Humanities)								
Engineering	0.163**	(0.054)	0.137*	(0.057)	-0.016	(0.078)	0.064	(0.062)
Sciences	0.148*	(0.057)	0.119*	(0.058)	0.021	(0.077)	0.080	(0.062)
Social Sciences	-0.031	(0.072)	-0.059	(0.092)	-0.011	(0.072)	0.029	(0.044)
Economics	0.292**	(0.032)	0.276**	(0.033)	0.237**	(0.067)	0.221**	(0.044)
Law	0.128**	(0.032)	0.053	(0.056)	0.070	(0.067)	0.026	(0.047)
Health	0.151+	(0.087)	0.093	(0.072)	0.117	(0.080)	0.124	(0.086)
Education Sciences	0.045	(0.048)	0.013	(0.052)	0.073	(0.052)	0.120**	(0.043)
Arts	-0.021	(0.042)	-0.032	(0.040)	-0.051	(0.064)	-0.043	(0.055)
Occupation-specific human capital								
Subject specific job, obj.			0.036	(0.028)				
Subject specific job, subj.			0.003	(0.002)				
Percentage women in subject (RC: male-dom.)								
Female-dom. subject					-0.255**	(0.070)		
Integrated subject					-0.156*	(0.067)		
Percentage women in occupation (RC: male-dom.)								
Female-dom. occupation							-0.274**	(0.030)
Integrated occupation							-0.097**	(0.029)
Constant	8.045**	(0.036)	7.910**	(0.116)	8.238**	(0.076)	8.152**	(0.051)
R^2	0.142		0.146		0.163		0.178	
N	3812		3812		3812		3812	

Source: HIS-Absolventenpanel (Graduate cohort 1997), own calculations, significant **p<0.01, *p<0.05, +p<0.1, estimates with robust standard errors, clustered by subject

On the contrary, model 3 shows that a high share of female students in a field of study (over 60 percent) has a strong negative impact on graduates' gross monthly income. Graduates from these subjects earn 26 percent less than graduates of male-dominated subjects. Even mixed-gender subjects have a negative impact on wages, compared to male-dominated ones. Model 4 shows that holding a job in a female-dominated occupation has a strong

negative influence on wage level. Respondents working in these occupational segments earn 27 percent less than those in male-dominated occupations. This is also true for respondents in mixed-gender occupations, albeit to a smaller degree. At the same time, inclusion of variables capturing segregation in terms of subject and occupation decrease the direct influence of a person's gender to about 19 percent. It also changes the influence of field of study; most importantly, the influence of a degree in engineering, law and natural sciences disappears.

The model which integrates all three main effects (table 2, model 5) also shows that occupational specificity does not have an effect on wages; however, we do observe a significant influence of gender segregation regarding subjects and occupations. This shows that female-dominated subjects as well as female-dominated occupations lead to lower wages, meaning that each has an independent influence. Taken together, studying a female-dominated subject and working in an occupation dominated by women, compared to studying a male-dominated subject and working in a male-dominated occupation, leads to a wage difference of 42 percent.

Since we control for occupational specificity, we can assume that the importance of subjects for wage differences between graduates is based on evaluative discrimination. Women do not earn less because they are less specialized but because they graduate in female-dominated subjects which are considered less valuable on the labour market. But not only female-dominated university degrees are devaluated and consequently associated with lower wages. Additionally, female-dominated occupations lead to wage discrimination, independent of the effect of female-dominated subjects.

Although we cannot test these supposedly underlying mechanisms directly, we assume that these gender wage differences between university graduates are due to socio-cultural mechanisms of stereotyped gender roles regarding choice of subject and occupation as well as due to institutional discrimination of female-dominated occupations in the wage bargaining process. Both processes are supported by the close link between (tertiary) education and the labour market in Germany. Since studying a female-dominated subject often leads to employment in a female-dominated occupation, many female graduates are confronted with double discrimination.

Table 2: OLS regression estimating logarithmised gross monthly income

	Model 5		Model 6		Model 6 Men		Model 6 Women	
Women (RC: Men)	-0.160**	(0.014)	-0.108**	(0.012)				
Field of study (RC: Humanities)								
Engineering	-0.065	(0.089)	-0.117*	(0.050)	-0.032	(0.054)	-0.165*	(0.069)
Sciences	-0.017	(0.087)	-0.121*	(0.052)	-0.046	(0.053)	-0.128*	(0.058)
Social Sciences	0.021	(0.054)	0.079*	(0.035)	0.169**	(0.040)	0.048	(0.045)
Economics	0.194*	(0.074)	-0.034	(0.053)	0.008	(0.048)	0.003	(0.068)
Law	-0.036	(0.087)	-0.112+	(0.062)	-0.063	(0.066)	-0.123+	(0.072)
Health	0.070	(0.080)	-0.099	(0.070)	-0.004	(0.085)	-0.099+	(0.059)
Education Sciences	0.109*	(0.048)	0.082**	(0.030)	0.111	(0.112)	0.050	(0.045)
Arts	-0.063	(0.066)	-0.041	(0.056)	-0.058	(0.047)	-0.018	(0.066)
Occupation-specific human capital								
Subject specific job (obj.)	0.017	(0.025)	-0.014	(0.015)	-0.017	(0.014)	0.014	(0.027)
Subject specific job (subj.)	0.002	(0.002)	0.002	(0.002)	0.001	(0.002)	0.004*	(0.002)
Percentage women in subject (RC: male-dom.)								
Female-dom. subject	-0.175*	(0.082)	-0.141**	(0.042)	-0.132**	(0.043)	-0.143**	(0.053)
Integrated subject	-0.122	(0.079)	-0.041	(0.044)	-0.031	(0.045)	-0.050	(0.044)
Percentage women in occupation (RC)								
Female-dom. occupation	-0.243**	(0.029)	-0.135**	(0.024)	-0.102*	(0.040)	-0.171**	(0.029)
Integrated occupation	-0.078**	(0.027)	-0.034	(0.021)	-0.033	(0.021)	-0.036	(0.035)
Family situation								
Parent with 'Abitur'			0.020*	(0.009)	0.031*	(0.012)	-0.009	(0.019)
Family status: married T2			0.010	(0.014)	0.039**	(0.012)	-0.030	(0.028)
Child T2			-0.024	(0.016)	0.005	(0.017)	-0.076*	(0.029)
Education								
Apprenticeship			0.011	(0.010)	0.013	(0.015)	0.011	(0.016)
Age of graduation (RC: 24-29 years)								
Age of graduation: <24			-0.028	(0.019)	-0.024	(0.037)	-0.061+	(0.032)
Age of graduation: >=30			-0.008	(0.016)	-0.008	(0.019)	-0.022	(0.033)
Type of degree (RC: 'Fachhochschule')								
University Diplom			0.085**	(0.010)	0.086**	(0.015)	0.075*	(0.034)
Magister			0.000	(0.032)	-0.013	(0.045)	0.044	(0.049)
Staatsexamen			0.209**	(0.032)	0.173**	(0.041)	0.215**	(0.048)
Employment biography since graduation								
Unemploym. (months)			-0.007**	(0.002)	-0.009**	(0.002)	-0.007*	(0.003)
Employment (months)			0.008**	(0.001)	0.005**	(0.001)	0.010**	(0.001)
Current employment								
Job in East Germany T2			-0.199**	(0.017)	-0.225**	(0.020)	-0.152**	(0.031)
Profession, managem. T2			0.098**	(0.023)	0.122**	(0.027)	0.044	(0.032)
Large firm T2			0.128**	(0.011)	0.109**	(0.013)	0.156**	(0.017)
Public sector T2			-0.136**	(0.029)	-0.238**	(0.021)	-0.011	(0.035)
Constant	8.182**	(0.149)	7.646**	(0.119)	7.850**	(0.116)	7.384**	(0.139)
R^2	0.191		0.404		0.352		0.374	
N	3812		3812		2378		1434	

Source: HIS-Absolventenpanel (Graduate cohort 1997), own calculations, significant **p<0.01, *p<0.05, +p<0.1, Estimation with robust standard errors, clustered by subject

In a next step, we included control variables capturing family situation, (university) education in general, employment history since graduation and current employment situation in

the model (model 6). The explanatory power of the model is doubled, while wage differences between men and women are reduced to 10 percent. As in previous research, we find strong evidence that wages between men and women differ due to differences in education, employment history and family situation (for Germany, see e.g. Achatz, J., et al. 2005, Braakmann, N. 2008, Gartner, H. / Rässler, S. 2005, Hinz, T. / Gartner, H. 2005). Women earn less because they have accumulated less work experience since graduation, have had more phases of non-employment, have worked in smaller firms and in the public sector. Moreover, they are less often in management positions or work in the professions, which is also associated with lower wages. Moreover, the two models which are estimated separately for both genders show that marriage has a positive influence on men's wages while women's wages are negatively influenced by children in the household. These findings once more confirm classical gender-specific roles which attribute the breadwinner role to married men and expect women to reduce their professional commitment in order to perform family duties. It is interesting to note that management positions or professional jobs only have a positive influence on men's wages; women do not profit from the professional status. Finally, working in the public sector only has a negative impact on men's wages, which could be explained by their superior success in pay negotiations in the private sector.

The essential point of all these findings, however, is that the significant influence of female-dominated subjects and occupations remains stable. Even after introducing control variables, a female-dominated subject in combination with an occupation dominated by women leads to a wage difference of almost 28 percent (model 6). Similar effects can be observed in the separated models for men and women. Thus, men who study typically female subjects or work in female-dominated occupations earn lower wages than men with male-dominated subjects or in male occupations, even if the discrimination is less severe than it is for women. All of these findings suggest that the devaluation of female-dominated subjects as well as occupations dominated by women lead to wage differences between male and female university graduates. Regarding female-dominated occupations, we can further assume that collective bargaining agreements contribute additionally to women's lower wages. Thus, the devaluation processes which have been observed for women in general (England 1992) can be equally observed among the highly qualified. The gender-specific investment in general or specific human capital, on the contrary, does not have an influence on wage differences.

In order to be able to specify the explanatory power of the various factors on gender wage inequalities, we now go on to present the results from an Oaxaca-Blinder decomposition (Jann, B. 2008, Oaxaca, R. 1973, Oaxaca, R.L. / Ransom, M.R. 1994).[11] In order to estimate the influence of different groups of variables, we summarized variables from model 6 in the following categories, as outlined in table 1: "field of study", "occupation-specific human capital", "percentage women in subject", "percentage women in occupation", "family situation", "education", "employment biography since graduation" and "current employment" (see table 3). Overall, wage differences between men and women add up to 27 percent. The decomposition shows that 16 percent of wage differences can be attributed to the explained components ("endowment effects"). Women earn significantly less because they graduate in female-dominated subjects (explained part: 19 percent) and work in occupations with a high share of women (explained part: 13 percent); the specificity of a person's human capital again has no influence. The most important explanatory power regarding wage differences between male and female university graduates is related to differences in their previous employment history as well as their current job situation. Moreover, subject areas and education add significantly to the explanation of wage inequalities. The negative coefficients indicate, however, that women whose educational or subject parameters remained unchanged but who had male coefficients and shifted parameters would even earn 12 or 15 percent more than men.

Overall, the explained components ("endowment effects") can explain almost 60 percent of wage differences between male and female graduates five years after graduation. By including the share of women in a field of study or an occupation we do not restrict our analysis to the respondents' previous employment history and their acquired human capital but we are able to focus more directly on gender-specific discrimination. We conclude that only those theories that propose gender segregation between subjects and occupations to explain wage inequalities by the gender segregation between subjects and occupations are found to have explanatory power.

[11] Oaxaca-Blinder decomposition is used to specify the contribution of single variables or variable groups to the explanation of the gender wage gap. Gender-specific wage inequalities are split up in two parts: One part (the "explained" component) concerns the observable unequal distribution between men and women regarding the different explanatory variables and thus the so-called "endowment effects". The other part (the "non-explained" component) concerns gender differences regarding those processes which lead to wage discrimination between men and women. This second part is usually associated with discrimination.

Table 3: Oaxaca-Blinder decomposition

	Coefficients	*Standard error*	*Explained part*
Predicted log wage men	8,205	0,022	
Predicted log wage women	7,938	0,041	
Wage difference	0,267	0,029	
Explained part of the wage difference			
Field of subject	-0,039*	0,018	-14,6%
Occupation-specific human capital	0,001	0,003	0,3%
Percentage women in subject	0,050**	0,020	18,8%
Percentage women in occupation	0,035**	0,009	13,1%
Family situation	-0,003+	0,002	-1,2%
Education	-0,032*	0,013	-11,9%
Employment biography since graduation	0,095**	0,017	35,5%
Current employment	0,051**	0,011	19,3%
Total	0,158	0,025	59,4%
Non-explained part	0,108	0,013	40,6%

Source: HIS-Absolventenpanel (Gradute cohort 1997), own calculations, significant **p<0,01, *p<0,05, +p<0.1, Estimation with robust standard errors, clustered by subject

Regarding the remaining 11 percent of wage differences between genders (table 2, model 6) we have to conclude that women can apparently earn less merely due to their gender, independent of their subject, the acquired degree or other differences in the explained components. We therefore conclude that more discriminatory processes are at stake; their exact mode of operation can however not be identified more specifically. Additional factors might include that women are less successful in pay negotiations, that they have less social networks helping them to access positions with higher wages or that they are simply being (statistically) discriminated by employers.

6. Discussion of the empirical results

Our analysis began with the observation that women, their equal participation in tertiary education notwithstanding, continue to have problems transforming this human capital on the labour market into wages equal to those of men. One important explanation which is usually proposed is the gender-specific choice of academic subjects. Our empirical results indeed reveal important wage differences between graduates of different subjects. Explaining wage differences between male and female university graduates by their gender-specific choice of subjects does not, however, provide an explanation of the underlying mechanisms. The goal of our study was to provide precisely this kind of advanced analysis of the mecha-

nisms which underlie the explanatory factor of "choice of subject". Our results support the assumption that, despite the high importance of occupationally specific education on the German labour market, gender differences between male and female university graduates cannot be explained by women's preference for general human capital. In other words, including a subject's occupational specificity in the model does not have a significant influence on gender-specific wage differences.

A decisive factor in explaining wage differences between male and female university graduates is – apart from the well-known differences in employment biographies, such as women's more frequent employment interruptions – whether they graduated in a female or male-dominated subject and whether they subsequently work in an occupation which is dominated by men or women. Our results support the idea that discriminatory processes, such as the socio-cultural devaluation of fields of study or occupations with a high share of women in combination with institutional components of wage setting processes for female-dominated occupations, contribute to the explanation of the gender wage gap among male and female graduates. Since our analysis only includes individuals working at least 35 hours per week, this discrimination of female-dominated subjects and occupations cannot be explained by women's higher participation in part-time work. By controlling for occupational status, we can also rule out the possibility that the described discrimination of female-dominated subjects and occupations is due to women's lower participation rate in leadership positions, their lower share in employees of large firms and their higher share in the public sector.

Generally, our results contribute to a deeper understanding of the mechanisms which lead to wage discrimination of female university graduates as compared to their male peers. We cannot confirm the assumption that women's preference for fields of study providing a more general training, such as the humanities and social sciences, contributes to wage differences between men and women with tertiary education. Previous studies, which identified individuals' choice of subject as a primary explanatory factor, implicitly assumed that women could individually achieve higher wages on the labour market by choosing a male-dominated subject. Our results suggest that while this might be possible in individual cases, a collective movement of women in male-dominated subjects or occupations will lead to their cultural devaluation and, subsequently, to financial discrimination. The remaining wage difference of

11 percent which is not explained by any of the three mechanisms discussed in this paper finally leaves space for further theoretical and empirical differentiation.

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Appendix

Appendix A: Percentages or means and standard deviations

Variable	Percentage or mean
Log monthly gross income	8,104 (0,406)
Women	0,377
Subject: Humanities	0,102
Engineering	0,344
Natural sciences	0,198
Social sciences	0,039
Law	0,141
Economics	0,053
Health	0,077
Educational sciences	0,026
Arts	0,021
Subject specific job (obj.)	0,391
Subject specific job (subj.)	0,587 (0,906)
Percentage women in subject	0,404 (0,256)
Percentage women in occupation	0,330 (0,213)
Parent with 'Abitur'	0,471
Age of graduation: under 24 years	0,026
24-29 years	0,791
30 years or older	0,183
Family status: married	0,422
Child in household	0,316
Education	0,377
Type of degree: 'Fachhochschule'	0,280
University Diplom	0,425
Magister	0,067
Staatsexamen	0,227
Unemployment (months)	0,160 (0,409)
Employment (months)	0,533 (0,171)
Professional status (profession, management)	0,349
Large firm	0,428
Public sector	0,345

Source: HIS Absolventenpanel (Graduate cohort 1997), own calculations

Appendix B: Match between subject and occupations, based on KldB 1992

Subject	Matched occupations, based on KldB 1992
Humanities	82, 821, 822, 823, 871, 880, 882, 89, 891, 894
Engineering	60, 32, 52, 61, 605, 601, 600, 606, 608, 611, 609, 603, 604, 871, 880
Natural sciences	61 77 612 611 774 775 776 777 778 779 871 880 883
Social sciences	76, 761, 763, 86, 861, 871, 880, 884, 886, 887
Economics	75, 750, 751, 753, 755, 756, 757, 764, 765, 771, 772, 773, 871, 880
Law	76, 81, 761, 811, 813, 814, 871, 880
Health	84, 841, 842, 843, 844, 871, 880
Education	87, 870, 871, 872, 873, 874, 875, 876, 878, 879, 885, 880
Arts	83, 831, 832, 833, 834, 835, 836, 837, 838, 839, 871, 880

Source: HIS Absolventenpanel (graduate cohort 1997), own calculations; for an overwiew on the KldB 1992 classification, see *Statistisches Bundesamt*, 1992: Klassifizierung der Berufe. Systematisches und alphabetisches Verzeichnis der Berufsbenennungen. Stuttgart: Metzler-Poeschel.

Appendix C: Description of subjects

Field of study	Subject	Gender	Occup. specificity %
Educationl			
	Education	female	59
	Special education	female	61
Humanities			
	Protestant theology	integrated	44
	Catholic theology	integrated	65
	Philosophy	male	39
	History	integrated	59
	Library science	female	76
	Linguistics and literature	integrated	12
	Classical philology	female	35
	German studies	female	52
	English studies	female	51
	Romance studies	female	48
	Slavic studies	female	45
	Non-European languages	female	24
	Cultural sciences	female	25
	Language and culture	female	59
Health			
	Psychology	female	57
	Sport science	integrated	54
	Medicine	integrated	79
	Dentistry	male	86
	Veterinary medicine	female	45
Engineering			
	Industrial engineering	male	54
	Landscape planning	female	51
	Agrarian food science	male	52
	Forestry	male	60
	Food and household science	female	51
	Engineering	female	61

	Mining	male	44
	Mechanical engineering	male	57
	Electrical engineering	male	56
	Traffic engineering	male	62
	Architecture	integrated	61
	Regional planning	integrated	100
	Construction	male	64
	Surveying	male	85
Arts			
	Arts	female	59
	Design	integrated	55
	Performing arts	female	55
	Music	integrated	51
Natural sciences			
	Mathematics - natural science, general	female	75
	Mathematics	integrated	56
	Computer science	male	71
	Physics, astronomy	male	57
	Chemistry	male	67
	Pharmacy	female	72
	Biology	female	55
	Geoscience	male	48
	Geography	integrated	48
Law			
	Law	integrated	73
Social sciences			
	Economics and social sciences	male	28
	Regional sciences	female	55
	Political sciences	integrated	29
	Social sciences	female	50
	Social work	female	64
Economics			
	Public administration	male	68
	Economics	integrated	55

Source: HIS Absolventenpanel (graduate cohort 1997), own calculations