Gender Segregated Labor Markets and Social Inequality Between Occupations

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Thesis submitted for the degree of
Doctor of Philosophy in Sociology

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Thesis Abstract

This thesis is concerned with the link between gender segregation in the labor market and social inequality between occupations. Two topical questions are at the basis of the presented research: First, are female-typed jobs paid less than other jobs? Second, does women's gender-typed occupational sorting lead to wage inequalities in the female population? In both cases, interest lies in sizes of statistical effects or associations, and in the mechanisms driving observed results. All three of the empirical chapters in this thesis employ a measure of occupations' gender-type. This way, we classify occupations–either on a continuous or a categorical scale–as rather female-typed, male-typed, or as gender integrated. Confirming broad findings in the extant literature on segregation, this thesis identifies occupational gender-types as a key structural component of past and current wage inequality. Results on the United States suggest that cultural devaluation of female-typed jobs has been confined to the immediate post-war era, and to jobs in the bottom eighty percent of the wage ladder. Effects have strongly declined over time, which we explain by historical trends in society's adoption of gender-egalitarian views. Analyses of the German case also show a strong link between segregation and wage disparities. This is evidenced by two separate findings: First, occupational gender stereotypes covary negatively with wages in the bottom half of the wage distribution, and in particular for women. Second, gender segregation has recently become a source of emerging wage inequality between women. The most important factor explaining this trend has been the increasing rate at which highly educated women select into male-typed jobs.

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Contents

1 Introduction **1**
- 1.1 Why study occupations . . . 1
- 1.2 Occupations and gender . . . 3
- 1.3 Devaluation of female jobs . . . 5
- 1.4 Research concepts . . . 8
- 1.5 Agenda . . . 9

2 Occupational Devaluation Due to Feminization? Causal Mechanics, Effect Heterogeneity, and Evidence from the United States, 1960 to 2010 **12**
- 2.1 Introduction . . . 12
- 2.2 Devaluation so far . . . 15
- 2.3 Constructive criticism . . . 17
  - 2.3.1 Causal effects and mechanisms . . . 18
  - 2.3.2 Change over time . . . 20
  - 2.3.3 Variation between occupations and gender . . . 23
- 2.4 Hypotheses . . . 25
- 2.5 Data and Methods . . . 28
- 2.6 Results . . . 31
- 2.7 Discussion . . . 39
- 2.8 Conclusion . . . 43

3 Identification and Bias. Occupational gender stereotypes and wage penalties in the German labor market **45**
- 3.1 Introduction . . . 45
- 3.2 Discrimination of occupations & gender . . . 48
  - 3.2.1 The salience of stereotypes . . . 50
  - 3.2.2 The origin of stereotypes . . . 52
  - 3.2.3 Summing up & outlook . . . 55
- 3.3 Data . . . 57
  - 3.3.1 Individual level . . . 57
  - 3.3.2 Occupation level . . . 59
- 3.4 Methods . . . 63
- 3.5 Results . . . 65
  - 3.5.1 Stereotypes and compositions . . . 65

3.5.2 Stereotypes in focus . . . 67
3.6 Discussion . . . 70
3.7 Conclusion . . . 74

4 Gender Segregation, Occupational Sorting, and Growth of the Female Wage Gap 77
4.1 Introduction . . . 77
4.2 Findings on women's wages and careers in male jobs . . . 80
4.3 Mechanisms . . . 82
4.3.1 Sorting . . . 82
4.3.2 Returns to education & skills . . . 84
4.3.3 Discrimination . . . 85
4.3.4 Cumulative changes . . . 86
4.4 Data . . . 87
4.5 Methods . . . 90
4.6 Descriptive analysis . . . 93
4.7 Decomposing the change in wage differentials . . . 96
4.8 Job-level mechanisms . . . 99
4.9 Educational upgrading . . . 101
4.10 Conclusions . . . 103

5 Conclusions 110
5.1 Findings . . . 110
5.2 Contributions . . . 114
5.2.1 Social interaction . . . 114
5.2.2 Occupational stereotypes . . . 116
5.2.3 Cultural beliefs . . . 118
5.2.4 Career choices . . . 119
5.2.5 Occupation-specific skills & technological change . . . 120
5.2.6 Occupational institutions . . . 121
5.2.7 Macro-institutions . . . 123
5.3 Going forward . . . 124
5.3.1 Devaluation theory: under construction . . . 124
5.3.2 Work & family . . . 126
5.3.3 The future of segregation . . . 128

Bibliography 133

List of Tables

1.1 Empirical studies on the effect of occupational feminization on wages 6

2.1 Total N of observed occupation-industry cells by quintile and period 30
2.2 Coefficients (t-values in parentheses) from fixed effects regressions of occupational log wages 32
2.3 Correlations of Percent F and current/subsequent occupational log wages 37
2.4 Coefficients (t-values in parantheses) from OLS regression of 2010 occupational log wages 38

3.1 Sample descriptives 58
3.2 Examples of extreme occupations in the male-female spectrum . . 61
3.3 Coefficients (t-values in parentheses) from random intercept models of hourly wages in 1991/92 66

4.1 Sample descriptives: pooled means and deltas 95
4.2 Summary components of change in wage gaps between male and mixed/female jobs, 1992/93 to 2014/15 97
4.3 Detailed components of change in wage gaps between male and mixed/female jobs, 1992 to 2015 98

5.1 Discerning male and female jobs: the demographic and cultural approaches 117
5.2 Cross-correlations of percent Female and closure variables 122

List of Figures

2.1 A theoretical model of occupational devaluation due to feminization 19
2.2 Marginal effects of feminization on wages, by occupational wage quintiles and gender (1960–2010) 35
2.4 Differences in marginal effect sizes, 2010 and 1960, by wage quintile and gender, and 95 percent confidence intervals 36

3.1 Correlation between stereotypes index and sex compositions (190 occupations) 60
3.2 Coefficients from unconditional quantile regressions and 95% confidence intervals 68
3.3 Stereotype coefficients by gender from unconditional quantile regressions 69
3.4 Coefficients from UQRs on stereotypes, including additional controls (and 95% confidence intervals) 76

4.1 Median hourly wages in male, female and mixed jobs 1992–2015, by gender (2015 Euros, smoothened) 93
4.2 Marginal differences, empty and accounting for ind. char's, by year-dyads, 1992–2015 (95 percent CIs) 99
4.3 Marginal differences accounting for job skills, by year-dyads, 1992–2015 (95 percent CIs) 100
4.4 Proportion women and men with tertiary degree, by occ. gender type, 1992–2015 102
4.5 Coefficients for skill types from fixed effects regression, 1992–2015: analytical, quantitative, verbal, creative 108
4.6 Coefficients for skill types from fixed effects regression, 1992–2015: management, care, computer, routine 109

5.1 Exploratory variable space linking gender segregation in the labor market with social inequality 115

Chapter 1

Introduction

1.1 Why study occupations

This dissertation is centrally concerned with occupations. Technically, occupations can be understood as clusters of paid work activities defined by similar tasks.[1] They exist independently of the organizational context, which makes them distinct from jobs that are defined to exist within concrete work environments (e.g. in the firm). Occupational classification systems, such as the U.S. Standard Occupational Classification (SOC), are built around this technical interpretation of occupations. The SOC's first coding guideline is that "[a] worker should be assigned to an SOC occupation code based on work performed" (Executive Office of the President of the United States, Office of Management and Budget 2018, 10). From a scientific point of view, it is remarkable how much of social structure can be captured by looking at divisions defined through this single criterion. What people do for a living has a fundamental impact on many very broad aspects of their lives. Occupational groupings underly social class boundaries (Grusky and Sørensen 1998; Erikson and Goldthorpe 1992; Oesch 2006; Weeden and Grusky 2005) that are consequential for income, social risk, political

[1] Sociologically, occupations are, of course, much more than just that. Their cultural and institutional underpinnings will be discussed at length throughout this dissertation.

opinion, cultural consumption, or health. Occupations underly intergenerational reproduction, as parents pass on knowledge, cultural orientations and networks to their children, making them prone to following their parents footsteps (Jonsson et al. 2009; Hout 2018). Rather than declining in importance, stratification based on occupational classes has become more important in recent decades (Zhou and Wodtke 2018).

For centuries, *change* in the occupational structure has been at the center of various scholarly and public debates. And the social and economic stakes have always been high: When the late 16th century saw the invention of a knitting machine that could substitute for manual labor, this did not lead to the inventors deserved remuneration, but rather to his exit from Britain due to opposition from guilds that aimed to protect their core workforce (Acemoglu and Robinson 2012, 182f.). Today, we are looking at the uncomfortable prospect of ever more powerful machines that could substitute the largest part of all productive work in our economies within the next several decades (Frey and Osborne 2017). And once again, discussions are controversial, reaching from robot taxes and the basic income to the hope that machines will unfold unprecedented economic potential to benefit us all. The attention that occupational change has received in these debates over centuries is a great reminder of the important role they play in shaping our lives. This thesis makes the attempt to push our knowledge a little bit further to understand the extent to which occupations determine socio-economic outcomes, and to appreciate the mechanisms at work in this relationship.

1.2 Occupations and gender

Throughout this thesis, I discuss various aspects of occupations, but occupational gender segregation is by far the most important one. Speaking of gender segregation, we refer to the extent to which women and men work in different occupational fields. Although there has been much change since the immediate post-war era in the degree of segregation, it is still a remarkable feature of labor markets in developed economies, and it continues to have a profound impact on individual lives. A standard tool to measure the aggregate level of segregation is the dissimilarity index D (Duncan and Duncan 1955). The index quantifies the percentage of workers who would have to switch into another occupational group in order to adjust each occupation's gender ratio to the overall gender ratio in the labor market. Using the most detailed Census coding scheme[2], Cotter et al. (2004) find that in the year 2000, 52 percent of all women or men in the United States would have to switch occupations so that each of these occupations would match the 46.5 percent of women in the labor market. These figures are comparable, if not slightly lower than e.g. in the German case (Hausmann and Kleinert 2014). Notwithstanding the total level of segregation at any point in time, studies consistently find that segregation has strongly declined over the past 60 to 70 years, although with decreasing pace in more recent decades (Blau et al. 2013; Cotter et al. 2004; Hakim 1994; Hausmann and Kleinert 2014; Jacobs 1989b). These findings are comparable with results on segregation in the educational context (England and Li 2006).

Prior research has identified several ways in which gender segregated labor markets contribute to overall social inequality. Gender wage gaps, for instance, are

[2]The total level of D depends on the level of detail at which we measure occupational groups, and on the consistency of such groups over time (Blau et al. 2013).

heavily determined by the allocation of women and men into different occupations. Blau and Kahn (2017) estimate that about a third of the 2010 gender wage gap in the United States can be accounted for by occupation-level segregation, net of differences in experience and industry factors (p. 827). Some characteristics, such as educational attainment, have equalized between women and men, which contributed to declines of the gap in wages. At the same time, the impact of segregation has remained rather stable so that its *relative* contribution to the wage gape strongly increased over time (Blau and Kahn 2017, 825ff.). Gender segregation may thus be seen as the last remaining source of substantial wage inequality between women and men. At first glance, the persistent link between segregation and gender inequality is surprising, in particular with women's advances in some high-paying professional and managerial occupations and their declining representation in low-wage care jobs (Moore 2018). Several points have been raised in that respect: horizontal segregation based on essentialist views has remained resilient to much of recent cultural shifts, which makes it one of the key forces to keep women in lower paying jobs (Charles and Grusky 2004; Levanon and Grusky 2016). Although some women have reached high-reward jobs, vertical segregation is still well visible (Ibid.). A related issue is that women have been 'swimming upstream', meaning that they reached better paying jobs while overall wage inequality went up (Blau and Kahn 1997; Gupta et al. 2006). Other factors, such as increasing payoff to overwork, might have further put a halt to declines in the gender wage gap, despite women's success in professional and managerial jobs (Cha and Weeden 2014).

Overall, while women have caught up in several ways with men's standing in the labor market, gender inequality is still a strong feature in our economies today. Patterns of occupational gender segregation are very much at the bottom

of this fact. Gender segregation has been remarkably persistent over time (see also my discussion in section 5.3.3), so any problems emerging from segregation are unlikely to disappear in the near future.

1.3 Devaluation of female jobs

One mechanism that potentially perpetuates the effect of segregation on inequality is the devaluation of female jobs. This topic features prominently in all three chapters of this thesis and, thus, merits a short introduction. This introduction will spare theoretical details that are well explored throughout the next chapters, and it will focus on the past and current standing of the research strand: The main premise of the devaluation hypothesis is that female-typical work is paid less because it is culturally devalued. Research within this area dates back to the 1970s and in particular sociologists have been showing great interest in it up until today. Table 1.1 extends the tabular overview by England (1992, 36), listing central contributions to the literature since the late 1980s. It is interesting to see the spread of research on devaluation from the United States to the European context. There are early papers with European country focus by de Ruijter et al. (2003) or Polavieja (2008), but most other contributions were published in the the past five years. This *renaissance* of devaluation has, of course, been driven by interesting research findings and the apparent relevance of the topic to explain persistent gender wage inequality. Mandel's research, for instance, has been advancing the field in pointing out that recent success of women in higher-tiered jobs might have led to less favorable results than expected, as these feminizing jobs started to be seen as less worthy than before (Mandel 2013, 2018). Magnusson (2013) pointed out that the relationship between gender compositions and wages is non-linear

TABLE 1.1: Empirical studies on the effect of occupational feminization on wages

Study, results page number	**Size negative effect in %**[a]	**Effect type**[b]	**Data**	**Lev. of anal.**	**Method**[c]
Gerhart and Cheikh (1991, 69)	n.s. (w), 21 (m)	CMTF	U.S. (NLS 1983, 1986)	individual	FEs
England et al. (1988, 553)	8–11 (w), 9.9 (m)[h]	CMTF	U.S. (NLS 1966–1981)	individual	FEs
Kilbourne et al. (1994b, 701)	0.1 (w), 0.04 (m)	% fem.	U.S. (NLS 1966–1981)	individual	FEs
Kilbourne et al. (1994a, 1160)	0.1–0.24 (w), n.s. (m)	% fem.	U.S. (NLS 1966–1980)	individual	FEs
Macpherson and Hirsch (1995, 446)	5.5 (w), 3.4 (m)	CMTF	U.S. (CPS ORG 1983–1993)	individual	FEs
Karlin et al. (2002, 13f.)	13–15 (w), 8.3–22.5 (m)[f]	CMTF	U.S. (CPS 1984-1991)	occupation-industry	FEs, cross-lags
England et al. (2007, 1254f.)	mostly n.s. (w), 3–5 (m)	MXTF	U.S. (CPS 1983–2001)	occupation-industry	FEs, cross-lags
Levanon et al. (2009, 881)	0.015–0.025 (w), 0.01–0.03 (m)	% fem.	U.S. (IPUMS 1950–2000)	occupation-industry	FEs
Mandel (2013, 1199)	0.7 (m)[i]	% fem.	U.S. (IPUMS 1970–2007)	individual-occupation	multi-level, dynamic
Mandel (2018, 686f.)	0.7 (m)[i]	% fem.	U.S. (IPUMS 1960–2015)	individual-occupation	multi-level, dynamic
Murphy and Oesch (2016)	3 %	CMTF	Germany (SOEP 1991–2010)	individual	FEs
Hausmann et al. (2015a, 234f.)	n.s.	% fem. (or categorical)	Germany (SIAB 1976–2010)	occupation	FEs, static and dynamic
Leuze and Strauß (2016)	inconclusive[d]	% fem.	Germany (HIS-Absolventenpanel 2001/02, 2005/06)	individual	OLS

Table 1.1 – continued from previous page

Busch (2013, 321ff.)	3.3 (w), 1.9 (m)	PMTF	Germany (SOEP 2000–2010)	individual	FEs
Perales (2013, 615)	7–15 (w), 8–13 (m)	CMTF	UK (BHPS 1991–2007)	individual	FEs, OLS
Brynin and Perales (2016, 169f.)	7 (w), 4 (m)[g]	CMTF	UK (BHPS 1991–2007)	individual	FEs
Murphy and Oesch (2016)	13 %.	CMTF	UK (BHPS 1991–2009)	individual	FEs
Grönlund and Magnusson (2013, 1013f.)	inconclusive[d]	% fem. (or categorical)	Sweden (LNU 2000)	individual-occupation	multi-level, cross-section
Magnusson (2013, 233f.)	3.8 (w), 0.7 (m)	% fem.[e]	Sweden (LSS + Register 2001 + 2003)	individual	OLS
de Ruijter et al. (2003, 354, Model 2)	7 %.	PMTF	Netherlands (LSO 1997)	individual-occupation	multi-level, cross-section
Murphy and Oesch (2016)	7 %.	CMTF	Switzerland (SHP 1999–2011)	individual	FEs
Polavieja (2008, 207)	n.s.	% fem.	Spain (ESS 2004)	individual	Heckman selection

Source: Author's depiction
[a] w = effect on women's wages, m = men, n.s. = not significant
[b] CMTF = completely male to comp. female, PMTF = predominantly male to pred. female, MXTF = gender mixed to pred. female
[c] FEs = fixed effects, OLS = ordinary least squares
[d] Difficult to compare due to methodological choices or specific focus.
[e] Also showing models with categorical percent F variables with better model fit. Here, mixed occupations have highest wages.
[f] Coefficient converted approximately from absolute change to % change.
[g] In another specification using OLS on LFS data, the devaluation effect disappears for women after controlling for occupational productivity.
[h] Effect for white men. Non-significant effect for black men.
[i] This is the largest estimated effect, applicable only to small subset of data.

and stimulated further reasoning about causal mechanisms. Murphy and Oesch (2016) developed ideas about cross-national variation and displayed evidence from three countries. All of these are examples of how the discipline has evolved, much in a promising way. At the same time, several problems have emerged within the field that require new theoretical and methodological solutions to be found. A few of such novelties are presented throughout this thesis. Beyond that, I discuss several potential pathways for future research on devaluation in section 5.3.1.

1.4 Research concepts

In this dissertation, I make an attempt to answer a few central questions to which the extant literature offers no or only limited answers. The overarching topic throughout this work are outcomes in social inequality that can be linked back to gender segregation in the labor market. More specifically, I am looking at *wage inequality that can be observed between occupations with different gender typicality.* This is how the dependent and the independent variables in this framework are conceptualized:

The dependent variable of interest throughout are gross hourly wages, hence the market price per hour of work. This is, of course, only one of several possible outcomes to look at within my area of interest. Interesting findings in this area exist with respect to prestige (Magnusson 2009), status (Ridgeway 2014), authority, or labor income. The latter has the advantage of better representing individuals' current living conditions: Those who gain a lot of money per hour are often also those who work many hours, which amplifies the effect of market prices on aggregate inequality. I will therefore refer to income in some places to put findings on hourly wages into perspective.

Speaking about occupations' *gender typicality*, I refer to widely shared cultural beliefs about which gender is typical for an occupational group. White et al. (1989), e.g., find that amongst jobs with a strong male typicality are farmer, carpenter, and electrician. Jobs with a strong female typicality include dental hygienist, dietitian, or elementary teacher. Conceptually, the idea on occupational gender types is embedded in the literature on stereotyping. In social psychology, stereotypes are defined as "socially shared set[s] of beliefs about traits that are characteristic of members of a social category" (Greenwald and Banaji 1995, 14). In our case, the social category of interest is "occupation", and the trait of interest is "gender". Concretely, Lippmann (1922) defined stereotypes as the picture that typically pops up in our head when we think about a social category. It is widely acknowledged that stereotyping is a way to build heuristics that help people to make sense in an informationally complex world (Dovidio and Gaertner 2010, 1089). Hence, occupational gender types help people to understand gender segregation in a way that is conform with broadly shared beliefs in society. Throughout the text, I often speak about "male" or "female" jobs/occupations, which is a reference to the gender-typing of occupational groups.

1.5 Agenda

Based on my interest in wage inequality between occupations of different gender categories, I formulate two broad research questions to be addressed in this dissertation. These questions serve to clarify the conceptual frame of the presented work. I do not make the attempt to present an exhaustive answer to them, as they are much too broad and there is already a large amount of good research that addresses them from different angles as I do. Research questions formulated

in the following empirical chapters will be more specific, and they will be a subset of the two questions outlined here:

> Question 1: *Are female-typed jobs paid lower wages than male-typed or gender-integrated jobs? If yes, to what extent and through which mechanisms?*
>
> Question 2: *Does women's occupational sorting by gender-type lead to wage inequality between women? If yes, to what extent and through which mechanisms?*

The approach chosen to answer these question is empirical-analytical: I rely on representative secondary survey data and frequentist statistics in order a) to test whether we find reliable evidence for a phenomenon, b) to quantify the magnitude ("extent") of the phenomenon, and c) to test causal channels ("mechanisms") that explain it. In chapters 2 and 3, the first question is addressed. Here, the intention is to look at occupation-level mechanisms that create inequality. In essence, both of these chapters heavily rely on devaluation theory. Chapter 4 is a proposed answer to the second research question. I look at both, individual- and occupation-level variation between women working in male, mixed and female jobs. The three chapters are all motivated through their interest about the link between segregation and inequality. But they also connect to each other via more concrete questions and findings. In chapter 2, I take stock of devaluation, and I propose a novel occupation-level theoretical model linking segregation and inequality. On the basis of this model, I attempt to advance a nuanced discussion of devaluation's cultural underpinnings. Empirically, I contribute to the current literature by disaggregating the devaluation effect, unveiling effect variation over time and over different occupational groups. Although I contextualize my findings

within the proposed theoretical model, a key variable in it – occupational gender types – is not measured. Chapter 3 addresses this shortcoming by operationalizing the concept on the basis of survey data. Lastly, chapter 4 reports on the link between segregation and inequality solely amongst women. Two things are done here: First, I zoom *out* from purely occupation-level mechanisms, asking first and foremost how demographic groups are distributed over gender-typed occupational groups. This is crucial to understand the social inequality emerging from sorting processes of economically advantaged individuals into advantaged occupations. Second, I zoom *in* to focus solely on women. I argue that occupational sorting processes amongst women have changed considerably over the past several decades, which had a fundamental impact on inequality between women. This also means that we have to be careful when modeling outcomes of segregation for women and men combined. In the final chapter of this dissertation, I discuss in more detail what the implications of these three studies are and where we might want to go from here.

Chapter 2

Occupational Devaluation Due to Feminization? Causal Mechanics, Effect Heterogeneity, and Evidence from the United States, 1960 to 2010

2.1 Introduction

When occupations experience a larger inflow of female workers–meaning that they feminize–this leads to their devaluation, translating into a lower status and a decline in wages. The basic premise of the devaluation hypothesis is that this link between feminization and devaluation is indeed causal, and that it is due to cultural norms that attribute more economic value to the work done by men than to the work done by women. In the cross-section, this translates to the phenomenon that predominantly female occupations are paid less than gender integrated or predominantly male occupations, which puts all of those who work in a "female sector" at a disadvantage. Evidence for devaluation exists for various developed economies (United States, UK, Germany, Sweden, Netherlands, Spain,

Switzerland). Moreover, recent studies applied panel data methods to cope with unobserved heterogeneity on the individual or occupational level, and to shed light on change over time (England et al. 2007; Levanon et al. 2009; Murphy and Oesch 2016). Estimations of the devaluation effect have shown to be robust when being tested against diverse competing hypotheses coming from human capital or power resources theory. Overall, the existence of devaluation hence comes close to being an established fact and it is a prominent feature in explanations of wage inequality between occupations.

While empirical results thus speak in favor of the devaluation hypothesis, there is persistent insecurity about its underlying causal mechanisms. Even though cross-sectional data shows relatively large associations between the proportion of female workers (from here on: percent F) and wages, panel data models using occupational fixed effects can hardly explain variation in occupational wages (e.g. England et al. 2007). Hence, the question emerges of what mechanisms drive this large cross-sectional association, if it is not the assumed relationship between occupational feminization and wages. Moreover, there have been several findings of heterogeneous effects over time (de Ruijter et al. 2003; Levanon et al. 2009; Mandel 2013) and countries (Grönlund and Magnusson 2013; Hausmann et al. 2015a; Murphy and Oesch 2016), for which mere ad hoc explanations could be offered. Devaluation hence seems to be embedded in time- and space-specific contexts. Given the lack of research addressing these contexts, authors have consequently called for a "refinement of the theoretical discussion" and for putting more emphasis on "the search for mechanisms" (Grönlund and Magnusson 2013, 1015).[1]

[1] Mandel (2013, 1202) also urges that "further investigation is required to explicate the mechanisms underlying the over-time trends" of the percent F effect.

Tapping into this debate, we argue that the relationship between occupational feminization and devaluation is governed by two main mechanisms. The first mechanism is the link between feminization (increases in the share of women) and the formation of occupational gender stereotypes.[2] This is the process in which occupations are attributed a gender label, conditional on the share of women within that occupation. The second mechanism is the interaction of occupational stereotypes with a cultural bias that attributes a lower value to female labor, which then results in devaluation. As a consequence, changes in occupational gender compositions are linked with devaluation conditionally on the cultural context defined by said two mechanisms. Adding ideas on how these mechanisms could play out differently for men and women, and between higher- and lower-pay occupations, we derive several hypotheses about the effect heterogeneity in the devaluation process. Testing these hypotheses with census data from the United States ranging from 1960 to 2010, we show that the effect of feminization on wages via devaluation has been restricted mostly to the bottom 80 percent of occupations between 1960 and 1980, where mostly women received a penalty. Yet this is not true for the highest-paying occupations, where men have even received rewards after sectoral feminization. Overall, we observe significant declines in the devaluation effect from 1960 to 2010, to which our theoretical model offers two competing explanations: On the one hand, the spread of egalitarian gender norms and the equal pay movement could have undermined the bias that attributes less value to female work. This way, devaluation could be a phenomenon of the past.

[2]The term "occupational gender stereotype" is very central in the following debate. The general idea behind this is that there are broad societal views on what gender is typical for an occupation. This is a subjective category, which is not the same as the actual or objective gender composition of an occupation, which is usually measured in studies on devaluation. We also refer to research on sex-typing of occupations that reaches back to the 1970s (White and White 2006, 259) and where stereotypes are defined as "unconscious habits of thought that link personal attributes to group membership" (Reskin 2000, 322).

On the other hand, if unmeasured occupational gender stereotypes would have become resistant to underlying changes in the labor market's gender composition, then the declining effects could simply be an artifact of a deficient testing strategy that solely identifies changes in the gender composition, neglecting stability in stereotypes, on which devaluation is truly based. This latter argument is supported by our finding that past levels of percent F are equally good predictors of current wages as more recent percent F, showing that occupations that previously had a large proportion of female workers are still lagging behind in wages, even though their gender composition has changed in the meantime. Keeping in mind that previous findings as well as ours do not provide enough evidence to adjudicate between those two competing stories, we strongly suggest that causal narratives with respect to the devaluation hypothesis need to be made with much care toward both theoretical considerations and modeling strategies.

The following section (Devaluation so far) shortly summarizes the standard devaluation model and previous empirical results on the topic. Thereafter, in the Constructive criticism section, we propose a theoretical model and we discuss mechanisms and the potential for heterogeneous effects. We then formulate several hypotheses about effect heterogeneity over time, genders, and occupations. Following, we present the data and our empirical results, that we further embed in a broader context in the Discussion section.

2.2 Devaluation so far

The devaluation hypothesis has emerged as a theoretical instrument to explain the gender wage gap and to shed light on inequality between occupations. As such, this framework could be seen as complementary to more conventional ap-

proaches to the wage function, for instance building on human capital theory. At the same time, scholarly research on devaluation has received objections toward its empirical testing strategies, which has resulted in much of the field's resources being focused on identifying a robust devaluation effect, net of potential confounding and selection mechanisms. First, reverse causality has been suggested by the crowding hypothesis following (Bergmann 1974), where decreasing wages could follow if women are discriminated in higher-paying and more prestigious occupations by male employers. Second, if male occupations were protected better by closure strategies (Bol and Weeden 2015; Weeden 2002), then the correlation between percent F and wages could be spurious. Third, neoclassic economic theory suggests that in particular the division of labor in the traditional household could result in women's lower investment in high-return, specific labor market skills, which would explain why occupations with a higher share of women pay less in general.[3]

On the empirical side, there is a relatively rich set of findings on devaluation from different countries, the majority of which support the devaluation hypothesis at least to some extent. For the United States, studies consistently show that–net of confounding factors–if a completely male occupation hypothetically becomes completely female, this would result in a wage penalty of 4 to 9 percent for women and a penalty of 9 to 19 percent for men (England et al. 1988, 2007; Gerhart and Cheikh 1991; Karlin et al. 2002; Kilbourne et al. 1994a,b; Levanon et al. 2009; Macpherson and Hirsch 1995).[4] In the most recent of these studies, Levanon et al. (2009) for instance find that female-typed occupations' wages were 6 to

[3]For an excellent full-scale discussion of potential confounders and selection mechanisms, see, for example, recently Murphy and Oesch (2016).

[4]Even though these are seemingly impressive figures, they also tend to inflate the importance of devaluation by assuming the irrelevant case in which an occupation switches from zero to 100 percent female.

10 percent below those of mixed occupations. Evidence from other countries than the United States also speaks in favor of the devaluation hypothesis, where similar effect types are estimated to be in the range of 3 to 13 percent.[5] Not all of these articles' methods perform equally well in controlling for confounders and selection mechanisms, but many are good in at least addressing one or two of the mechanisms listed above. Piecing them together, we know that devaluation is very likely not a phantom, and that it exists despite variation in human capital requirements (Murphy and Oesch 2016; Perales 2013),[6] institutional barriers (Bol and Weeden 2015; Murphy and Oesch 2016), and potential crowding (de Ruijter et al. 2003; Karlin et al. 2002; Levanon et al. 2009).[7]

2.3 Constructive criticism

Whereas the literature is rich in studies showing that female occupations are being devalued, we know relatively little about how devaluation really works. The following discussion is built around a theoretical model that helps shed light 1) on the mechanics behind devaluation; and 2) on the plausibility of heterogeneous effects over time, between different types of occupations, and between genders.

[5] See evidence for the UK (Brynin and Perales 2016; Murphy and Oesch 2016; Perales 2013), for Germany (Busch 2013; Murphy and Oesch 2016) but also (Hausmann et al. 2015a; Leuze and Strauß 2016), for Sweden (Grönlund and Magnusson 2013; Magnusson 2013), and for the Netherlands (de Ruijter et al. 2003), Switzerland (Murphy and Oesch 2016), and Spain (Polavieja 2008, effect non-significant).

[6] Some evidence points into the opposite direction, for example (Tam 1997) or (Polavieja 2008).

[7] Controlling for crowding is notoriously difficult to do. de Ruijter et al. (2003) employ a measure of how concentrated women are to a restricted number of occupations. A clear problem with this measure is that women could be concentrated in some occupations for many reasons that are not based on discrimination or distorted preferences. Levanon et al. (2009) simply show for the United States that if wages in occupations decrease, this does not trigger a larger influx of women. This is probably a better attempt of controlling for crowding, as it rules out reverse causality in the devaluation story altogether.

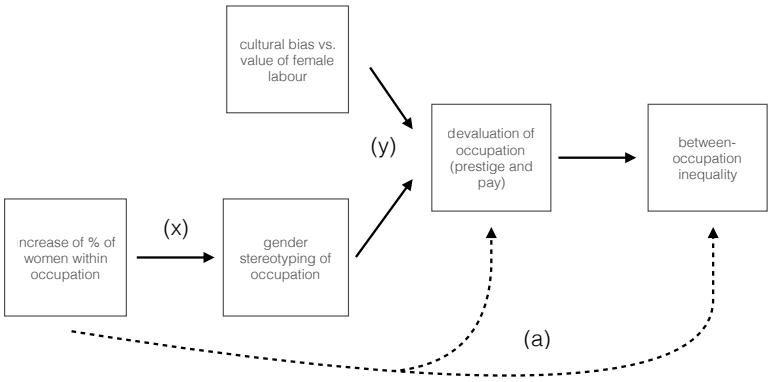
2.3.1 Causal effects and mechanisms

The basic premise of the devaluation hypothesis is that occupational wages and prestige drop with an influx of female workers. This, in turn, leads to social inequality between occupational groups. In figure 2.1, this relationship is described through link (a). However, research has remained surprisingly silent with regard to the mechanisms that produce this effect. In the most general way, previous views on devaluation have assumed that "gendered cultural beliefs ... portray men as more competent and status-worthy than women," and that "the value assigned to work in different occupations depends on the characteristics of the occupations' incumbents" (Levanon et al. 2009, 868). Or, as England et al. (2007, 1238) put it: "Somehow, the low status of women 'rubs off' on employers' evaluation of the occupation, and they set a lower pay level for both men and women in the occupation." Yet, this "somehow", as important as it seems to be in this process, has received far too little attention in the past, which is why we lack a better procedural understanding of how occupations are stigmatized and devalued in the first place.

We hence propose a theoretical model to account for the process underlying female occupational devaluation. This model includes two main mechanisms that are believed to govern the way in which feminization leads to devaluation, and ultimately to between-occupation wage inequality. The first mechanism is the formation of occupational gender stereotypes, given the share of women within occupations (link x in figure 2.1). This is the step in which an individual characteristic–being female–is ascribed to the entirety of an occupational group. This has so far been widely ignored in the literature, even though it seems like an absolute necessity if we are talking about the gender trait of a group that almost always includes mixed genders. In research, the notion "female occupation" is often used

as a reference to both occupations that have a lot of female incumbents and occupations that are seen as "typically female" in public perception. We believe that this is sufficiently imprecise, as it conflates an objective demographic characteristic of a group (the gender composition) with people's view on the typical representative of this group (the stereotype). In the long run, these can be two very different things, as demographic accounts are updated every time a person joins or leaves the occupation, while stereotypes often remain sticky even though they might have become a very inaccurate representation of reality since the time they emerged (see also discussion under the section "Change over time"). The second mechanism is the interaction of gender stereotypes with a cultural bias against the value of female labor, leading to devaluation. This link (labeled y in figure 2.1) follows the intuition that devaluation can only emerge if the perception of an occupation to be female is paired with the judgment that women's work is worth less than men's work.

FIGURE 2.1: A theoretical model of occupational devaluation due to feminization



The idea that male and female work can be differently valued due to cultural norms has previously been featured, for example in work on the drivers of segregation (Charles and Grusky 2004; Levanon and Grusky 2016) and in status

characteristics theory (Berger et al. 1977), where the bias we describe would be understood as a "status belief" (see also Ridgeway and Correll 2004). We pick up this idea and apply it to the framework that explains how occupational wages are generated. One important distinction between the two variables we include in our model (differential valuation of work and stereotypes) is that cultural norms, which define the intrinsic worth of male and female labor, are not tied to specific jobs, as they operate on a broader societal level. To the contrary, we are interested in stereotypes only insofar as they are tied to specific occupations. This distinction also makes clear why we believe that the two variables can vary independently from each other: It is, for example, not given that the spread of egalitarian gender norms, which would result in the equalization of the perceived worth of male and female work, would automatically diminish the extent to which society views specific occupations as typical for one or the other gender. We discuss this claim in more detail in the next section, where we elaborate on how such changes over time might have occurred in the United States over the past several decades.

2.3.2 Change over time

In the conventional view on devaluation, when female occupational shares change, this also affects wages. But has this link been constant over time? The theoretical model indicates that for the effect to be constant, the core mechanisms leading to devaluation must stay in place. Yet, the research suggests that both the formation of stereotypes and cultural valuations of female work are embedded in historical contexts that have changed significantly at least since the immediate postwar era.

The differential valuation of male and female work is well documented for the United States. Lalive and Stutzer (2010) present a review of evidence based on

vignette studies indicating the existence and extent to which such differential valuations persist. In one study, for instance, Jasso and Webster Jr (1997) find that the female-to-male ratio of perceived fair pay is 0.85 for men and 0.88 for women. These beliefs imply that it would be fair to pay women more than 10 percent less in wages, all else being equal. The systemic relevance of these beliefs is demonstrated by the intriguing findings that both men and women throughout societies have similar biases that attribute less value to women in general and to female labor specifically (Eagly et al. 2000; Lalive and Stutzer 2010).

On the bright side for the proponents of the equal pay movement, there is little doubt that the support for gender equality has significantly risen over the second half of the past century (Bolzendahl and Myers 2004; Charles and Grusky 2004; Mason et al. 1976). This is true in a wide array of life domains, including work and family responsibilities, where women have traditionally been expected to care for the household. While this can be seen as progress in various ways, it is also widely known that such progress comes at a slow pace: Cultural views on gender are learned in early life stages, while they prove to be relatively stable throughout the life course (e.g. Alwin and Krosnick 1991). This is why generational change is often a prerequisite for wider cultural shifts.[8] Furthermore, gender systems are built on firmly institutionalized beliefs, and unequal distributions of resources help maintain those systems (Ridgeway and Correll 2004). Without major external shocks, it thus takes decades for culturally induced inequality to vanish.

Evidence on occupational stereotypes in the United States is not abundant, mainly because they are difficult to measure, but we nevertheless know a lot about them. The first extensive surveys found that the most male-typed occupa-

[8] One study addressing attitudes on fair pay directly, and also within the context of generational change, is presented by Auspurg et al. (2013), who show that older cohorts in West Germany put more weight on a person's gender when judging on fair pay in work.

tions were, for example, miner, construction worker, or engineer.[9] Female-typed occupations were manicurist, nurse, or secretary, among others (Albrecht et al. 1977; Panek et al. 1977; Shinar 1975). This all sounds familiar, but it is less clear if stereotypes have remained stable over time, given the sometimes strong changes in the gender composition within these occupations. White et al. (1989) find that there have been significant changes in stereotypes between the mid-1970s and the late 1980s. By that time, occupational stereotypes had become less strongly perceived, although they were still an important feature of how people thought about occupations. Other findings suggest that compositional changes in occupations also result in adapted stereotypes (e.g., Diekman and Eagly (2000)). This makes sense in particular if we accept the premise of sex role theory (Eagly 1987) that the roles in which people act on a daily basis shape their ideas about their appropriate place in society.

To the contrary, several studies show that despite desegregation in various socio-economic domains, female stereotypes and the gender stereotypes attached to occupations have remained surprisingly stable (see Lueptow et al. (2001) for a meta-study). Although people nowadays avoid alluding to stereotypical ideas when being asked about them, it is plausible that stereotypes are hardwired in our brains to the extent that implicit processes still bias our thoughts and actions along the lines of traditional gender views, without us knowing about it (White and White 2006).[10] This line of thought is also reminiscent of the evidence on the stability of gender essentialism, the belief that women and men have innately different abilities and interests that make them more suitable for one or the other

[9] Research on stereotypes has employed different test strategies to probe gender-typical views attached to occupations. They hence do not rely on the objective gender composition in occupations to identify female- and male-typed occupations. For an introduction of the instruments, see White and White (2006).

[10] For a distinction between explicit and implicit stereotypes in this context, see White and White (2006, 259ff.).

occupation (Charles and Grusky 2004; Levanon and Grusky 2016). Indeed, essentialist views, such as the belief that women are particularly suited for caring activities, do not only result from social role-derived knowledge, but they are also based on more deep-rooted biological claims (Epstein 2007), religious beliefs, traditionalism, and political views (Knight and Brinton 2017).

In state-of-the-art research, correlations between occupational gender compositions and wages, all else equal, are interpreted as evidence for the devaluation of female occupations. The previous discussion has its merit in defining the potential mechanisms that must be in place for this interpretation to be valid when we look at variation over time. More specifically, we see two scenarios in which declining correlations could be indicative of two very different processes: First, if the spread of egalitarian norms undermines the bias that justifies the differential valuation of male and female work, then declining effects could be interpreted as a decline of devaluation altogether. On the other hand, with a stability of occupational stereotypes (despite shifts in gender compositions), declining correlations could be viewed as an artifact of our focus on gender compositions, whereas the correlation between stereotypes and wages persists.[11]

2.3.3 Variation between occupations and gender

Our understanding of devaluation as an essentially cultural phenomenon enables us to appreciate its dynamics over time. In this section, we argue that in addition to that, some occupations might be more prone to devaluation than others: We look at the occupations' rank in the wage distribution, speculating that higher-paying occupations might be more susceptible to devaluation. Moreover, zooming

[11] A similar reasoning can be found in England et al. (2007), who discuss if inertia, particularly in the wage structure, might be a reason for the observation that feminization has not led to much change in pay levels after all.

in from the perspective on inequality between occupations to broadening gaps within groups, we discuss the idea that men and women, both working in the same feminizing occupation, might not receive the same penalty, and that either group might even profit from post-feminization wage adjustments.

Several studies have pointed out that the wage penalty in female occupations varies between different occupational types or "classes". de Ruijter et al. (2003) show that in the Netherlands, the share of female workers is a stronger negative correlate of wages in occupations with high education and skill requirements.[12] Mandel (2013) produces evidence for the United States (1970 to 2007), suggesting that the feminization effect was strongest in high-wage male-typed occupations. In general, the intuition so far has been that this group of occupations is most susceptible to devaluation because it has the highest status attached to it and thus it has the "most to lose" from an entry of women who are seen as low-productivity, low-status workers (Ibid., 1187ff).

Furthermore, occupational gender stereotypes may not have the same inherent relevance for both genders. This means that feminization could play out quite differently for male and female workers in the same occupation. In fact, due to a methodological byproduct in part of the devaluation literature,[13] we already have evidence on such variation. Previously, the wage penalty after feminization was often found to be larger for men than for women (England et al. 1988, 2007; Gerhart and Cheikh 1991; Macpherson and Hirsch 1995). Yet, such evidence has not been complemented with much theoretical accounts that could explain it. A more recent study furthermore does not find large effect differentials between genders (Levanon et al. 2009). We offer, once again, two competing views on

[12] Grönlund and Magnusson (2013) test if this is also true in the Swedish case but do not find any significant effects.

[13] Several surveys using occupation-level data include separate statistical models for men and for women in order to control for the individual-level wage gap.

this problem: Williams's (1992) work suggests that, due to the male stereotype of high competence and leadership qualities, men are more prone to be selected into supervisory and managerial positions when working in predominantly female work environments. Hence, it might be to the advantage of male workers when the sector they work in feminizes, as this increases their propensity to move up in the wage hierarchy. Importantly, such promotions can occur within one and the same occupation, so that these changes would be observed between genders and not between occupational groups. Even though this "glass escalator" phenomenon might only partially apply in today's world of work (Williams 2013), it strongly suggests that men's wages might be less negatively affected by feminization or that they even might receive a net benefit from it. To the contrary, status characteristics theory (Berger et al. 1977) offers the view that a general status characteristic (here: being male or female) can lose part of its relevance in situations where a specific characteristic (working in a male or female task setting) is more salient. In other words, although men might be seen as more competent than women in general, this must not be true in settings requiring skills that are typically seen as being in the domain of female work (see also Busch (2013)). Indeed, the ensuing specific status expectations could tip the scales in favor of women in female and feminizing sectors, while men would profit from working in roles that are typically seen as more suitable for their specific skills and abilities.

2.4 Hypotheses

The theory section allows us to derive hypotheses about how the effect of feminization on occupational wages has shaped up over time and about how it varies between different groups.

H1.1: *Increasing female shares in occupations have constantly led to a decline in wages since the postwar era.*

Constant effects are plausible if no change has occurred in the way in which feminization is translated into stereotypes, and if those stereotypes interact with a constant cultural bias that attributes less value to female work. This would undermine vast empirical evidence that the United States has experienced a shift toward egalitarian gender norms.

H1.2: *The negative effect of increasing female shares in occupations on wages has slowly declined since the postwar era.*

This hypothesis is motivated through two conflicting points of view: First, a net decrease in the effect would be given if the rise of egalitarian norms outweighs any change in the importance of stereotypes. The slow pace of such change would be the result of the stability of cultural norms within cohorts that precludes fast cultural revolutions. Second, if unmeasured stereotypes have become stable and resistant to changes in the occupational gender structure, then we would also observe declining effects, even though devaluation could persist through the correlation between stereotypes and wages.

H2: *Declines in wages due to increases in female occupational shares are located primarily in the high-paying sectors.*

It is possible that high-status, high-wage occupations are most susceptible to an influx of lower status (female) workers. However, this theoretical idea is not very well developed and it might require further refinement.

H3.1: *After an occupation experiences an increase in its female share,*

only women receive a wage penalty in this group, while men's wages are not negatively affected.

This hypothesis is about additional wage inequality within occupations. If men can indeed profit from their stereotypical perception as better leaders and higher-competence workers, then they are more likely to be propelled into managerial and more specialized positions (within the same occupation) when an increasingly large proportion of their occupation becomes female. Hence, men would not be negatively affected and they even could profit after occupational feminization.

H3.2: *After an occupation experiences an increase in its female share, men's wages are more negatively affected than women's wages.*

If views on the suitability to fulfill job requirements are based on occupational skills (rather than generic skills), then men could be evaluated less fit to perform in feminizing occupations.

H4: *Current wage levels are determined by earlier levels of feminization, not by current levels.*

It is not clear if stereotypes are updated with changes in the group's gender composition, or if they are established at a given point in time, remaining relatively constant thereafter. If the latter is true, then the stereotypes of the past would still govern wage determination processes at later stages, even if occupational segregation has declined.

2.5 Data and Methods

Data are drawn from the Integrated Public Use Microdata Series (IPUMS) (Ruggles et al. 2015). The sample used for this study includes six waves of US census data and ranges from 1960 to 2010, where data are available every 10 years. Data from 1950 are available but excluded, as per methodology, this year offered a far too small number of occupational observations (see clustering method below). In order to generate a quasi-panel data set from the micro-level census files, I aggregate data using occupation-industry groups for men and women, respectively. The key variables are the share of women (measured as percent of women at a given point in time) and the median wage within each group (log-transformed). As control variables, I include the mean years of education, mean of potential labor market experience,[14] mean working hours, percent working in the public sector, percent ratios of ethnic minorities/non-Hispanic white, percent married, percent with young children in the household, and the relative size of the group within the labor market. The latter variable is used to control for structural economic change that influences the demand for workers in the given sector.[15] Whereas most of the variables are derived by gender, this is not the case for female shares, ethnic compositions, and the relative size of groups, as their influence on wages is believed to be located purely at the occupational level.

The occupation-industry clusters are derived from the IPUMS's SOC1990 and IND1990 variables that sort individuals into harmonized occupational and industrial categorizations.[16] The method used for this harmonization is backward and

[14]Following approaches in the literature, we proxy labor market experience by taking individuals' age, subtracting their years of education, and adding 6 (the typical age where children enter school in the United States).

[15]Changes in the group sizes could also reflect supply-side factors. One variant discussed in the paper is crowding, where women are shifted toward less favorable segments in the market.

[16]There are different approaches to group individuals into occupation and industry clusters.

forward coding. As a result, some occupations that are observed in 1990 are not observed in earlier or later decades. Levanon et al. (2009) use the same data and attempt to solve this problem by merging occupations containing no observations in some cells (over years) with similar occupations. If this is done correctly, this could increase the precision in the median and mean values per occupation. However, this step potentially also introduces bias, as it might conflate occupational groups that are different in their female proportion or wage determination mechanisms. We thus do not merge any cells. However, we drop occupation-industry clusters for which we have below 20 observations for either gender. This leaves us with 1,455 occupation-industry groups that are observed on average 3.9 times. With an average of 3.9 observations per group, there are some groups that are not observed the maximum of 6 times. If possible, we also tested all models excluding groups with missing year-cells, which left the results virtually unchanged. See table 2.1 for the total N within each wage quintile and period cell.

The aggregation of occupation-industry data is based on a restricted sample, dropping individuals not at work, having zero income, and being younger than 25 or older than 65. Whereas some studies only include full-time employees in the sample (e.g. England et al. 2007), we believe that this could artificially distort the measured profile of occupations, as women are particularly prone to working less than full-time. Consequently, a control for average working hours is included in order to avoid bias due to potential higher returns in jobs with large volumes of hours worked.

The approach in this paper was previously found to deliver good results. See Levanon et al. (2009) for a thorough discussion and tests with other classifications.

TABLE 2.1: Total N of observed occupation-industry cells by quintile and period

	Year					
Quintile	1960	1970	1980	1990	2000	2010
1st	127	126	231	269	253	170
2nd	104	128	239	281	249	154
3rd	100	126	242	278	258	154
4th	90	103	241	277	258	160
5th	60	79	228	277	263	195

Data: IPUMS USA 1960–2010

Statistical tests of all but the last hypothesis will be based on the fixed effects method (Allison 2009; Wooldridge 2010). This method allows us to exploit the quasi-panel structure of the data set and draw all inference from variation within the occupation-industry groups over time. The fixed effects models difference out constant heterogeneity between group-level clusters. In order to control for the potentially large changes in period-specific average wages from 1960 until today, I include binary time variables for each year. Interacting these period effects with the gender composition variable allows us to test effect heterogeneity over time (Allison 2009, 19ff.). Panel robust standard errors are employed to correct for serial correlation (Wooldridge 2010). The last hypothesis (H4) is tested via standard OLS models of 2010 occupational wages. Here, wages are regressed on current percent female, and subsequently on the same variable in 1980, testing the predictive power of both approaches.

2.6 Results

In table 2.2, we observe the results of male and female fixed effects regressions, testing the hypothesis that feminization leads to a decline in occupational wages. "P.c. female" is the main effect, and all included control variables are displayed in the table. In this first step, feminization is assumed to be constant, which leaves us with a single coefficient for the male and female wage regression, respectively. The male model results in a highly significant positive effect, whereas the effect for women is close to zero and not significant. We do not find a negative average effect, as predicted within the devaluation framework.[17] Substantively, the effect implies a 0.12 percent raise in median wages for men with every percent increase of women in an occupation. The within-occupation standard deviation from 1960 to 2010 is 8.23, which leaves us with a standardized effect of 1 percent per unit change in percent female. The hypothetical change from zero to 100 percent women in an occupation would be expected to result in a wage increase of 12.75 percent for men. This finding is interesting in itself, including initial evidence that men are favored in the wake of occupational feminization (H3.1). However, assuming a constant feminization effect on wages is not satisfactory given our theoretical model.

[17] Although our study uses a similar methodology and data than Levanon et al. (2009), we receive contrary results in this first step: They find a negative effect of changes in percent F on wages for both genders (Ibid., 881, table 4), while our estimates are positive and significant for men but non-significant for women. In order to probe if the different findings can be explained by our methodological choices, we have attempted to fully replicate the findings by Levanon et al.. This included, inter alia, the inclusion of 1950 to 2000 IPUMS data, a different treatment of occupation-industry clustering, the conversion of percent F into logits, slight differences in sample restrictions, the inclusion of lagged independent variables including a 10-year lag of logit(percent F), and the implementation of a dynamic fixed effects model correcting for endogeneity. With these specifications, we were unable to replicate the authors' findings of negative coefficients. To the contrary, results were similar as shown in our table 2.2. Hence, even though it is difficult to suggest what has led to the different findings, we are confident that none of the methodological choices listed above play an important role.

TABLE 2.2: Coefficients (t-values in parentheses) from fixed effects regressions of occupational log wages

	Male wages		Female wages	
	Coefficients	t-values	Coefficients	t-values
P.c. female	0.0012***	(4.23)	0.0004	(1.49)
1960 (ref.)				
1970	0.2137***	(26.94)	0.1632***	(20.87)
1980	0.1740***	(12.33)	0.0114	(1.06)
1990	0.1210***	(8.03)	−0.0231	(−1.84)
2000	0.1103***	(6.54)	0.0009	(0.06)
2010	0.0958***	(4.82)	0.0037	(0.20)
Working hours	0.0050*	(2.34)	0.0076***	(4.85)
Public sector	−0.0013 * *	(−2.82)	0.0000	(0.11)
Ratio black	0.0042	(0.17)	0.0311	(0.98)
Ratio native	−0.4976*	(−2.27)	−0.5567 * *	(−2.83)
Ratio asian	0.2316 * *	(2.63)	0.2245 * *	(3.25)
Ratio hispanic	−0.1018*	(−2.45)	−0.0923 * *	(−2.95)
Years edu.	0.0753***	(14.60)	0.1063***	(14.29)
LM exp.	0.0403***	(7.11)	0.0281***	(5.47)
LM exp.^{2}	−0.0006***	(−5.01)	−0.0005***	(−4.18)
P.c. married	0.0070***	(16.68)	0.0017***	(4.60)
P.c. child	0.1181 * *	(2.81)	0.2364***	(4.75)
Sector size	0.0096	(0.97)	−0.0031	(−0.25)
Constant	0.3442*	(2.51)	0.3183 * *	(2.63)
N_{total}	5720		5720	
N_{groups}	1455		1455	

Data: IPUMS USA 1960–2010

Significance: * p < 0.5 , ** p < 0.1 , *** p < 0.01

In a further step, I hence decompose the previous results by period and occupational wage quintiles. Figure 2.2 depicts marginal effects of feminization over the entire time span for each quintile. Estimations include identical control variables,

but marginal effects are derived from including an interaction term between P.c. female and periods. Furthermore, the sample of 1,455 occupation-industry groups was split in quintiles according to average wages in each group over the full time span.

The results suggest that feminization can cause occupational devaluation. Seen in historical context, however, this relationship has been tied to specific periods (1960s–1980s), was stronger for women than for men, and was rather located in the second and fourth wage quintile. These findings are partly in line with our ideas on effect heterogeneity and the theoretical model, but they are also more diffuse than we expected. We summarize in three points:

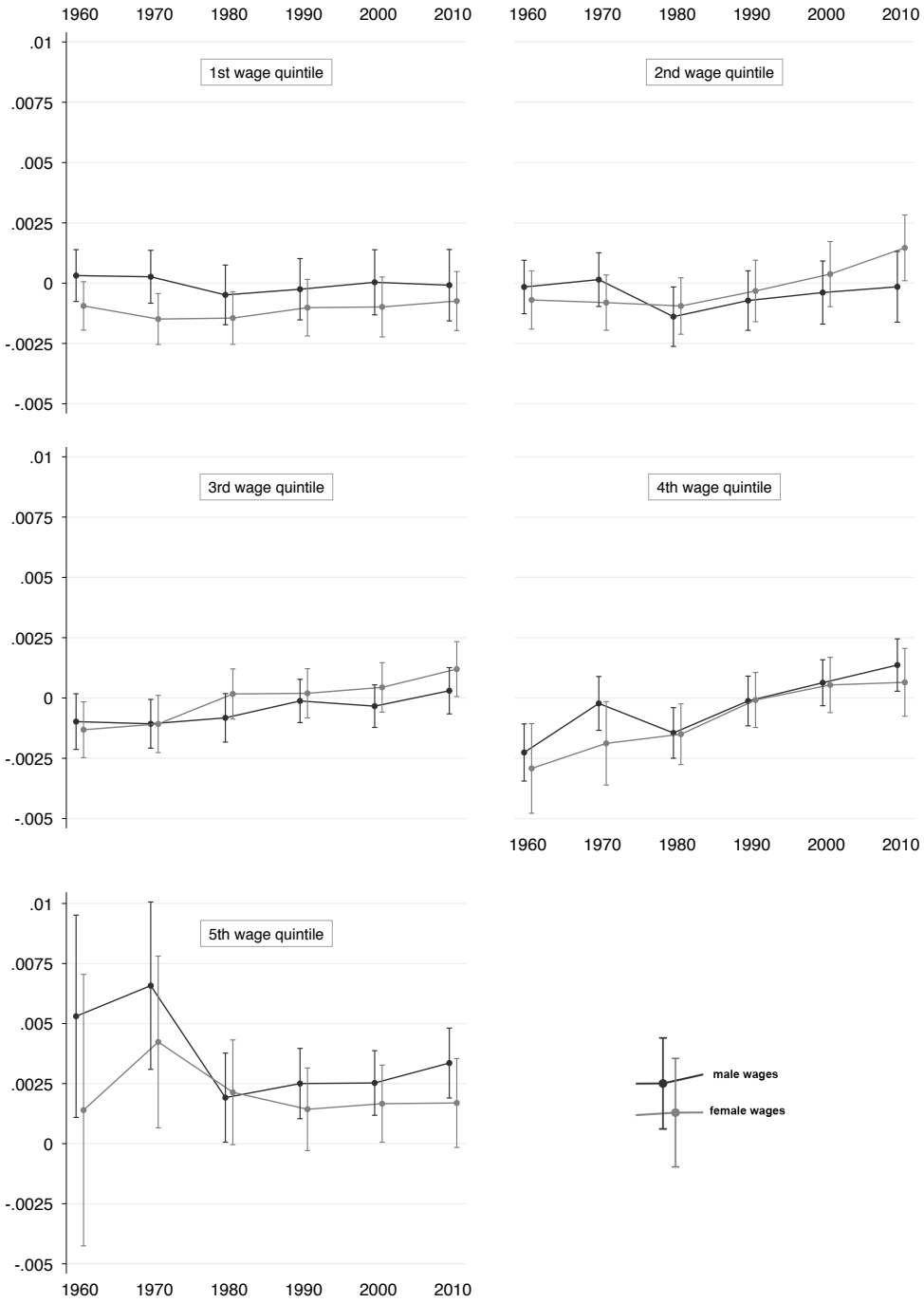
First, effect sizes are relatively similar between all wage groups, excluding the very top quintile. In quintiles one to four, effect sizes are mostly either negative or around zero (in earlier decades), becoming slightly positive in more recent years. Negative coefficients, which are evidence for the predicted wage effect via feminization, are largest in the fourth quintile. In the fifth, however, we find exclusively positive wage effects, for both women and men. As such, wage developments at the top of the income ladder are related to feminization in a very different way, as it is the case for all remaining groups. At the top, positive effect sizes for men range between 0.19 percent per unit increase in P.c. female in 1980, and 0.53 percent in 1970. This partial view also explains the positive wage effect found in the previous step: Replicating the male model shown in table 2.2 excluding the fifth quintile, the previously significant positive effect comes very close to zero and is non-significant. Taken together, this undermines the plausibility of H2, according to which devaluation would be located primarily in the top sectors. In the highest quintile in 1960 and 1970, confidence intervals are relatively large for both genders, which is due to the lower N of observations within

these period-cells (see also table 2.1). The magnitude of the errors makes our analysis less reliable for these years, but an estimation of similar models including only groups without any missing period-cells does not lead to any substantively different results (not shown here).

Second, effect sizes are relatively similar between genders and most trends seem to apply to both men and women. We implement z-tests, following (Clogg et al. 1995), confirming that in every single period-quintile cell except one, male and female coefficients are not significantly different from each other with $p < 0.5$ (results not shown). In figure 2.2, we yet also observe that when devaluation existed, it was mostly impacting the wages of women. This is clearest in the second and fourth quintiles, where women were affected by feminization the most. Another twist is observed in the top wage group: Here, the effect on male wages is positive and significant over the entire range of years, while this is the case for women only in two periods. The lack of more significant female coefficients is because of both smaller effect sizes and wider confidence intervals, describing more variation in wages overall. Evidence thus speaks more in favor of H3.1 (men are losing less and they are gaining more after feminization), while H3.2 finds no support at all.

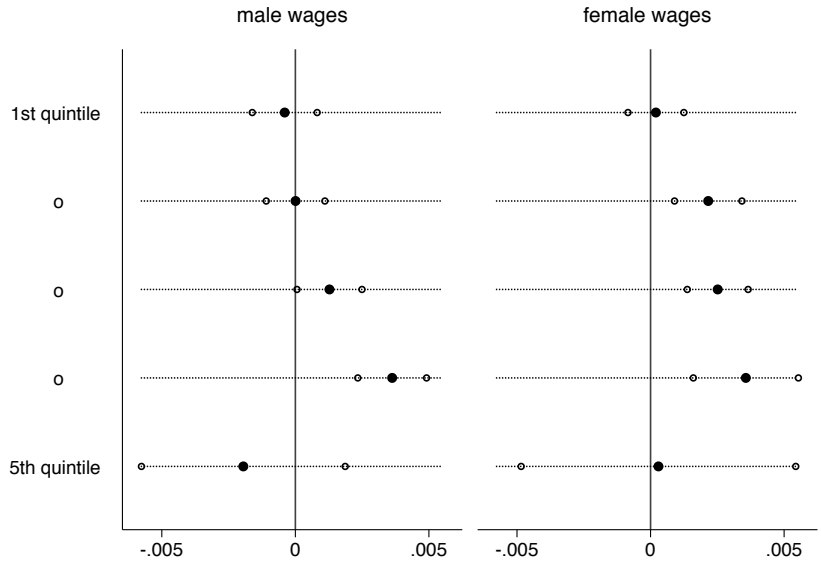
Third, on visual inspection of the marginal effects, we would believe that the devaluation effect has been decreasing in time at least for the second, third, and fourth wage quintiles. This trend seems to be following a relatively linear pattern for women, while it is bumpier for men. Figure 2.4 depicts results of a pairwise comparison of marginal effects in 2010 and 1960, by wage quintile and gender. The positive and statistically significant differences for men and women in quintiles 2–4 suggest that effect sizes have in fact decreased over time. The largest significant decline in the feminization effect is observed for women in the fourth quintile (0.36

FIGURE 2.2: Marginal effects of feminization on wages, by occupational wage quintiles and gender (1960–2010)



points difference), and the smallest one is observed for men in the third quintile (0.12). According to this analysis, no significant change happened in the highest- and lowest-paying sectors. Evidence thus speaks–at least for part of the wage distribution–in favor of H1.2: The effect of occupational feminization on wages has slowly decreased over time.

FIGURE 2.4: Differences in marginal effect sizes, 2010 and 1960, by wage quintile and gender, and 95 percent confidence intervals



Finally, we address the question of whether stereotypical gender views of the past are still affecting current wages. Here, I employ a strategy using the full sample, including male and female observations, and occupational median wages as a dependent variable. This is equivalent to the methodology in cross-sectional studies that use OLS wage regressions to quantify the adverse effect of working in a female occupation. Table 2.3 lists cross-correlations of P.c. female and occupational median log wages. The bold figures in the diagonal show the correlation of current levels. A striking feature of the results is that the correlation between

P.c. female and wages was strongest in the 1970s and 1980s, while it dropped severely in 2000 and 2010. This result is fostering our previous assertion that the effect of feminization on wages has significantly declined over time. Moreover, we observe that the female percentages of previous decades are much stronger correlates of 2010 wages than the 2010 percentages themselves: corr($wages_{2010}$,p.c. F_{1970})=0.32 vs. corr($wages_{2010}$,p.c. F_{2010})=0.17. This finding would support the hypothesis that past gender segregation is still influencing the current pay levels in occupations, even though the distribution of male and female workers over occupations has changed (H4).

TABLE 2.3: Correlations of Percent F and current/subsequent occupational log wages

	p.c.F_{1960}	p.c.F_{1970}	p.c.F_{1980}	p.c.F_{1990}	p.c.F_{2000}	p.c.F_{2010}
$\ln(wages)_{1960}$	**−0.45**					
$\ln(wages)_{1970}$	−0.49	**−0.50**				
$\ln(wages)_{1980}$	−0.54	−0.55	**−0.56**			
$\ln(wages)_{1990}$	−0.44	−0.45	−0.45	**−0.39**		
$\ln(wages)_{2000}$	−0.36	−0.37	−0.36	−0.30	**−0.27**	
$\ln(wages)_{2010}$	−0.31	−0.32	−0.31	−0.24	−0.20	**−0.17**

Data: IPUMS USA 1960–2010

After the implementation of a multivariate OLS regression of 2010 log wages, this initial judgment can be put into perspective. In table 2.4, I depict the results of six models, where three models use current P.c. female as predictor and the remaining three models include P.c. female from 1980.[18] The first two mod-

[18] We use the 2010 to 1980 comparison to maximize the N of occupation-industry clusters available in both years. Tests were also run with 1970 and 1960 data.

els, including only our main independent variable, simply replicate the findings from the cross-correlations table where the 1980 percentages are a much stronger predictor of 2010 wages levels than its 2010 equivalents. However, the subsequent two models critically show that, holding constant the educational levels in occupations, the two correlations with P.c. female are approximately level. This suggests that the initial finding is biased by a selection mechanism that has changed in the period between 1980 and 2010: Nowadays, women are much more likely to select into high-education, high-paying jobs, while this was not the case in 1980 (see also Mandel 2013). In the two last models, I include all remaining control variables, which lowers the effect of percent female in both instances, but this does not change the overall evaluation that both current and past levels of feminization are similarly good predictors of current wage levels. This finding can be interpreted as partly confirming H4.

TABLE 2.4: Coefficients (t-values in parantheses) from OLS regression of 2010 occupational log wages

	Only: P.c. F_{2010}	Only: P.c. F_{1980}	Added: Education		Added: Other controls	
P.c. F_{2010}	−0.0036***		−0.0046***		−0.0017***	
	(−5.98)		(−15.65)		(−6.45)	
P.c. F_{1980}		−0.0058***		−0.0043***		−0.0017***
		(−11.22)		(−16.15)		(−7.11)
Education			0.1946***	0.1822***	0.1583***	0.1516***
			(48.56)	(45.60)	(23.17)	(23.03)
N	736	736	736	736	736	736
Adj. R^2	0.0451	0.1452	0.7733	0.7769	0.8768	0.8783

Data: IPUMS USA 1980, 2010

Significance: * p < 0.5 , ** p < 0.1 , *** p < 0.01

2.7 Discussion

Previous results showing that in the United States occupational feminization leads to devaluation were confirmed in this study. Yet, this is only true if we look at sometimes relatively specific contexts in which devaluation seems to play a larger role than in others. Relying on a single coefficient for the United States of the past fifty or sixty years is not nearly enough to capture the complex and culturally contingent mechanisms that produce devaluation. This was shown by decomposing the average feminization effect by periods, by occupational wage groups, and by gender. This attempt, especially when added up with similar research from the past, should caution following studies against ignoring effect variation, especially when describing a phenomenon working through the channels of cultural bias and stereotyping. The latter are neither stable over time, nor do they always affect different subgroups in the population in the same way.

We have observed a decline in occupational devaluation in the middle part of the wage ladder. This decline seems to have taken place as part of a slow and steady development from 1960 to 2010, which fits well with our theoretical expectations that incremental cultural change toward gender egalitarian norms would have slowly eradicated devaluation. However, if we believe the theoretical model, then we should be cautioned that the declining effect over time could also be due to an increasing stability in gender stereotypes. In such a scenario, ongoing change in the occupational gender structure would have less or no effect on stereotypes, which would logically weaken the observed correlation between feminization and wages, even though devaluation would persist. This interpretation finds some evidentiary support in our results showing that previous levels of occupational segregation are about equally good predictors of today's wages as current segre-

gation levels. As this paper does not offer a more refined strategy to isolate one causal narrative from the other, we yet caution the reader not to derive a strong causal claim from our findings. We clearly require further tests of how the link between feminization and wages has shaped up over time. Currently, we see two ways to address this issue: We either build statistical models in which we test the composite effect of current and past feminization at the same time. Or we find a way to measure occupational stereotypes–possibly even over time–including them as a new control in our wage regressions. The former approach would need to deviate from standard fixed effects models, as those measure changes in key variables that make it difficult to test any type of inertia in wage determination mechanisms. The latter approach would enable us to directly test the model's mechanisms, but data on stereotypes by occupation is very scarce, if available at all.

The theory section included some vague ideas on how the feminization effect could differ between higher- and lower-status occupations. Our intuition was that at the top of the wage ladder, occupations are prestigious and mostly dominated by men, which could make them more susceptible to an inflow of lower-status female workers (Mandel 2013). We have tested these ideas by estimating separate models by wage quintile, showing that the interesting part of the variation might in fact be located between the fifth quintile and the rest of all occupations. In the fifty years before 2010, trends were relatively similar in the bottom 80 percent of occupations. The fact that wage penalties were strongest in the fourth quintile could, however, be interpreted as some support of the high-status-susceptibility hypothesis. The most striking result yet was found for the top 20 percent: For this group, female devaluation does not seem to have existed at all. Men have profited from feminization all along, while female effects were also positive, even

though rather non-significant. This is forcedly a novel finding, because–to our knowledge–previous studies have not looked at such a granularity when dividing occupations into wage or status groups. One might be tempted to think that this finding could be explained by an increasing shortage of specific skills located in high-paying jobs. Liu and Grusky (2013) demonstrate that particular analytic skills, but also computer, managerial, and social skills, have seen a rise in payoff between 1980 and 2010. However, this account would not allow to us to explain the constant rewards for men in these high-paying jobs, or the large feminization coefficients in the 1960 and 1970, where much of the skill-biased structural change would not have happened yet. At this point, we certainly require more research–including different data sources and possibly cross-country insights–to confirm this peculiarity, and to help better understand the impact of feminization on wage generation mechanisms at the top of the wage ladder.[19]

In the past, surveys have sometimes shown different coefficients for the devaluation of male and female wages. For the United States, there is, however, no clear tendency showing either of the genders to be more disadvantaged than the other. In the most similar study to the one at hand, Levanon et al. (2009) show very similar effect sizes for men and women, which is confirmed by our own results. Significant devaluation effects were found mostly for female wages, and in the top wage group, benefits were significant over all periods only for men. The results yet seem insufficiently skewed in favor of men to speak of any healthy evidence for the glass escalator effect. (Budig 2002) argued that previous evidence for men riding glass escalators in female occupations might be misleading due to a

[19]The deviation of our results by occupational group from those by Mandel (2013) are strong and underline the merit of replication studies using different data. A reason for the differences could lie in the choice of occupational clusters, as Mandel looks at under 400 occupations, while we divide the sample into over 1,400 groups altogether. See Levanon et al. (2009) for the implications of these choices.

lack of appropriate counterfactual reasoning. In such cases, studies often focus on predominantly female sectors (such as nursing), neglecting a more meaningful comparison of results with male advantage in mixed or predominantly male sectors. Furthermore, we can also not find any evidence for Mandel's (2013) judgment that women are "moving up the down staircase"–meaning that women have reached high-skilled jobs yet tend to experience declining wages.

Even though this study was able to shed light on various under-researched features of devaluation, it also neglects an important criticism that certainly deserves more attention. Several authors have highlighted that the assumption of a linear relationship between feminization and devaluation could be too simplistic (Magnusson 2013). The most popular alternative approach is to divide occupations into clusters of predominantly male, female, and gender-mixed groups, where the event of switching to the female-dominated sector is operationalized as a main predictive variable. From a statistical point of view, this approach could be favorable due to its relaxation of the linearity assumption. Moreover, assuming that the cultural process in which occupational stereotypes are formed follows a stepwise (not continuous) adaption where certain thresholds in the share of women must be reached in order to change a prevailing stereotype, then splitting up occupations into more or less female groups might make a lot of sense. Unfortunately, the data used in the present paper does not allow to further break up occupational groups without seriously undermining statistical efficiency. Finally, studies using similar statistical models have previously been criticized for a lack of more refined controls for specific vocational training and changes in skill requirements within occupations. This is due to a trade-off where we chose very long time series (useful to observe incremental change over decades) over data that include richer background variables, yet being limited to a shorter time span.

2.8 Conclusion

The idea that occupations devalue due to their feminization has received a lot of attention–not just because it challenges dominant views of how wages are determined, but also because it was backed up by ample empirical support. In this paper, we claim that if further progress is to be made on this topic, then we need to more explicitly address the causal mechanics of female devaluation. Without explaining in more detail how feminization impacts occupational wages, we will also be unable to understand why this effect seems to be heterogeneous over time, between countries, and between different occupational groups. The proposed theoretical model is an attempt to address these concerns. It captures the mechanisms by which occupational gender stereotypes are formed and through which those stereotypes interact with a cultural bias against female labor to result in devaluation. Given the very plausible changes within these mechanics over time, we have shown that feminization might be linked to devaluation in various different ways. Moreover, if stereotypes freeze at any given point in time, devaluation might be entirely decoupled from ongoing changes in gender compositions, as it would be governed by past segregation processes. In the empirical section, we have shown that feminization did result in a decline of wages in the United States from 1960 to 2010, but that the effect was restricted to sometimes very specific contexts in which they occurred. Devaluation was mostly observed in the 1960s to 1980s. Men seem less affected than women, even though this result has received only weak evidentiary support. In the top wage quintile, all of the above does not apply. Here, no devaluation could be observed in any period or for either gender. This finding undermines the notion that in particular high-status occupations would be susceptible to an inflow of lower-status (female) workers.

Over and above the results on effect heterogeneity, this paper raises important questions pointing at the culturally contingent contexts in which devaluation might be embedded. This is missing in the canonical view on devaluation and–in our view–deserves more rigorous testing in future research.

Chapter 3

Identification and Bias. Occupational gender stereotypes and wage penalties in the German labor market

3.1 Introduction

Income differentials between occupations have long been identified as a crucial determinant of wage disparities between women and men. Gendered patterns of sorting into higher and lower paying sectors remain one of the main reasons for a substantial gender pay gap (Charles and Grusky 2004; England 2010; Levanon and Grusky 2016). This is true even after we have seen this gap narrowing down over long periods in the past fifty years (Blau et al. 2006; Cotter et al. 2004; Mandel and Semyonov 2014). In large parts, the structural importance of occupations in today's economies is self-evident if we understand occupational boundaries as strongly aligned with socio-economic factors such as education and skills, that, today more than ever before, are key drivers of economic success (Goldin and Katz 2009). At the same time, sociological research has insisted that

occupations are more than the sum of their individuals' characteristics (Mandel 2016), shaping inequality directly through various occupation-level mechanisms (e.g. Weeden 2002).

Within the devaluation framework (England and Norris 1985; England 1992), such a mechanism is identified in the discrimination of individuals on the basis of the perceived gender-type of their occupation (the occupational gender stereotype). Here, the causal argument is explicitly located at the occupational level: In so-called female occupations, overall wages would be depressed because of the low value associated with femininity in the labor market. This is true for women and men alike – the individual characteristic is in fact not part of the core theory[1]. This goes so far that some of the most widely cited articles on the topic restrict their analyses on occupations as level and unit of measurement (England et al. 2007; Levanon et al. 2009; Karlin et al. 2002; Hausmann et al. 2015b).

Despite the emphasis on devaluation to be an occupation-level phenomenon, previous research on the topic mostly borrowed from ideas of individual-level discrimination to build their theoretical framework (England and Norris 1985). This has led to some inconsistencies, both at the theoretical and the empirical level. Theoretically, devaluation theory has left some gaps about the mechanism through which individuals are penalized for a characteristic that is located on the group-level. In classic theories of discrimination, the social markers at the basis of discrimination are typically disclosed in personal interaction. Individual gender or race, for instance, are visible in hiring routines as early as the personal name appears on the applicant's resume (Bertrand and Mullainathan 2004). To the contrary, we argue that occupational gender stereotypes are socially constructed categories that do not equate with the objective sex compositions within groups.

[1]It's worth to note that there have been multiple attempts to bring individual gender back into the debate on devaluation (e.g. Busch 2013), as also documented below in this paper.

A missing link, hence, is the question of how occupational gender-types are constructed in the first place. This process of "identification" is where cultural labels of masculinity or femininity are ascribed to groups that almost always have a mixed sex composition.

Empirically, this implies that in order to gauge the level of devaluation in the labor market, we need to test co-variation between occupational gender stereotypes and wages, rather than relying on measures of aggregate sex compositions. This puts research in front of a difficult task, as much unlike data on the sex of individuals, there is very little information on occupation-level gender-typing. A few studies have previously made the attempt to quantify gender stereotypes (White and White 2006; Beggs and Doolittle 1993). These data are, however, based on local student populations, which undermines their value for nationally representative studies. In this article, we thus present unique stereotype measures based on a German data set, the BIBB/IAB Employment Survey 1991/92 (Hall et al. 2015). With some nuance, these stereotype measures offer an interesting way to test devaluation theory from a different angle. Substantively, our findings suggest that at the mean of wages, sex compositions correlate with wages while this is not the case for gender stereotypes. Yet, this association at the mean is not representative of the entire wage distribution: We show that stereotypes are negatively correlated with wages below the median, and in particular for women. Men, on the other hand seem to profit from working in high-income female-typed occupations, where they arguably receive higher compensation due the stereotype of male competency and leadership skills.

We make several contributions to the existing literature: First, we attempt to provide research on occupation-level gender discrimination with a more rigorous theoretical foundation. Second, we revive the sociological tradition of viewing oc-

cupations as more than a collection of individual characteristics (Mandel 2016), which, we believe, enriches our empirical understanding of the phenomenon. Furthermore, this puts the analytical strategy "in synch" with the core of the devaluation theory that was originally located at the level of occupations. Lastly, we gain crucial information by employing quantile regressions to estimate associations across the entire wage distribution. This tool, although well integrated in other disciplines, has not been given the attention it deserves in sociological research. In the next section, we give a broader outline of the core ideas that motivate this paper.

3.2 Discrimination of occupations & gender

The early literature on occupational devaluation was strongly influenced by the idea that women were at disadvantage in an economic world in which the decision makers were largely men who either did not appreciate the extent to which women contributed to their business, or who actively sought to keep women out of profitable positions. England and Norris (1985), for instance, had three reasons in mind why female occupations would be paid less than male occupations: Employers have inherited norms that suggest to pay less to women. Employers underestimate the marginal profits that women bring to their firm. Employers, who are male, want to secure insider rents (high wages for men), while keeping wages for outsiders (women) artificially low. The corresponding research strategy that was proposed in this literature, and that has dominated the field until today, includes the operationalization of occupational gender stereotypes via the proportion of women in each occupation-cell, and the attempt to identify a robust correlation of changes or differences in this variable with wages (England

et al. 1988; Gerhart and Cheikh 1991; Macpherson and Hirsch 1995; Karlin et al. 2002; England et al. 2007; Levanon et al. 2009; Mandel 2013; Murphy and Oesch 2016, to name some of the most important contributions over the years). In the German context, evidence on devaluation remains ambiguous, with affirmative results (Murphy and Oesch 2016; Busch 2013), and findings that are inconclusive or show no sign of devaluation (Hausmann et al. 2015b; Leuze and Strauß 2016).

Although intuitively appealing and convenient in terms of operationalization, the analytic strategy in the devaluation literature, that was adopted from research on individual-level gender discrimination, is conceptually unclear: The discrimination of *women* is based on an *individual* characteristic that is highly visible in the interaction between employers and (future) employees. This justifies the many studies on gender differences in hiring and promotion processes within firms (e.g. Petersen and Togstad 2006; Blau and DeVaro 2007) where we can measure the differential outcome between women and men. Yet, the same strategy does not add up when we look at occupations: First, occupations' gender compositions are not visible in social interactions, and the literature has ignored how actors derive their views on occupations' gender-types in the first place. Second, even in the most extreme cases of gender segregation, occupations are at least to some extent composed of both genders. If discriminatory processes are directed against women, then it is initially unclear why men should also be discriminated against just because they work in a similar job. Third, while the hiring process is arguably the most important stage at which wage penalties for women emerge in firms (Petersen and Togstad 2006), the same is implausible if we think about female occupations. Occupational gender is not revealed in hiring processes, as it is the case for individual gender–it is rather known pre-hire and stays constant throughout the process. We thus must think more carefully about the mech-

anisms that allow occupational gender to become salient in wage determination processes. In what follows, we describe that actors are unlikely to discriminate on the basis of objective sex compositions. The identification of occupations as typically male or female hinges on a complex process that goes well beyond aggregate sex ratios in groups.

3.2.1 The salience of stereotypes

Occupations include large amounts of people who are demographically diverse in various ways. Their true gender compositions are unknown to those who do not actively engage in collecting this information or gathering it from authoritative sources. An implicit assumption made in previous studies on devaluation is that discriminatory action is directed against occupations based on their actual gender composition. Busch (2013) calls this "quantitative devaluation". We argue that, although discriminating actors (e.g. firms) would be able to identify sex compositions in job-cells, it is unlikely that they do. Collecting such information in a precise way is costly, and it would require a conscious and directed effort to engage in discriminatory practices. According to sociological conflict theory, discrimination is part of a deliberate hegemonic strategy to secure insider benefits on the costs of an outsider group (e.g. Blalock 1967; Reskin 1988). However, this theory did not provide much insight about the origins of inter-group conflict or the mechanisms underlying discriminatory processes (Reskin 2000). Moreover, pervasive evidence shows that women have been vertically mobile in the labor market up to an extent that they occupy very high-skilled sectors in the economy today (Charles and Grusky 2004; Mandel 2013). This rise of women in the world of work, that was most strongly perceived in the professions, undermines the popular view that men in powerful positions actively attempt to keep women

out of high-status jobs. In line with this doubt, social cognition theory holds the belief that social biases arise as an automatic by-product of interactional and unconscious evaluative processes in society (Fiske 1998). This means that "biases are cognitive rather than motivational; [...] they occur independently of decision makers' group interests or their conscious desire to favor or harm others" (Reskin 2000, 320f.). This is also why discriminatory beliefs are often not peculiar to hegemonic actors, but shared even by those who could be seen as the target or outside group (Lalive and Stutzer 2010; Eagly et al. 2000). In sum, bias against female-typed jobs is probably mostly non-conscious and non-intentional. Furthermore, actors accessing information about sex compositions is unlikely as it would generate costs without providing any practical added value. Consequently, we find a chain of events very unlikely in which actors 1) look up occupational the compositions to 2) use them in order to discriminate.

We contend that occupations are associated with notions of femininity and masculinity on the basis of stereotypes. Per definition, stereotyping is the process in which agents label a group with specific characteristics, given the agents' perception of the typical representative of this group (Dovidio and Gaertner 2010). In our case, the general public ascribes gender labels to occupations, given the perception of who the typical incumbents of those occupations are. When Lippmann (1922) introduced the term "stereotype", he referred to it as the typical picture one has in mind when thinking of the member of a particular group. Since then, social cognition theory has taught us that stereotyping is essential to all human cognitive processes. In a complex world, multifaceted information is condensed into categories that help people to find orientation and to make sense of their self and their environment (Operario and Fiske 2002; Dovidio and Gaertner 2010). Stereotypes can thus be viewed as an extension of categorical thinking in which

categories of people (in our case: occupational categories) are associated with exaggerated or otherwise distorted beliefs about this particular group. As early as in the 1950s, Walker (1958), for instance, found that lawyers were seen as "alert, calculating, well educated, shrewd, clever", and coal miners "rough, tough, friendly, honest, industrious" (123). Shinar (1975) was first to explicitly survey the gender stereotypes of occupations in a student population in the United States. She showed that within the heavily male-typical spectrum, there were e.g. miners, highway workers, and building contractors. Gender-neutral occupations were e.g. history professors, computer programmers, and psychiatrists, whereas amongst the strongly female-typed occupations were nurses, secretaries, and elementary school teachers. This showcased the existence of a "subjective reality" (Ibd., 99), that would be salient in social-interactive processes and that, we believe, informs discriminatory processes at the occupation level.

3.2.2 The origin of stereotypes

We maintain the argument that in discriminatory processes on the occupational level, identification of female-typical occupations is made via stereotypes, not the objective sex composition in groups. This potentially poses a serious problem for empirical studies on devaluation: Relying on sex compositions to approximate gender-types works out if the one is a linear representation of the other. However, non-linearity between the variables could introduce serious measurement error abundant enough to invalidate core findings of previous work.

In a general way, one could claim that true gender compositions are sufficiently good approximations of stereotypes. Social cognition theory views stereotypes in light of an underlying socio-economic structure (Reskin 2000). With the complexity of this structure, people fall back on a simplified version of it that nevertheless

represents its most important features. This way, the perception of the typical gender of a group would still be motivated by the actual sex composition. This view coincides with the proposition of social role theory (Eagly 1987) that people's stereotypes are shaped and reinforced through observations that are made about real-life role occupancy of roles. If women work in a specific occupation, this would hence translate into the public perception that this activity is more compatible with female traits, and hence, the occupational stereotype is formed. By extension, changes in the sex compositions would also lead to changes in stereotypes, at least after a time lag that allows culture to "catch up" (Diekman and Eagly 2000). Consistent with these ideas, several studies showcase a strong correlation between gender typing and compositions (Cejka and Eagly 1999; Krefting et al. 1978). Furthermore, *changes* in compositions seem to be related with *change* in stereotypes (Cejka and Eagly 1999). Although this allows us to make the case that stereotypes and compositions are strongly related, we should still doubt that they are not systematically different.

If stereotypes emerge because the human brain is prone to limiting costly processing of new information, then the frequent updating of stereotypes becomes less likely out of the same reasons. Stereotypes are more stable over time than the reality they describe, because their functionality in enabling humans to make sense of the world would be strongly undermined if they changed at fast pace. Moreover, in order to recalibrate personal views on occupations, individuals would be required to access public archives to recurrently asses information about structural change in the labour market. This is why stereotypes are often seen as strongly influenced by mass media such as television programs to which the general public is exposed on a regular basis (Signorielli et al. 1994; Smith 1994). In general, since stereotyping is probably contingent on our limited perception of

social structure in real life, it is also reasonable to assume that occupations with a low visibility in popular media are less strongly perceived to be typical for either gender. While e.g. the roles of doctors and nurses are often subject of television storytelling, consumed by millions of viewers, we are less exposed to the picture of e.g. chemical engineers, architects, or carpenters. This is not to say that gender stereotypes only exist for the former group of occupations, but that the latter are probably less strongly perceived, and that they require different sources of information to be maintained.

Indeed, the literature suggests that perceptions of occupational gender are strongly influenced by the gender-typing of jobs' task content. This means that occupational stereotypes are not only defined by who works in which occupation, but also by the type of activities that they entail. This argument has long been maintained by sociological accounts on the roots of gender segregation (Charles and Grusky 2004; Levanon and Grusky 2016). Here, essentialist views, the idea that women and men have innately different abilities and tastes, are seen as causes of occupational sorting. Crucially, essentialism itself is not only based on social role observations, but also on psychological, cultural, and biological factors that prove to be stable despite ongoing shifts in the division of labor: Evolutionary psychologists explain gender-differentiated social behavior through genetic variations between women and men that are rooted in prehistoric selective and reproductive pressures (Wood and Eagly 2002; Buss and Kenrick 1998; Gangestad and Simpson 2000). Social constructionists deny the biological foundation of gender differentiation, claiming the very meaning of gender would be contingent on inter-relations between people and their use of language (Bohan 1993; Marecek 1995). This view is also compatible with the sociological notion of "doing gender" (West and Zimmerman 1987), which emphasizes people's adaptation to

behavioral patterns that resonate with gender-typed expectations in interactions with others. Although biological and social-constructivist approaches are very different in their assumptions about the roots of gender differentiation, they both portray gender labels as contingent on other influences than true gender compositions. The first case emphasizes biological predetermination, the other highlights culturally contingent factors that are present in each respective society.

More than a loosely defined collection of rules and norms, cultural beliefs about gender are embedded in institutionalized systems that help to nourish and maintain stereotypical views despite changes in their underlying realities (Ridgeway and Correll 2004; Ridgeway 2011; Ridgeway and Correll 2000). Beliefs that differentiate genders are imposed and enacted in hegemonic systems that rely on mass media, governmental policy and other distributive channels (Ridgeway and Correll 2004). This dominance is demonstrated, for instance, by the acceptance of vast bias even amongst disadvantaged groups (Lalive and Stutzer 2010; Eagly et al. 2000), and the social and economic penalties for those who show deviant behavior or attitudes. Hence, "although changing socioeconomic conditions and personal and collective resistance do gradually modify cultural beliefs about gender, the core structure of the beliefs are not easy to erode." (Ridgeway and Correll 2004, 528).

3.2.3 Summing up & outlook

The baseline of our argument is that labour market discrimination of groups, such as occupations, has to be evaluated on a different conceptual basis as individual-level discrimination. Studies on devaluation must be based on a coherent theory of how occupations are identified in a perceived male-to-female spectrum. While actors are unlikely to be motivated to maintain detailed records on sex compositions

that would inform such a process of identification, we have proposed that a more plausible instrument are the gender stereotypes of occupations. Although both of these concepts are probably strongly related (see evidence in section 3.2.2), we have brought up various ideas on how they could differ. The salience of these ideas is further corroborated by empirical accounts on the relative stability of gender-typical views in general (Lueptow et al. 2001; Williams and Best 1990; Ruble 1983) and more specifically in the labour market (White and White 2006; Beggs and Doolittle 1993; Powell et al. 2002) despite of large-scale socio-economic changes and desegregation. The most important implication of this is that the previously used imperfect metric of occupational gender (the proportion of women in each group) introduced measurement error that–depending on its size and direction–could invalidate key findings on devaluation. In the empirical section, we thus attempt to isolate wage differentials that exist in occupations with different sex compositions from those that exist between occupations varying in their gender-type. Based on the previous considerations, we formulate several working hypotheses:

H1: *Both, compositionally female and typically female occupations generate lower wages.*

It is possible that associations with wages are hardly discernible on statistical grounds. This would be the case if sex compositions have such a strong impact on stereotypes that the latter are a linear function of the former.

H2: *While compositionally female occupations receive lower wages, this is not the case for typically female occupations.*

We have a sound understanding of correlations between sex compositions and

wages. Studies have consistently shown that jobs that are demographically female received lower wages than other jobs. If we found that such a penalty is not visible in typically female jobs, then this would undermine some of the theoretical underpinnings of devaluation theory.

3.3 Data

3.3.1 Individual level

Data are drawn from the BIBB/IAB Employment Survey 1991/92. This is a representative survey of the German population belonging to the paid labour force, age 15 and older, with a usual work time per week of minimum 10 hours. The total number of observations is 34,277, that were made between November 1991 and February 1992. In order to gain consistency, we restrict the working sample to West Germans until (including) the age of 67. The decision to drop the East German population was made to avoid complexities that derive from the economic and cultural differences between West and Easter Germany, that were only reunited one year prior to the of time data collection. This leaves us with 20,100 observations with non-missing values.

The Employment Survey sorts respondents into 320 occupations on the three digit level of the the German classification of occupations KdlB88 (Bundesanstalt für Arbeit 1988). Due to its historical emergence, KdlB88's architecture is skewed towards capturing male-dominated occupations at a higher detail, which could give them an overly large weight in the analysis. We therefore follow Hausmann et al.'s (2015a) lead to re-structure a small part of the classification based on a similarity index between occupations. After furthermore dropping occupations with less than 10 incumbents, we are left with 190 clusters for analysis.

On the individual level, we can draw from a wide breadth of work-related variables. The respondents' hourly wage is constructed from a discrete work income variable, that we project onto a continuous log-scale using the 18 categories' midpoints divided by working hours. Control variables capture variation in demographic characteristics (age, gender, not born in Germany, children below the age of 6 at home), job-related factors (industry, working hours, firm size, work status), and human capital (education, labor market experience). "Not born in Germany" and "Children below the age of 6 at home" are binary variables. Industries are captured in 6 broad categories, firms are either small, middle, or large size, and the work status distinguishes between permanent employees, temporary workers, and the self-employed. Finally, education is operationalized along the 9-categories CASMIN classification, and labor market experience is measured in years. We initially also derived two variables capturing occupation- and firm-specific human capital, respectively. They are not included in the models as they did not change coefficients, while restricting the sample due to missingness. Both, working hours and labor market experience, are centered around their mean and also included in later analyses as second order polynomial.

TABLE 3.1: Sample descriptives

	Total		Men		Women	
	Mean	SD	Mean	SD	Mean	SD
Wage/hour[a]	20.53	8.7	22.25	8.44	17.68	8.36
Age[c]	39.44	11.47	40.32	11.43	37.99	11.41
LM experience	19.2	12.22	20.01	12.18	17.87	12.16
Working hours[b]	38.64	10.12	42.07	8.11	32.98	10.55
Female	38%	–	–	–	–	–
Kids < 6	17%	–	20%	–	12%	–
Born in foreign country	7%	–	7%	–	6%	–
Industry						

Table 3.1 – continued from previous page

Manufacturing	27%	–	33%	–	17%	–
Craft sector	17%	–	21%	–	9%	–
Trade	15%	–	9%	–	23%	–
Public organisation	27%	–	24%	–	31%	–
Agriculture	1%	–	1%	–	1%	–
Other industry	14%	–	11%	–	18%	–
Work status						
Permanent empl.	89%	–	89%	–	90%	–
Temporary empl.	5%	–	4%	–	6%	–
Self-employed	6%	–	8%	–	4%	–
Firm size						
Small	46%	–	41%	–	55%	–
Mid-sized	32%	–	33%	–	30%	–
Large	22%	–	26%	–	15%	–
Education[d]						
CASMIN 1a - 1c	53%	–	56%	–	47%	–
CASMIN 2a - 2c	33%	–	28%	–	42%	–
CASMIN 3a + 3b	14%	–	16%	–	11%	–

Source: BIBB/IAB Employment Survey 1991/92

[a] Displayed on natural scale, not log-scaled or centered.

[b] This variable has a lower bound of 10.

[c] This variable has lower and upper bounds of 15 and 67, respectively.

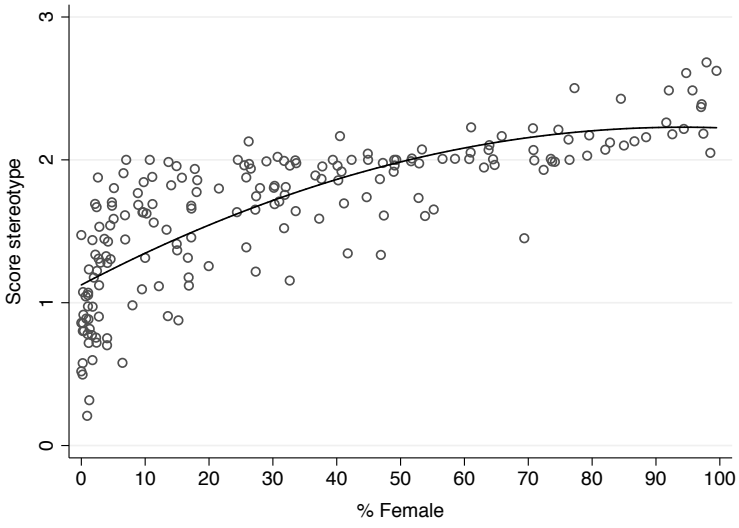
[d] For readability, the CASMIN classification is collapsed into its three main components.

3.3.2 Occupation level

We are interested in two variables that are located on the occupational level: sex compositions and gender stereotype. The first variable is drawn from the *OccPan* data set (Hausmann et al. 2015a) that, amongst other occupation-level data, includes the 1991 gender composition per occupation in West Germany. Operationalizing the gender stereotype per occupation is more difficult. There have been various attempts to achieve something similar in the past. Task-based approaches, for instance, focus on gender-typed connotations of specific tasks that are required at work (Cejka and Eagly 1999). A female occupation would

therefore be characterized by typically female work tasks (Levanon and Grusky 2016). This particular methodology might however be problematic to operationalize stereotypes, as it would require the assumption that such stereotypes are completely channeled through task content, which we should not expect to be the case (see previous discussion). Another approach gauges stereotypes more directly, by asking survey respondents explicitly about the gender type of listed occupations (Shinar 1975; White et al. 1989; Beggs and Doolittle 1993; White and White 2006). Although these studies are explicitly designed to provide data on occupational gender stereotypes, they are usually based on very small samples of university students and a relatively small number of occupations.

FIGURE 3.1: Correlation between stereotypes index and sex compositions (190 occupations)



For a novel and more comprehensive approach, we have thus decided to follow Janssen and Backes-Gellner (2016) in using the Employment Survey's unique question about the suitability of each gender to perform in a given job. More specifically, the survey asks each respondent: "Can your job be done equally well

by a man and a women, given that they have the required qualifications?". The answer is captured in five categories: the job can be done 1) only by a man, 2) rather by a man, 3) equally well by women and men, 4) rather by a women, 5) only by a woman. To construct our stereotype score (SC), this information is interpreted along a continuous scale, extracting unconditional means by occupation that are located between the bounds of 0 (typically male) and 4 (typically female) with midpoint 2. For the regression-based analyses, this variable is standardized and centered at its mean.

TABLE 3.2: Examples of extreme occupations in the male-female spectrum

On-diagonal female[a]	On-diagonal male[b]	Off-diagonal male[c]
Florists	Metal producers, melters	Precision mechanics
Laundry cutters, sewers	Metal drawers	Shoemakers
Pharmacy aids	Mould casting	Electrical engineers
Stenographers, typists	Welders, cutters	Architects, civil engineers
Dietary assistants	Concrete workers	Survey engineers
Medical receptionists	Scaffolders	Chemists, chemical engineers
Medical laboratory assistants	Road makers	Physics engineers, mathematicians
Nursery teachers, child nurses	Mining technicians	Commercial agents, travellers
Hairdressers		
Housekeeping managers		
Household cleaners		

Source: BIBB/IAB Employment Survey 1991/92

[a] More than 90% women, stereotype score larger than 2.0.

[b] Less than 10% women, stereotype score lower than 0.75.

[c] Less than 15% women, stereotype score larger than 1.75.

Figure 3.1 depicts the correlation between our stereotype score (SC) and sex compositions by occupation. Pearson's correlation coefficient r is 0.756. On visual inspection, we want to emphasize two observations about the covariation of the

two variables: First, while the sample represents occupations along the entire distribution of gender compositions, most stereotype scores are below the scale's midpoint of 2. Most jobs are thus stereotypically seen as rather or strongly male, while only very few occupations are slightly female-typed. In other words, the world of work is generally seen as a strongly male domain – which seems to be true at least for Germany in 1991/92. Second, the variation in stereotypes is much larger in occupations that are predominantly composed of men. Visually, this trend seems to be starting gradually below the 50 percent of women mark, being most extreme in occupations that are composed between 90 and 100 percent of men.

In Table 3.2, we list extreme cases found in Figure 3.1 to showcase on-diagonal cases (indicating that sex compositions and stereotypes correspond to each other), and off-diagonal cases (suggesting that stereotypes can deviate from true compositions). On-diagonal cases sort into sectors that are well-known to be dominated by either gender. This includes lower-tier medical jobs, personal services, and assistant jobs in the female spectrum, and metal or construction jobs in the male spectrum. The off-diagonal is more interesting: Here, amongst some mixed occupations, we observe several technical jobs in engineering or the sciences. This is surprising as previous findings strongly indicate that segregation into technical and engineering jobs are strongly influence by both, supply-side (Correll 2001), and demand-side essentialist views (Hanson 1996). Our evidence yet rather suggests supply-side driven segregation in engineering jobs, while practitioners see men and women more or less equally suited to perform in these jobs.

This section supports our view that empirically, sex compositions and stereotypes are very similar but not identical. A weakness of the descriptive evidence we display is that stereotype scores are constructed from observations made solely

of the incumbents of each occupational group. This is equivalent to non-random sampling and almost might introduce bias.[2] Moreover, our stereotype measure is slightly skewed towards individuals' *ability* to perform well in a job. In the next sections, we thus employ multivariate techniques to analyze the wage disparities between occupations.

3.4 Methods

We use two approaches to estimate associations with log-wages of individuals i who are nested in occupations j. With the first approach, we look at mean effects that are estimated in hierarchical linear models including random intercepts. This approach takes into account heterogeneity of mean wages between j, which, if ignored, could lead to incorrectly estimated standard errors and wrong test statistics (Rabe-Hesketh and Skrondal 2012). Specifically, to gauge the association between gender compositions and wages, we are interested in a final specification

$$ln(wages)_{ij} = \beta_1 + \beta_2(\%Female_j) + \beta X_{ij} + \zeta_j + \epsilon_{ij} \tag{3.1}$$

where β_1 is the overall mean, β_2 indicates the wage dispersion between occupations with different sex compositions, and where X_{ij} is a matrix summarizing all individual-level control variables. ζ_j is the occupation-specific error component, absorbing differences in pay levels between groups that could result from omit-

[2] More recent evidence suggests that women's gender-typical beliefs about occupations are weaker than those of men (Shinar 1975; Beggs and Doolittle 1993; Kennison and Trofe 2003), although the literature also offers enough contrary evidence to this claim (Albrecht et al. 1977; O'Keefe and Hyde 1983; Yanico and Hardin 1986; White et al. 1989). Furthermore, higher educated workers could be more prone to express gender egalitarian views, which could also compress our stereotype score.

ting variables or from unobserved factors. A model with identical specifications, yet including the occupational stereotype instead of %Female is furthermore of interest to test the association between gender-typing and wages. In all of these cases, parameter optimization relies on full maximum likelihood.

The literature on devaluation has been mostly concerned with estimating average devaluation effects on the *mean* wage. While this is the canonical way of summarizing population-level statistics, it might theoretically fall short of accurately describing the penalty of working in a female sector at any part of the wage distribution. Mandel (2013) suggests that highly paid occupations are more susceptible to the cultural pollution effect of feminization, as they are initially regarded as high status niches in the labour market. Our second approach thus incorporates unconditional quantile regressions (UQR) to estimate average devaluation effects at different parts of the wage ladder. This approach so far received relatively little attention in sociological research (Budig and Hodges 2010; Killewald and Bearak 2014), and we believe it is an excellent tool to check the robustness of our mean effects and to compare coefficient estimates in the low, middle, and high paying sectors. Specifically, we follow Firpo et al. (2009) in transforming our dependent variable using the recentered influence function

$$RIF(Y; q_\tau, F_Y) = q_\tau + \frac{\tau - \mathbf{1}\{Y \leq q_\tau\}}{f_Y(q_\tau)} \tag{3.2}$$

where τ is a quantile, q_τ is the value of dependent variable Y, ln(hourly wages), at the τth quantile, and where $f_Y(q_\tau)$ is the density if Y at q_τ. $\mathbf{1}\{Y \leq q_\tau\}$ is a trigger being 1 if Y is equal or below the given quantile value, otherwise 0. Using simple OLS can then be used to implement the UQRs at different quantile values, where coefficients can be interpreted as marginal difference in the unconditional

quantile with a small location shift in the independent variable, holding other covariates constant (Firpo et al. 2009). We choose to run this model for nine quantiles to get a broad representation of the wage distribution. To cope with the nested structure of our data, cluster-robust standard errors are obtained through bayesian bootstrap where cluster weights are drawn from a Dirichlet distribution (Nembrini 2017).

3.5 Results

3.5.1 Stereotypes and compositions

Table 3.3 summarizes relevant coefficient estimates from our hierarchical linear models that include *ln(hourly wages)* as dependent variable. Exponentiated coefficients are thus interpreted as indicating percent differences between occupations. The empty model 1 serves as a benchmark to observe the variance component on the occupational level. It shows that, assuming a normal distribution, variation of wages *between* occupations amounts to a standard deviation of 0.231. The extent to which this variation between occupations can be explained in the subsequent models is demonstrated by the decline in this value in each respective model. In models 2 and 3, we include no individual-level controls at all, and simply look at the correlation between wages and gender compositions (model 2) and stereotypes (model 3).

As demonstrated in previous studies, the percentage of women strongly correlates with wages. Exponentiating the estimate, $e^{0.26}$, shows that the unconditional difference between completely male and female occupations is about 30 percent. Accordingly, a 10 percent difference in the proportion of women equates to a 3 percent wage differential. Furthermore, the variance component indicates that

about 6 percent of the variation in occupational wages lies between occupations with different sex compositions.

TABLE 3.3: Coefficients (t-values in parentheses) from random intercept models of hourly wages in 1991/92

	Empty	No controls		Including controls[a]	
	Model 1	Model 2	Model 3	Model 4	Model 5
% Female		−0.26***		−0.07*	
		(−5.32)		(−2.22)	
Stereotype			0.00		0.02*
			(0.12)		(2.36)
sd(constant)	.231	.217	.231	.135	.135
AIC	16357.27	16337.49	16359.26	11735.99	11735.47
BIC	16380.98	16369.1	16390.87	11964.99	11964.48
N	19995	19995	19995	19995	19995

Data: BIBB/IAB Employment Survey 1991/92

Significance: * p < 0.5 , ** p < 0.01 , *** p < 0.001

[a] Control variables as displayed in Section 3.3.1.

Conventionally, the negative coefficient for the sex composition variable would be interpreted along the lines of the devaluation hypothesis. However, model 3 indicates that stereotypically female jobs are not paid more or less than typically male jobs, which contradicts this interpretation. The orthogonality of wages and stereotypes is surprising not just because it runs against the devaluation hypothesis, but because stereotypes and compositions are strongly correlated. In models 4 and 5, all individual-level control variables are added to the wage equations which results in a) the estimate for % Female to become smaller (although still statistically significant), and b) the stereotype coefficient to be positive and significant. While model 4 confirms that individual-level mechanisms confound the

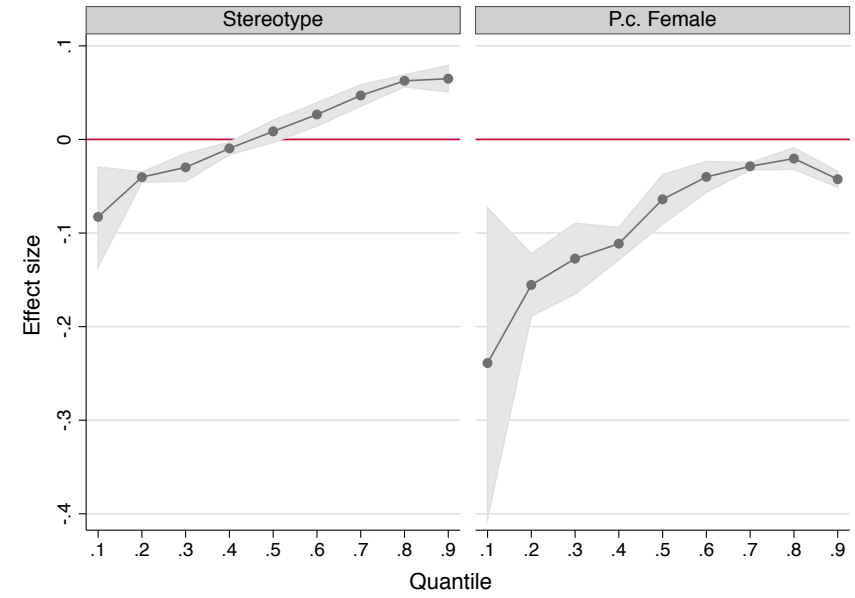
correlation between sex compositions and wages, model 5 suggests that, if anything, then stereotypically female jobs are paid more, once we take into account the socio-economic and demographic composition of occupations.

In a second step, we show results from two quantile regression models (Figure 3.2) that help to demonstrate the extent to which estimates at the mean of wages are representative of the entire wage distribution. Specifically, we recycle the variable specifications of model 4 and model 5 (Table 3.3) in a quantile regression framework, so that coefficients in Fig. 3.2 are all *net of individual-level confounders*. The left-hand panel demonstrates that the association of gender stereotypes and wages is monotonically increasing between the 10th and the 90th wage percentiles. Confidence intervals show that the negative associations between the 10th and the 40th percentiles are all statistically significant. From the 60th percentile and above, we observe significant *positive* associations. The right-hand panel in Figure 3.2 suggests that compositionally female occupations are paid less than male occupations throughout the entire wage distribution, but that the negative association is stronger in lower paid sectors.

3.5.2 Stereotypes in focus

The partly positive signs of the stereotype coefficients as displayed in Table 3.3 and Figure 3.2 require further investigation. One reasonable doubt would be that the positive significant association with stereotypes in model 5, and the positive associations above the median observed in the quantile-specific approach, are driven by omitted variables. Although we employ a standard control for educational attainment, this does not factor in the differential payoff within each educational group, depending on heterogeneous demand for specific skill sets. According to evidence from the United States and the United Kingdom, the middle part of

FIGURE 3.2: Coefficients from unconditional quantile regressions and 95% confidence intervals

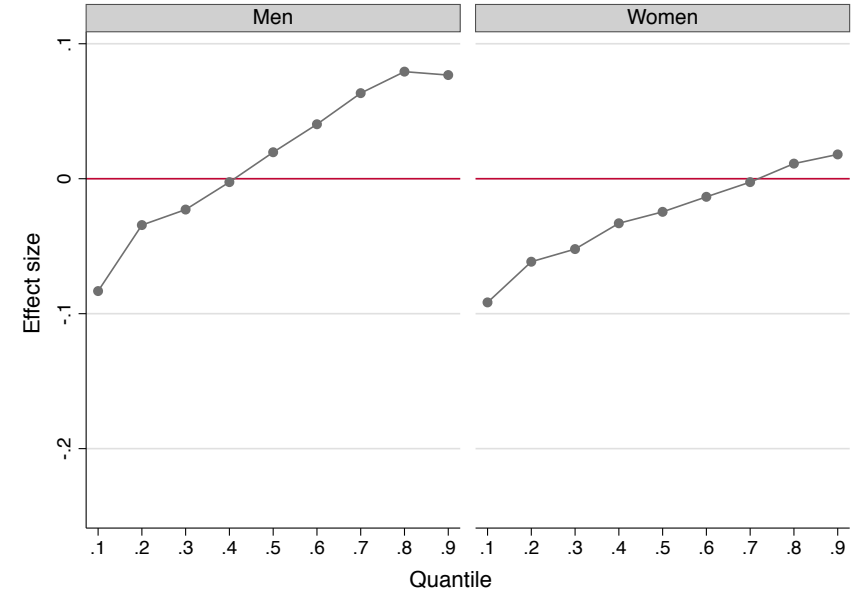


the wage distribution has been hollowing out from the 1980s onwards, when computerization started to eliminate routine-task jobs (Autor et al. 2003; Goos and Manning 2007). The existence of pervasive polarization in Germany, that would bolster relative wages at the top and the bottom, can be doubted (Oesch and Rodríguez Menés 2011; Tåhlin 2007), although some evidence speaks in favor of it (Spitz-Oener 2006). In order to test if the positive stereotype coefficients in the upper half of the wage distribution are driven by demand spikes that unevenly increased wages in the years prior to 1991, we employ two additional controls that are added to the previous UQR framework: the degree of routine tasks, and the sectoral growth in each occupation over the past five years[3]. Although including

[3]Routine task content is operationalized on the basis of an item in the Employment Survey asking the respondents about the frequency of repetitive work steps in their job. Sectoral change is captured on the basis of group sizes by occupation as documented in the OccPan data set (Hausmann et al. 2015a). The measure is equal to the harmonic mean of growth rates over the five years prior to 1991.

the two variables eliminates the positive significant effect on the mean of wages that we found in model 5, the coefficients by quantile are virtually unchanged (see Figure 3.4 in Appendix, left panel). We are thus confident that the relatively higher wages in female-typed high-paying jobs cannot be explained by demand shocks that were observed in the 1980s (Spitz-Oener 2006). Furthermore, the UQR models are supplied with a dummy variable capturing the professional sector, including health occupations, teaching, engineering, law or natural science jobs, amongst others. This enables us to probe if the advantage in female-typed occupations is limited to the high-skilled sector in which feminine traits are relatively highly valued. Just as before, the UQR results remain stable (Figure 3.4, Appendix, right panel).

FIGURE 3.3: Stereotype coefficients by gender from unconditional quantile regressions



Lastly, we attempt to disaggregate the quantile-specific stereotype coefficients by gender. Busch (2013) previously found evidence that jobs requiring male-typed

tasks generate higher wages for men, and lower wages for women. Furthermore, female-typed tasks are correlated with lower male wages. This is broadly interpreted as evidence for specific performance expectations (Berger et al. 1977; Wagner and Berger 1997), where women are assumed to be seen as more (less) competent in jobs requiring feminine (male) tasks, and vice versa for men. Figure 3.3 displays gender-specific stereotype coefficients estimated in quantile regressions that interact gender and stereotypes. Although the upward monotonic gradient from the 10th to the 90th percentile is still visible for women, it is largely located below zero. By equivalence, we observe that male wages in higher paid jobs are more strongly positive than it is the case for the mean as displayed in Figure 3.2. This result undermines previous findings (Busch 2013), and it emphasizes the salience of gender as a diffuse status characteristic (Berger et al. 1977) and potential glass escalator effects (Williams 1992) in the German labor market.

3.6 Discussion

As we investigate the nature and extent of wage disparities between typically male and female occupations, we realize the importance of evaluating this phenomenon at different locations in the wage distribution. Controlling for confounders, stereotypes and wages are more or less orthogonal at the mean of the distribution. Meanwhile, quantile regressions reveal the monotonic increase towards positive associations between the 10th and the 90th percentiles. This finding is pervasive in all specifications and it is robust to the inclusion of various statistical controls. Given this scrutiny, we are confident that this pattern cannot be explained by external demand shocks in the 1980s. A strong case can however be made that only men receive wage premiums in high-paying female-typed occupations – a

sign for a female competency stigma that elevates men working amongst women into well rewarded positions. Overall, although we are not the first to dissect estimates in different parts of the distribution (Mandel 2013), our findings should motivate more work considering that social behavior at the mean might often be a very poor approximation of parameters throughout the population.

As we make the general case that discrimination on the occupational level needs to be conceptualized and analyzed with care, our evidence remains limited to the West German economy in 1991/92. This temporal and geographical limitation is a good reminder that an important implication of our discussion is that discriminatory mechanisms are contingent on cultural contexts that can vary between countries and periods. Although Germany has been shown to exhibit significant wage gaps between predominantly female and male occupations (Murphy and Oesch 2016; Busch 2013), our own data indicates that only about 6 percent of the variation in occupational wages lies between predominantly female and male occupations[4]. Looking at countries where the explanatory power of gender compositions is higher than that, as e.g. in UK (Murphy and Oesch 2016), this would allow to test our argument in more salient environment.

Systematic measurement error is one of the reasons why we believe that conventional tests of devaluation (via the proportion of women) might have consistently introduced measurement bias in previous research outcomes. At the same time, we admit that only by proposing to focus on stereotypes, we might have opened Pandora's box of measurement error – a problem that is not easy to fix. Traditionally, stereotypes were seen as *explicit* beliefs and responses of which people are aware and which they can control (Dovidio and Gaertner 2010). It has however become increasingly clear that stereotyping includes *implicit* processes of which

[4]See model 2 in table 3.3.

people completely lack awareness or control. Implicit stereotypes can be understood as unconscious traces of learned knowledge from the past that continue to influence the mind (Ibd.). Explicit stereotypes can be measured by asking people about their beliefs and attitudes towards different social groups. Implicit stereotypes require more sophisticated measurement strategies, e.g. so-called response-latency tests, where psycho-social stimuli trigger unconscious associations that are measured and translated to a suitable scale of stereotyping (Dovidio and Gaertner 2010). These tests have been relatively expensive, although the internet has opened new ways of collecting such data on-line[5]. Crucially, implicit and explicit measures of stereotypes often only show modest or even relatively weak correlations, which applies in particular in studies on sensitive topics that suggest high social desirability of specific answers (Greenwald et al. 2009; Hofmann et al. 2005). White and White (2006) show that this problem might exist in the application on occupational gender stereotypes, as well. Furthermore, although we present a unique data set to operationalize stereotypes, our measure is partly skewed towards people's ability to perform well in given jobs. Taking into consideration these limitations, we concede that the results we present should be viewed as an explorative contribution to the application of a new idea. More robust measurement strategies in future research should bring in more certainty about the cultural underpinnings of devaluation.

This paper invests into the idea that discriminatory processes against female-typed jobs is based on cultural notions of femininity and masculinity attached to occupational groups. We cover a lot of ground to support the argument that these stereotypes are systematically different than simple gender compositions – and the presented data support this view. However, we only briefly mention

[5]See e.g. Project Implicit at `https://implicit.harvard.edu/implicit/`.

further theoretical concerns that generate doubt about the validity of conceptualizing individual and occupational gender discrimination within one and the same framework: While the hiring process is plausibly key to understanding how women are disadvantaged on the basis of their individual gender (Petersen and Togstad 2006), this is much less plausible for the case of collective or occupational gender that are not disclosed at some stage during the personal interaction between firm and job applicant. With respect to wage disparities between occupations, this thought should shift our attention to *pre-hire* decision making about job-specific compensation schemes in firms. This probably also implies a focal shift from decision-making in intermediary human resources that are responsible for day-to-day hiring, to higher management in which general guidelines for firm-wide hiring are manufactured.

The descriptive comparison of gender compositions and stereotypes has revealed that the West German labor market in 1991 featured some high-paying, technical jobs, particularly in engineering, that were dominated by men although they were evaluated as very close to gender-neutral. Gender segregation between occupations is often evaluated against its demand- and supply-side drivers (Levanon and Grusky 2016). For Germany, the literature offers evidence for sorting mechanisms on both sides (Solga and Pfahl 2009), although our evidence suggests that, at least in engineering, firms would be prone to taking in more women than they find amongst their pool of applicants. Although this emphasizes to some extent equality of opportunity, our results also display that men receive larger premiums in high-paying jobs that are more gender-neutral or female-typed. This puts female workers at disadvantage in the exact same jobs that are supposed to be more female-friendly and economically more rewarding in general.

3.7 Conclusion

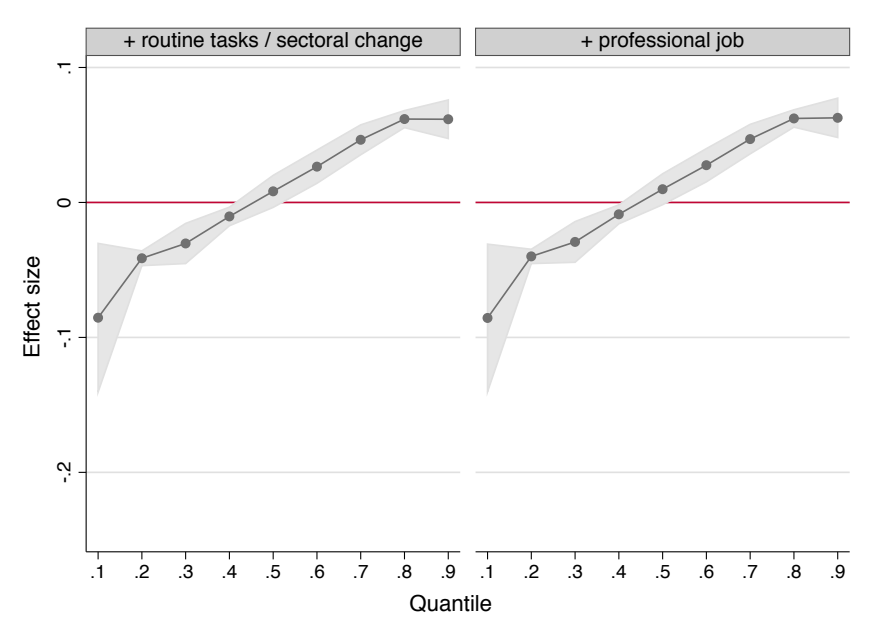
In the German context, occupations with a high proportion of men are not always identified as typically male occupations. In fact, the deviation between stereotypes and compositions seems to be particularly pronounced in some higher paying engineering jobs that are traditionally seen within the male spectrum of skills and abilities. This systematic difference between actors' perception of occupational gender and the true gender composition is mirrored in wage regressions that indicate significantly lower wages in compositionally female occupations, while stereotypes and wages are practically orthogonal. We deliver first evidence on this phenomenon, and hence there is reason to cautiously interpret our findings. One puzzle we cannot answer is how to explain pervasive findings about negative correlations between sex compositions and wages, if not via devaluation. Yet, our approach to devaluation is a contribution to set research on occupational gender discrimination on a more rigorous theoretical foundation. It is up to future studies to find more sophisticated ways to test the impact of cultural gender-typing on wages.

Substantively, although typically female occupations are not paid less if we look at jobs with average wages, further scrutiny reveals that the result at the mean is not very informative about discrimination in lower or higher paid jobs. Indeed, we observe that the association between stereotypes and wages is increasing monotonically throughout the wage distribution. Hence, the disadvantage of working in a female-typed job does exist in occupational sectors that are already paid less. More than a robustness check, the findings by quantiles reveal that discriminatory processes might work in very different ways if we look at jobs separately by level of skills or status. Lastly, we were able to explain the posi-

tive association of wages and stereotypes in higher-paying jobs through the male advantage in gender-neutral and female-typed sectors. With a large variety of ambiguous findings on this phenomenon in the literature, both in Germany and in other developed economies, focussing on gendered experiences in segregated occupations promises much merit in future research.

Appendix

FIGURE 3.4: Coefficients from UQRs on stereotypes, including additional controls (and 95% confidence intervals)



Chapter 4

Gender Segregation, Occupational Sorting, and Growth of the Female Wage Gap

4.1 Introduction

The declining gender segregation of the occupational landscape has been one of the big structural changes in the economy within the past 60 years. Although rates of desegregation lagged behind change in other areas of gender equality (Charles and Grusky 2004; Goldin 2006), they were still substantial in size and desegregation was observable in various country contexts (Blau and Kahn 2017; Hakim 1994; Hausmann and Kleinert 2014; Jacobs 1989a). The dissimilarity index (Duncan and Duncan 1955) for the United States, for instance, went down from 64.48 to 51.04 between 1970 and 2009 (Blau et al. 2013).[1] Analyses of the demographic gradients in desegregation have revealed that the largest share of these observed trends can be attributed to women with particularly high educational credentials, and from younger cohorts (Blau et al. 2013; Jacobs 1999). Furthermore, much of

[1] Substantively, this means that in 2009, 51% of all workers would have had to switch into another occupational group so that each groups' sex compositions had been identical with the overall sex composition in the labor market.

the change was confined to specific occupational groups: Women integrated a few sectors that were previously dominated by men, in particular white collar, service and sales jobs. At the same time, desegregation was practically inexistent in other fields such a blue collar work (Blau et al. 2013; Cotter et al. 2004; England 2010).

Several studies documented how these changes have contributed to the convergence of average wages *between women and men* (Blau and Kahn 2017; Mandel and Semyonov 2014). The baseline finding is that despite desegregation, occupational sorting remains a powerful driver of gender inequality in the labor market today (Ibd.). What we are missing so far, however, is a structured analysis of how the demographic and occupation-specific dynamics of desegregation have contributed to growing inequality *within the female population*. The idea is that desegregation was primarily achieved through the sorting of highly endowed women into a set of increasingly well-paid, traditionally male occupations. This would have led to a divide between women in male-typed occupations and other women, who are less qualified and who work in less advantaged jobs. Knowledge about the extent of the growth of such a "female wage gap" is close to null, as existing evidence is restricted to empirical snapshots showing group differences between women at single points in time (Cotter et al. 2004; de Ruijter et al. 2003; Levanon et al. 2009; Magnusson 2013; Murphy and Oesch 2016). A few articles have picked up the topic of the changing demographic profile of women in male-typed jobs (e.g. Mandel 2013, 2018), but they did not deliver a systematic analysis of the trending wage gap over time. Other studies focused on wage *penalties* (and changes thereof) in predominantly female occupations (Busch 2018; Levanon et al. 2009), mostly ignoring the rising wage *premiums* for women in predominantly male occupations.

In this article, we address this gap in the extant literature by studying changes in the wage differential between women in typically male occupations and other women, a phenomenon we term *growth of the female wage gap*. We consider demographic, cultural, and occupational factors that would have contributed to this growing wage gap. The specific theoretical mechanisms we are interested in are a) changes in the occupational sorting process of women, b) quickly rising returns to education and specific labor market skills in male-typed occupations, and c) decreasing discrimination of token women in typically male work. While each of the three mechanisms is theoretically important in its own respect, their *cumulative* effect could have contributed to a substantial wage advantage for women in traditionally male occupations. On the aggregate level, such a shift would be mirrored by a strong rise in social inequality in the female population.

Using data from the German Socio-Economic Panel (GSOEP) 1992 to 2015, this article shows that the wage gap between women in male-typed occupations and other women has strongly grown over the past quarter-century. Due to the parallel unfolding of several processes starting in the 1990s, average female wages in typically male occupations skyrocketed, while economy-wide wages increased moderately at best. The cumulative effect of these processes was substantial: We find that in 2015, women's mean hourly wages in male-typed occupations were 29% (13%) higher than in female-typed (mixed) occupations. In the early 1990s, women working in typically male lines of work still earned slightly *below* women in gender-integrated occupations, and only slightly more than those in female-typed occupations. This shows that the female wage gap is a recent and pervasive phenomenon. Our analysis reveals that the increased sorting of highly educated women into male-typed occupations is the most important driver behind the growing wage gap. Rising returns to specific skills and to other wage-related

personal characteristics have also fueled growth of the female wage gap, although to a lesser extent. Contributions of unobserved components to growing inequality suggest that the decreasing token status of women in male-typed jobs has improved their economic standing, too.[2]

The following section briefly highlights previous findings on wage differentials between women in male-, mixed, and female-typed occupations. There is, however, not much evidence beyond mean comparisons at a given point in time. Thereafter, the "Mechanisms" section develops the theoretical foundation of our main argument that several simultaneous changes in the labor market have led to a substantial increase in wage inequality between women. We formulate hypotheses that are subsequently put to the test. The article closes with a discussion of our findings and their broader implications for research.

4.2 Findings on women's wages and careers in male jobs

In this section, we briefly summarize existing evidence on the female wage gap. Several studies show a negative linear correlation between the gender ratio in occupational cells and women's earnings (e.g. Levanon et al. 2009, 876). More refined analyses take into account that the relationship between pay and gender composition is non-linear, which is true for the United States as well as multiple European countries (Cotter et al. 2004; de Ruijter et al. 2003; Magnusson 2013; Murphy and Oesch 2016).[3] In the United States, just as in Germany, gender-

[2]We cannot tell if the declining token effect is not confounded by an increasingly positive selection of women on unobserved individual characteristics. See the "Discussion" section for further comments on this problem.

[3]This is no recent development and has possibly been true for the entire post-war era (Cotter et al. 2004, 36).

integrated jobs typically generate the highest income for women, although earnings are only marginally higher than in male jobs. On the other hand, earnings are substantially lower in female sectors (Busch 2013; Cotter et al. 2004; Murphy and Oesch 2016). Similar patterns, although with some nuances, can be observed for other countries (Murphy and Oesch 2016, 13). Job cells with 90% to 100% male incumbents (e.g. truck drivers) usually generate lower income for women than slightly more integrated jobs (Cotter et al. 2004; Murphy and Oesch 2016). Furthermore, in Germany, women's wage differences in jobs with between 20% and 60% female workers seem to be very small, if they exist at all (Murphy and Oesch 2016, 13). Even when using an extensive set of control variables, this non-linearity persists (Cotter et al. 2004; Murphy and Oesch 2016).[4] The previous research does not deliver systematic analyses of changes in wage gaps over time. Hence, it is difficult to assess ex ante if (and at which rate) wage discrepancies between women in male, mixed, and female-typed jobs increased. Furthermore, although the evidence strongly suggests that women in male-typed jobs generate relatively high wages, there are also several studies that cast doubt on this. A common finding is that women, and in particular those working in lower-tier jobs, exhibit better wage outcomes if more women are present in managerial positions in the firm (Bell 2005; Cohen et al. 1998; Ehrenberg et al. 2012; Kurtulus and Tomaskovic-Devey 2012; Shin 2012). Other studies report adverse wage-related labor market outcomes for women in some specific male-dominated sectors such as in STEM (e.g. Glass et al. 2013; Hunt 2016).

[4]With controls, Budig (2002, 269) finds a more or less linear fit to describe the difference between wages in female, mixed and male jobs.

4.3 Mechanisms

The mechanisms potentially leading to growing wage inequality between women are varied. This section describes changes in a) occupational sorting processes, b) the returns to education and specific labor market skills, and c) discrimination in male jobs. These all are all candidate explanations for changing wage differentials between women in male-typed jobs and other women. We formulate the working hypotheses of this article at the end of each subsection.

4.3.1 Sorting

Gender segregation in the labor market is an aggregate outcome of occupational sorting processes on the individual level. Women's sorting into male jobs has changed over time. This has led to fundamental changes in the composition of women who are working in typically male domains. Mandel (2018) discusses the accelerated entry of highly educated women into male jobs and its implications for wages in feminizing sectors. In particular professional jobs have experienced a large inflow of women who are now claiming a large share of employment in this sector. Much of the de-segregation we have observed since the 1960s was achieved through the entry of highly educated women into male jobs (Blau et al. 2013). Younger cohorts of women in the professions and management jobs have shown strongly elevated levels of education and participation rates in male jobs (Percheski 2008). Examinations of the German case have shown that women were particularly successful to secure positions in fast-growing high income jobs (Oesch and Rodríguez Menés 2011, 522). According to this evidence, we expect to observe that growing educational differences contributed to increasing wage gaps between women in male jobs and other women.

H1.1: *The increased selection of highly-educated women into male jobs has elevated their wages relative to other women.*

Another source of growing inequality comes from unobserved characteristics. Institutionalized career pathways significantly decrease the baseline propensity of women to enter a male-typed job in the first place. The segregation process starts early in life (e.g. Correll 2001) and it is already well visible in education (Charles and Bradley 2009). Even if women were successful in a traditionally male educational field, they are still much less likely to enter a male-typed job thereafter (Shauman 2009).[5] Conversely, those women who "make it" into a male job against the odds are probably positively selected on personal traits such as tenacity and ability, increasing their chances to become economically successful. We are not aware of studies looking specifically at compositional changes in unobserved characteristics of women in male jobs. However, with the breaking up of institutional and cultural barriers that kept women out of male work domains, penetrating such a domain as a woman is probably considerably easier today than it was in the 1960s or 1970s. In Germany male jobs have, indeed, become more inclusive of women over time, even if this happened at a slow rate (Hausmann and Kleinert 2014). A possible result of the increased inclusiveness is that women are less positively selected into male jobs on unobserved traits:

H1.2: *Decreasing positive selection on unobserved characteristics has contributed to a decreasing wage advantage of women in male jobs relative to other women.*

[5]With science jobs in minds, research has long referred to the 'leaking pipeline' metaphor to describe such a process that out-selects large parts of female candidates for male jobs (e.g. Lee 1998, 200)

4.3.2 Returns to education & skills

Opportunities in male jobs have changed over time due to structural shifts in the economy: Starting in the 1980s, the spread of information technology complementary with high-skill analytical work, promoted wages on the top of the wage ladder (Violante 2008). This was highly consequential for the German labor market where many well paid jobs were created during that time (Oesch and Rodríguez Menés 2011). In its original form, the so-called skill biased technological change (SBTC) hypothesis stated increased demand at the top of the wage ladder would bump up educational premiums. Goldin and Katz (2009), for instance, conclude that between 1980 and 2005, the college/high school wage ratio rose from about 3.7 to about 6 points as demand for high-skilled labor outpaced its supply. As many of the traditionally male jobs fall into the spectrum of high-skill demand, we expect to see that rising educational premiums in these jobs contributed to wage inequality between women.

> H2.1: *Rising returns to education have contributed to a wage advantage of women in male jobs relative to other women.*

While the SBTC hypothesis predicted occupational upgrading, its theoretical expansion proclaimed the hollowing out of the labor force due to routine biased technological change (Autor et al. 2003; Fernández-Macías 2012; Goos and Manning 2007).[6] The idea was that computerized systems would be able to substitute jobs that involve a high degree of routinized tasks. Further theoretical contributions in the field identified specific skill sets that would be complementary with recent technological advances. Liu and Grusky (2013, 1358), for instance, demon-

[6] Although some countries have exhibited a hollowing out of the wage structure (Autor et al. 2003; Goos and Manning 2007), evidence for this phenomenon is weak in the German case (Oesch and Rodríguez Menés (2011); Spitz-Oener (2006); Spitz-Oener (2006, 261ff.).

strate the increasing value of analytical, computer, managerial, and nurturing skills. The authors attribute the increasing value of analytical and computer skills in large parts to technological change. On the other hand, rising returns to managerial and nurturing skills are explained through patterns of labor demand that might be specific to the United States. There is not much evidence on this fact within the German context. To convert the existing evidence on skill content and levels of routine at work in our research, we rely on the broad idea that male-typed jobs are mostly found in the highest ranks of the wage distribution. These jobs often require analytical and managerial skills that are very low in routine contents.

H2.2: *Rising returns to specific labor market skills, and the decreasing value of routine work, have contributed to a wage advantage of women in male jobs relative to other women.*

4.3.3 Discrimination

Despite wide consensus that male jobs often pay larger salaries (England 1992; Levanon et al. 2009), some scholars pointed out that token women in these jobs might not profit from such an advantage. In the societal division of labor, women and men are expected to fulfill roles specific to their gender (Parsons et al. 1953; Parsons and Bales 1955) and deviant behavior could be penalized. Such an outcome is also congruent with the predictions of status characteristics theory (Berger et al. 1977), when gender serves as a specific status characteristic from which employers infer expectations that women are not well suited to perform in male task settings (Wagner and Berger 1997, 12ff.). These discriminatory standards are based on cultural beliefs that justify people's tendency to attribute less value to

female work (or women) against male work (or men) (Auspurg et al. 2017; England et al. 1988; Ridgeway 2011). Despite a surprising degree of stability in gender beliefs (Lueptow et al. 2001), there is a consensus that Germany, just as other developed economies, has experienced a shift away from traditionalism towards more gender egalitarian cultural norms (Bolzendahl and Myers 2004; Brewster and Padavic 2000; Ciabattari 2001; Davis and Greenstein 2009; Inglehart and Norris 2003; Knight and Brinton 2017). As traditional beliefs are one of the key components of the under-valuation of women, we hypothesize that the discrimination of women in typically male occupations has declined over time. On the other hand, a comparable discriminatory effect would not have existed to the same extent in more gender-integrated or female-typed fields. This is due to the lack of a female token status within fields that are already culturally marked as more typical for women. Hence, the declining penalty due to the token status of women in male-typed jobs would have led to increasing average wages for women in these jobs, relative to other women.

H3: *Declining discrimination of women in male-typed jobs contributed to their wage advantage relative to other women.*

4.3.4 Cumulative changes

The final hypotheses address the cumulative effect of all of the discussed mechanisms on overall wage inequality between women. If we only cared about individual components of inequality, then it would be easy to dismiss some of the discussed changes as rather trivial or inconsequential. For instance, differences in educational or unobserved characteristics exist *independently of occupational sorting*. In other words, highly educated women would also profit from their edu-

cational background if they were not employed in a male sector. This argument, however, would miss the *cumulative* advantage that is likely to emerge from the joint effect of multiple mechanisms. With the exception of changes in the structure of unobserved characteristics, all discussed hypotheses point towards a growing aggregate wage advantage for women in male jobs over other women. The additive effects of discussed mechanisms imply, for instance, that women with strong educational credentials increasingly selected into jobs that have generated growing rents for highly educated workers. We thus expect to observe that average wages of women in male jobs have out-grown the wages of other women over the past decades.

H4.1: *During the past several decades, average wages of women in male jobs have out-grown the wages of other women.*

Although we are skeptical about the effect size of potential changes in the structure of unobserved characteristics, we still formulate a counter-hypothesis. In this way, we address the possibility that the larger inclusiveness of women in male jobs (pushing down the positive wage effect of unobserved characteristics) balanced any aggregate effects on the wage structure.

H4.2: *During the past several decades, average wage differences between women in male, mixed, and female jobs remained relatively stable.*

4.4 Data

We use individual-level data from the German Socio-Economic Panel Study (SOEP) (Wagner et al. 2007). The SOEP is a representative study of the residential population living in private households in Germany since 1984. In 1990, the population

was extended to include households in the former German Democratic Republic. Furthermore, the sampling probability varies between some demographic groups as, e.g. immigrants and high-income earners, are over-sampled. These details make it necessary to carefully avoid discontinuities in the data, and to use weighting techniques where required. We employ weights in all computations in sec. 4.6, 4.7, and 4.9. The main dependent variable is the natural logarithm of gross hourly wages deflated to 2015 Euros.[7] The sample is restricted to observations made between 1992 and 2015, and the self-employed are not included.

Occupations are captured on the basis of the KldB-1992[8], and they are grouped into one of three clusters that designate the jobs' gender type: male, mixed, or female. The choices made when aggregating jobs this way are not trivial as previous explorations have shown (e.g. Levanon et al. 2009). We apply an idea by Murphy and Oesch (2016) who suggest that occupational gender categories in Germany are best captured looking at the 60 percent threshold of gender ratios (Ibd., 18f.). Hence, female jobs are defined as including at least 60 percent of women, male jobs include at least 60 percent men, and mixed jobs are in between.[9] Furthermore, it is generally a good idea to capture job-level gender ratios on a very detailed level, because we quickly lose precision when conflating similar job groups that have different gender compositions. This is why we start from the most detailed 4-digit job level, only merging them with a similar job if less than 20 observations were available. This leaves us with a total of 1,147 clusters for which we compute gender ratios. For longitudinal analyses, the gender types of

[7] This variable is constructed using the current monthly labor income and weekly work hours multiplied by 4.35. We also restrict the leverage of outliers by top- and bottom-coding hourly wages. This affects about 0.37 percent of all observations and makes our wage-gap estimates slightly more conservative.

[8] The German KldB-1992 (Statistisches Bundesamt 1992) is a typical hierarchical classification of occupations, comparable with the U.S. SOC.

[9] Results in this paper are similar but a bit attenuated if we use slightly different gender thresholds, e.g. 70 percent, to compute occupational gender groups.

occupations (male, female, mixed) are kept constant over the 1992 to 2015 period, as changes in gender compositions can be expected to have very minor effects over this short time span (England et al. 2007; Busch 2018).

In order to derive out main independent variables, we rely on two data sources. The SOEP delivers information on individuals' formal education in the CASMIN standard. We condense the CASMIN categories into three groups for analysis [10] The skill components of jobs are derived on the basis of the Employment Surveys by the BIBB/IAB (1991/92 and 1998/99) and by the BiBB/BAuA (2005/06 and 2011/12) (Hall et al. 2015).[11] We compute average skill measures per KldB 3-digit level and marry the results with the SOEP data. Staying close to domain-specific previous work (Liu and Grusky 2013, e.g.), we extract values for seven task contents: verbal, quantitative, analytical, creative, computer, management, and care. Furthermore, we quantify the level of routine at work to account for the substitution effect via automated systems.

We also employ a set of control variables in the analyses. Differences in acquired human capital are held constant by including individuals' labor market experience (years in full-time employment and their second order polynomial) and firm tenure (also measured in years). Previous research produced evidence on rising premiums for very long work-hours, which we control with a dummy variable for those working 50 hours or more (Cha and Weeden 2014). Conflict potential between family and work is controlled by variables detailing if a woman has a child below the age of six in the household, and indicating the amount of hours spent in the household and with child care. Finally, we add control variables on the work

[10] Category 1: basic vocational or elementary education and below; category 2: intermediate education (general or vocational); category 3: tertiary education

[11] Although being a series, the surveys, and in particular its item response scales, are not consistent enough to provide information on skill *changes within jobs over time*. This is why we rely on skill measures that are constant in job cells over time. However, they are based on all four consecutive surveys, so they mostly represent the time we are interested in.

place: firm size, the industry, and a dummy for public vs. private sector; and demographic background variables: east vs. west, marital status, living with partner. The final data set includes 88,138 women with at least 2,177 observations per year and with at least 296 observations per gender type-year.[12]

4.5 Methods

In the theory section, we develop a framework that allows us to analyze the wage advantage built by women in male-typed occupations over other women. Although this suggests a two-fold comparison (male-typed jobs vs. other), we split the "other" group into women in mixed and female-typed occupations. This allows us to stay in line with the broader literature on gender segregation. We proceed by looking at the changing wage inequality between women in two ways: First, we decompose changes in wage gaps between women in male-typed occupations and women in mixed and female-typed occupations, respectively. The decomposition technique we apply in this step was introduced by Juhn et al. (1991) and it has since been used in different applied studies in the social sciences (e.g. Blau and Kahn 2017; Cha and Weeden 2014). Second, we implement job switch models via fixed effect regression that allow us to control for stable idiosyncratic traits and to estimate the contribution of occupational characteristics to inter-group wage differences. Although we have yearly data from the SOEP ranging from 1992 until 2015, we use bi-yearly data in all statistical models to increase the stability of estimates.

In order to estimate the components of change in the wage gaps between group A (women in male-typed occupations) and group B (either women in mixed occu-

[12]The group of women in mixed jobs is the smallest due to our choice of gender ratio thresholds. However, group sizes are large enough for robust estimation in every period.

pations, or women in female-typed occupations), we start with the time-specific log-wage model

$$Y_{it} = X_{it}\beta_t + \sigma_t\theta_{it}, \tag{4.1}$$

where Y_{it} is the natural log of wages for individual i at time t, X_{it} is a vector of explanatory variables, and β_t is a vector of coefficients. The residual is split into two parts: θ_{it} is the standardized residual with mean zero and variance of 1, and σ_t is the residual standard deviation. σ_t reflects the within-group inequality at a given point in time, and θ_{it} is an individual's position in the conditional wage distribution at time t. Given the two groups, A and B[13], their wage differential at time t is

$$D_t = \bar{Y}_t^A - \bar{Y}_t^B = \Delta X_t\beta_t^A + \sigma_t^A\Delta\theta_t \tag{4.2}$$

where Δ denotes the average difference in the variable it precedes, and β_t as well as σ_t are based on group A's model for both, A and B.[14] Furthermore, the change in the wage differential between time points 0 and 1, $D_1 - D_0$, can be decomposed into $E + U$:

$$E = \beta_0(\Delta X_1 - \Delta X_0) + (\beta_1 - \beta_0)\Delta X_0 + (\beta_1 - \beta_0)(\Delta X_1 - \Delta X_0) \tag{4.3}$$

$$U = \sigma_0(\Delta\theta_1 - \Delta\theta_0) + (\sigma_1 - \sigma_0)\Delta\theta_0 + (\Delta\theta_1 - \Delta\theta_0)(\sigma_1 - \sigma_0) \tag{4.4}$$

where we have omitted the A superscript for β and σ for readability. Here, E is the

[13] The choice about which group is represented by A and B is consequential for estimation results. Therefore, it is customary to display decomposition results by changing group assignment between A and B in a second run of all analyses. However, this only makes sense if we are strictly interested to compare two groups. In our analyses, we make two comparisons amongst three groups: We compare outcomes in male vs. mixed jobs, and outcomes in male vs. female jobs. In order to make these results comparable between each other, we fix A to represent women in male jobs.

[14] To further clarify what is behind $\Delta\theta_t$, we refer to Blau and Kahn (1997, 6ff.) who offer excellent insight.

observed change in the wage gap that is due to changes in *observed* quantities (left term), prices (middle term) and in their interaction. U is the *unobserved* change in the gap due to changes in *unobserved* quantities, prices, and their interaction.

The observed quantities component summarizes changes in the wage differential that can be attributed to changes in average characteristics of women (e.g. educational upgrading). The observed prices part details changes due to changing marginal returns (e.g. increasing returns to education). The *unobserved* quantities component captures if women in mixed/female jobs are moving up or down in the distribution of women working in male jobs. This component captures two substantive things we are interested in: Changes in unobserved traits (e.g. tenacity, ability) and changes in token discrimination. In our framework, we are not able to divide these two mechanisms. Hence, the estimated component can be interpreted as a cumulative outcome of both, changes in unobserved traits and discrimination. Furthermore, the unobserved prices component simply accounts for aggregate wage inequality in male jobs after accounting for observed characteristics.[15]

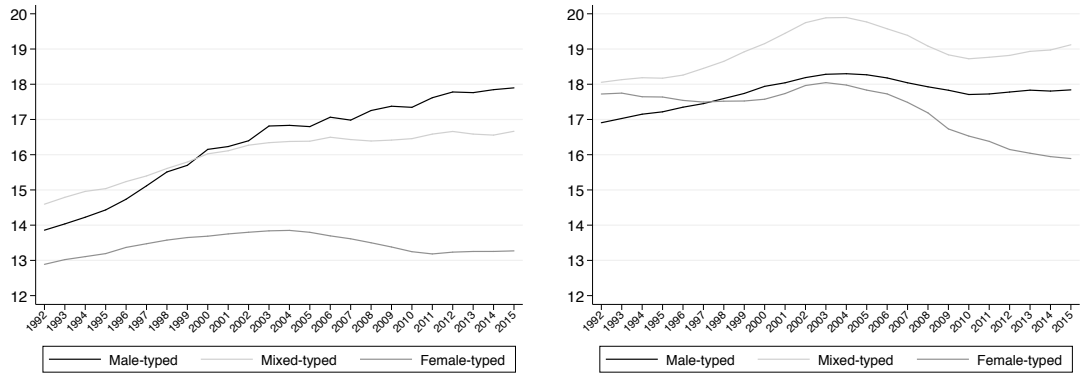
In the second part of our analysis, we apply fixed-effects regressions, exploiting the panel structure of our data. This way, we control for the individuals' constant unmeasured characteristics. Departing from a linear log wage model, the error term is decomposed into α_i, the individual-specific constant terms, and u_{it}, the time-varying idiosyncratic errors:

$$Y_{it} = X_{it}\beta_t + \alpha_i + u_{it} \tag{4.5}$$

[15]While in some studies, the observed and unobserved interactions are included in one of the other components, we decide to ignore them. We base this decision on the fact that a) these interactions do not have a substantively useful interpretation for our study, and b) the interaction terms summarize the joint contribution of quantities on prices on changes in wage differentials, so that it would be misleading to add them to either one of the other components in our case.

By applying the within-transformation to the data, α_i is eliminated which enables us to estimate the effect of switching the occupational gender groups (e.g. switching from a female to a male job) while controlling for plausible differences in performance-relevant unobserved factors. We use panel-robust standard errors with the fixed-effect models.

FIGURE 4.1: Median hourly wages in male, female and mixed jobs 1992–2015, by gender (2015 Euros, smoothened)



(A) Women's wages

(B) Men's wages

4.6 Descriptive analysis

In figure 4.1, we depict median hourly wages in male, mixed and female jobs over the period of 1992 to 2015. Panels A and B show the statistics for women and men, respectively. The figure shows that women working in male jobs have outpaced all other women in terms of wage growth since at least the early 1990s. Their median wage surpassed the one in mixed occupations somewhere in the early 2000s and it has gained more ground since then until today. Our main interest is in the wages of women, but the comparison with male wages is instructive in this case: Although men in male jobs have also done relatively well, the increase in wages they have seen is much less dramatic, and it is less steep than changes

observed for men in mixed occupations. The fact that female and male wages in the same male-typical jobs have not experienced all too similar shifts suggests that the underlying factors for women's increasing wage performance are likely located on the individual rather than occupational level.

This leads us to think about potential factors that drive the trend of increasing wages for women in male jobs. In table 4.1, we display average characteristics that summarize how the socio-economic compositions of women in male, mixed and female jobs differ. In addition to the pooled sample means, we show deltas in between 1992 and 2015 in order to give the reader a sense of shifts over time. Although these shifts are ultimately of most interest if we want to study the increasing gap between women's wages in different occupations, it is worthwhile to appreciate that women in male roles have been distinct in various ways over the entire observed period: Two factors that must positively affect their income relative to the other two groups are their high educational attainment and their tendency to work long hours.[16] Other notable differences are that women in male jobs work much more often in manufacturing–a typical male field–and that they are more often located in the Eastern part of Germany where wages are generally lower. While these differences exist towards both, women in mixed and female jobs, the latter group also shows some interesting characteristics: those employed in a female job have lower education and experience, and they spend considerably less time at work (where they are often employed in small firms), and more at home, caring for the household and children. Overall, the differences in characteristics between the three groups illustrates well that women in male jobs are most strongly geared towards monetary success in the labor market. On the other hand, women working in a female-typed job are clearly much closer to

[16] In our analyses, we look at *hourly* wage as dependent variable. Observed differences in working hours amplify results that we show in the following sections.

TABLE 4.1: Sample descriptives: pooled means and deltas[a] (1992 – 2015)

	Male jobs		Mixed jobs		Female jobs	
	$\bar{X}$	Δ	$\bar{X}$	Δ	$\bar{X}$	Δ
Education & skills						
CASMIN 1a - 1c	0.26	−0.33	0.25	−0.3	0.34	−0.2
CASMIN 2a - 2c	0.37	0.09	0.54	0.15	0.5	0.15
CASMIN 3a + 3b	0.37	0.24	0.21	0.15	0.16	0.05
LM experience (years)	13.4	−0.79	13.08	1.66	12.07	0.45
Tenure (years)	9.81	2.17	10.97	2.57	9.38	1.75
Work & family						
W. hours (per contract)[b]	34.14	−1.97	32.55	−2.31	29.48	−3.22
W. hours (overtime)[b]	2.11	0.5	1.73	0.51	1.47	0.28
Overwork (50 hrs. +)	0.11	0.03	0.05	0.05	0.04	0
Kids < age 6	0.08	0.01	0.06	−0.02	0.07	−0.01
Hours household	1.72	−0.8	1.76	−0.68	2.05	−0.6
Hours childcare	1.33	0.24	1.31	0.05	1.66	0.17
Work sector						
Small firm	0.15	0.01	0.16	0	0.31	0.04
Mid-small f.	0.29	−0.08	0.25	−0.03	0.3	−0.04
Mid-large f.	0.26	−0.04	0.28	0.03	0.2	−0.05
Large firm	0.29	0.12	0.31	0	0.19	0.05
Public	0.31	0.05	0.3	−0.02	0.36	−0.1
Agric.	0.02	−0.01	0.01	0	0	0
Energy/Mining	0.02	0	0.01	0	0	0
Manufacturing	0.24	−0.2	0.17	−0.12	0.11	−0.08
Construction	0.1	0.01	0.05	0	0.04	−0.02
Trade	0.12	−0.02	0.1	−0.03	0.22	−0.01
Transport	0.06	0.02	0.09	−0.04	0.02	0
Bank, Insurance	0.03	0.01	0.26	−0.08	0.01	−0.01
Services	0.42	0.2	0.31	0.26	0.6	0.12
Demographics						
Age[b]	40.88	4.2	40.66	7.37	41.94	5.6
East	0.23	−0.1	0.18	0	0.19	−0.05
Partner in HH	0.68	0.02	0.68	−0.05	0.7	−0.02
Married-cohab.	0.51	−0.08	0.54	−0.05	0.58	−0.06

Data: SOEP v32, weights applied

Continuous variables are displayed on natural scale.

Categorical variables are given in proportions.

[a] Deltas Δ are derived from $X_{2015} - X_{1992}$

[b] Not included in multivariate analyses.

the traditional stereotype of the homemaker, taking over work in the family and orienting less towards a professional career.

Finally, we want to highlight the temporal dynamics that we observe in the displayed variables. Notable differences between male-typed jobs and the other two groups is that in the former, the proportion of women with a tertiary degree has strongly increased (from 26 percent in 1992 up to 50 percent in 2015), the amount they work overall has declined less sharply, and they have increased their presence in large firms. All of these changes could potentially explain why women in male jobs were able to increase their pay over the past couple of decades. At the same time, they have seen a relative decline in their average labor market experience. This could be due to the fact that younger women were more prone to enter male jobs, which pushed down average age and experience relative to other women.

4.7 Decomposing the change in wage differentials

Table 4.2 summarizes the aggregate components of changing wage differentials between women in male jobs and women in mixed or female jobs. The first two columns detail components of change between male and female jobs, and columns 3 and 4 display results for the comparison between male and mixed jobs. According to the results, the mean wage differential between male and female jobs opened up by 0.244 log points (0.146 points vs. mixed jobs). Exponentiated, this tells us that between 1992/93 and 2014/15, the male-to-female and male-to-mixed wage gaps have grown at a rate of 1.28 and 1.16, respectively. In both cases, changes in the observed components have been most influential. Changes

in observed quantities explain about half of total changes in differentials. It is also notable that the change in unobserved quantities had a relatively large positive impact on the opening of the wage gaps.

TABLE 4.2: Summary components of change in wage gaps between male and mixed/female jobs, 1992/93 to 2014/15

	Male vs. female		**Male vs. mixed**	
		% of total[a]		% of total[b]
Change in wage gap	.244		.146	
Observed total[c]	.185	75.9%	.121	82.8%
Quantities	.114	46.9%	.074	50.6%
Prices	.054	22.1%	.048	32.7%
Interaction	.017	6.8%	−.001	0.5%
Unobserved total[d]	.059	24.1%	.025	17.2%
Quantities	.05	20.5%	.022	15.0%
Prices	.01	4.0%	.015	10.2%
Interaction	−.001	0.5%	−.012	7.9%

Data: SOEP v32, weights applied

Note: The first two columns detail components of change in the gap between male- and female-typed occupations. Columns 3 and 4 display components of the changing gap between male- and mixed-type occupations.

[a] percent of total change in differential 0.244

[b] percent of total change in differential 0.146

[c] Equal to E as discussed in Methods (sec. 4.5)

[d] Equal to U as discussed in Methods (sec. 4.5)

Table 4.3 lists detailed components of changes in the wage gaps. The quantity components for education confirm that the entry of highly educated women into male jobs has strong elevated average wages in this group. Nearly half of the growth in the wage differential between male and female jobs (a third vs. mixed jobs) can be attributed to increasing discrepancies in average educational attainment. Changes in the time committed to paid work and to work at home

TABLE 4.3: Detailed components of change in wage gaps between male and mixed/female jobs, 1992 to 2015[a]

	Male vs. female		**Male vs. mixed**	
		% of total[b]		% of total[c]
Quantities				
Education	.110	45.0%	.047	32.3%
LM Exp.	−.003	1.2%	−.010	6.6%
Tenure	.003	1.1%	−.001	0.5%
Overwork	−.004	1.7%	.001	0.7%
Kids < age 6	.000	0.2%	0.000	0.2%
Household / childcare	.005	2.1%	.005	3.7%
Industry	.012	5.0%	.020	13.6%
Firm size	.019	7.6%	.016	10.8%
Public	−.008	3.1%	−.004	2.6%
East	.020	8.3%	.030	20.2%
Family status	.004	1.5%	.004	2.6%
Prices				
Education	−.018	7.3%	−.022	15.0%
LM Exp.	−.001	0.4%	0.000	0.2%
Tenure	.005	2.0%	−.002	1.3%
Overwork	.010	4.2%	.014	9.4%
Kids < age 6	0.000	0.0%	.001	0.5%
Household / childcare	.007	2.9%	−.005	3.4%
Industry	.022	9.1%	.040	27.6%
Firm size	−.002	0.6%	.003	2.0%
Public	.011	4.4%	.005	3.3%
East	.016	6.6%	.019	13.0%
Family status	−.003	1.0%	−.002	1.2%

Data: SOEP v32, weights applied

[a] Details of Interaction component and constant not displayed.

[b] % of total change in differential 0.244 (see tab. 4.2)

[c] % of total change in differential 0.146 (see tab. 4.2)

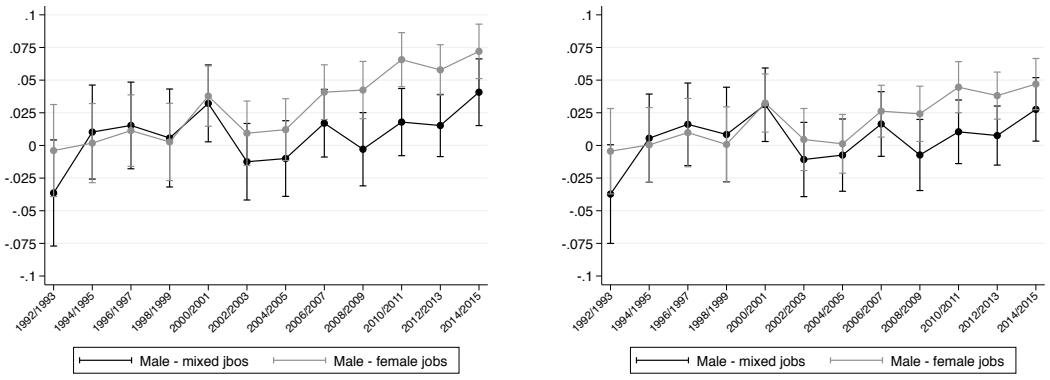
have not contributed appreciably. It is interesting to see that educational premiums (prices) in male jobs have slightly decreased, which somewhat limited the increasingly stratifying effect of educational differences. Furthermore, as observed

in other countries, prices for overwork have gone up which was to the benefit of those working in male domains.

4.8 Job-level mechanisms

The previous section is key in understanding how compositional changes have fundamentally transformed the group of women who work in male jobs, and how this transformation has impacted average wages. Yet, what we are lacking so far is a sense of how job-level mechanisms have contributed to observed trends in wages. We thus implement job switch models based on the formulation in eq. 4.5. Here, the idea is to measure changes in wages when individuals switch from one job group to another (e.g. from a male to a female job). This way, we filter out any stable characteristics (such as educational attainment or motivation) that would confound the relationship between the occupational gender type and wages.

FIGURE 4.2: Marginal differences, empty and accounting for ind. char's, by year-dyads, 1992–2015 (95 percent CIs)

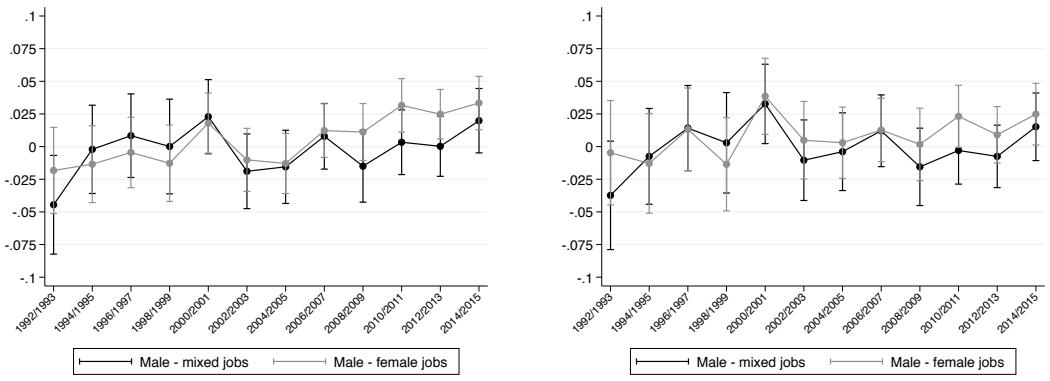


(A) Empty (B) Individual char's

To begin with, we implement a model that only includes the occupational gender type variable (male, mixed, female jobs) and bi-yearly dummies. This gives us the wage differences after switching into another gender type group as an

average over all years. According to the results (not displayed), women receive about 1 percent higher wages when switching from a mixed to male job (not significant), and 3.6 percent higher wages when switching to a female job (highly significant). In the next step, we disaggregate the average gender type coefficient of this "empty" model into yearly estimates that are displayed in figure 4.2-A.[17] We see that, for most years, women in our sample profited from switching to a male job. Yet, these effects are mostly insignificant up to the mid-2000s. From 2006/2007 onwards, the wage bonus associated with switching from a female to a male job became larger and significant (4.2 percent in 2006/2007 and 7.5 percent in 2014/2015). Figure 4.2-B, depicting results after including individual-level control variables (same as in the decomposition models), shows that about one third of the 7.5 percent wage effect in 2015 is due to non-constant person-level heterogeneity.

FIGURE 4.3: Marginal differences accounting for job skills, by year-dyads, 1992–2015 (95 percent CIs)



(A) Job tasks

(B) Job tasks (period effects)

In the next step, we add seven skill type variables and a variable for routine work to the wage equation. Figure 4.3, panel A, depicts the gender type coefficients

[17] Results are based on an interaction term of the gender type variable and period dummies.

after including skill variables as average coefficients for all years. Panel B shows results from the model where coefficients are allowed to vary over years, which accounts for potentially increasing returns to specific skills over time. We observe that another third of the 2015 wage effect between male and female jobs can be explained this way (fig. 4.3-B). Apart from 2000/2001 and 2014/2015, we reveal no significant wage effects beyond individual or skill-specific rewards. Overall, the fixed effects models show a wage bonus of up to 5 percent when switching to a male job. Yet, this bonus shapes up less like an advantage for male jobs, and more like a recent disadvantage in female jobs due to their inherent skill structure. Skills that we found critical for bumping up wages in recent years were related to computers, care, management (coefficients displayed in the Annex). With some nuance, this confirms previous findings on computer, managerial, and nurturing skills from the U.S. context (Liu and Grusky 2013), and findings on the value of management tasks in Germany (Liebeskind 2004).

4.9 Educational upgrading

Before proceeding with the conclusions of this article, we want to address the additional question how we can explain the strong educational upgrading in male jobs that has emerged during the analysis as the prime factor of increased wage inequalities. We see three principal mechanisms that plausibly could have led to such upgrading: First, increased demand for highly skilled workers in male jobs would have elevated the average educational attainment in the group. Second, and congruently with an argument we made previously, demographic and cultural change could have led more highly educated women to select into male jobs in order to pursue a more promising career. This would be a supply-side mechanism.

Third, if women had increasing difficulties to enter male jobs, for instance due to discriminatory barriers, then stronger positive selection could have also led to a rise in educational levels.

FIGURE 4.4: Proportion women and men with tertiary degree, by occ. gender type, 1992–2015

Figure 4.4 depicts the proportion of women and men with a tertiary degree (CASMIN = 3) for each of the three occupational gender types. In the top left, we observe the strong increase in highly educated women in male jobs (as in table 4.1). The comparison with the male graph illustrates that upgrading was mostly confined to the female population. Hence, the scenario of demand-driven upgrading is unlikely since this would have resulted in similarly strong changes in educational attainment for men.[18] Furthermore, the proportion of women in

[18]Note that in the overall population, the proportion of individuals with a tertiary degree is (and has been) relatively similar for women and men. Hence, it is neither plausible that there was demand-driven upgrading skewed towards female workers due to a lack of men with sufficient qualifications.

jobs that we categorized as typically male has increased from 6.2 percent in 1985 (only West Germany), to 9.1 percent in 1992 (re-unified Germany), up to 13.5 percent in 2015. Such de-segregation indicates that rather than facing stronger barriers, women have been more successful in penetrating typically male lines of work. This also makes the reinforced selection argument much less plausible. Overall, we believe that the data best supports the supply-side narrative in which particularly highly educated women had the motivation and the opportunity to choose more male-typed careers.

4.10 Conclusions

This article documents the growing wage advantage of women in male jobs as compared to women who work in female and gender-integrated fields. The analysis is central to evaluate career opportunities of women in strongly segregated labor markets. While it is a common claim that women in male jobs struggle to be successful and to advance in their careers, we show that they have out-earned other women for at least fifteen years. Some twenty-five years ago, observed wage differences between women were very small. Today, women's mean wages in male jobs are 0.294 (0.103) log points higher than in female (mixed) jobs. Estimating *monthly* labor income on the basis of observed hourly rates and work hours, we find that women in mixed jobs have 81 percent, women in female jobs have 61 percent of the expected income of women in male jobs. This is the result of fundamental changes in the wage structure within the female population in Germany.

The main aim of this article was to identify the driving forces behind these growing wage gaps. Results of formal decompositions strongly suggest that women's

educational upgrading in male jobs has been the prime factor for observed changes. Nowadays, 50 percent of women in male jobs have earned a tertiary degree, which makes them stand out extremely against women in other jobs, and also against men in comparable jobs. In 2014/15, educational advantages in male jobs accounted for a wage bonus of 12 (7) percent over women in female (mixed) domains.[19] As we see it, wage inequality between women has emerged primarily because of increased sorting of highly educated women into male jobs.

Occupation-level mechanisms seem to be negligible between women in male and mixed jobs. On the other hand, we provide evidence that the gap between male and female jobs has also been growing due to increasing returns to specific skills in male jobs. This is a recent phenomenon that we observe since the mid-2000s. In line with previous work (Liu and Grusky 2013), the value of several skill types (analytical, management, care) seems to have increased over time, while wages in routine-heavy jobs came under pressure. So far, there are very few studies that employ multi-dimensional skill type measures to explain the wage differential between occupational gender categories. The results undermine previous research on the feminization of occupations that rely on one-dimensional measures of skill and that find no effect on between-occupation wage differences (e.g. Murphy and Oesch 2016).

We furthermore exploit the longitudinal setup of the study to look at changes in unobserved factors that drive women's success in male jobs. To our knowledge, research has not produced any evidence on unobserved differences between male, mixed and female jobs so far. To that extent, our results are novel but they should also be seen as an explorative attempt to start a debate on this important issue. Overall, we found that unobserved factors had a sizable impact on changes in

[19] This result is based on a so-called Oaxaca-Blinder decomposition of current wage differentials (Kitagawa 1955). Results are not displayed.

the wage gaps between women. Two mechanisms that we discussed in the theory section could explain this finding: a decline in discrimination against token women in male jobs, and an increasingly positive selection on unobserved characteristics of women into these jobs. The former seems like a plausible scenario due to past adoptions of more gender-egalitarian values in society. We deem the latter as less likely since compared with earlier decades, today's women probably face lower institutional and cultural barriers when trying to enter a traditionally male occupation. The higher inclusiveness of women in these jobs would decrease the positive selection on unobservables, and thus, it would rather work in the direction of *lowering* returns relative to women who work in other fields. This argument, however, remains untested on statistical grounds.

A finding that went against our expectations was that educational returns in male jobs have *declined* relative to returns in other jobs. This has, in fact, slightly attenuated the growth of wage differentials between these groups. One possible source of the de-valuation of educational credentials is the massive inflow of highly educated women into male jobs. We have shown that within the course of a quarter-century, the percentage of women with a tertiary degree in male jobs went up from about 20 to 50 percent. If this landslide change in the educational composition in male jobs was not caused by demand-side mechanisms, then this likely would have created an over-saturation of highly educated workers, depressing the marginal returns to education. In other words: there was just not enough high-skilled work to do for all of the high-skilled female workers who came to work in a typically male job.

This narrative resonates well with an important side-finding we make on the question what has been behind the increasing rate at which highly educated women sort into male-typed jobs. Given the practical non-existence of similar

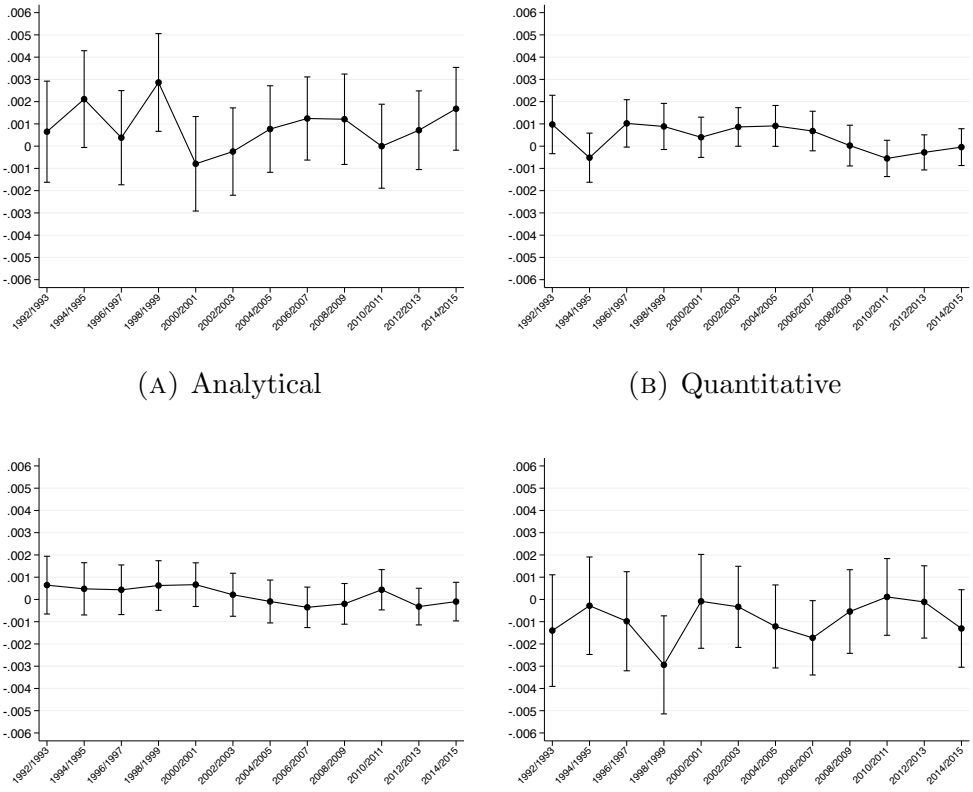
trends in educational backgrounds *amongst men in male jobs*, we find it very unlikely that occupational upgrading is at the bottom of the trend. At this time, we believe that the data best supports the notion that cultural change opened up career paths for high-achieving women who increasingly started to target traditionally male lines of work in order to maximize status and monetary returns. This cultural change did not just take place in the heads of those who pursue such careers (Goldin 2006). It also happened amongst firms and the wider public that have become more welcoming to the idea that women work in jobs that were previously in the hands of men. It would be very interesting to see research testing this theory about changes in occupational sorting in a more direct way.

Finally, we briefly raise two remaining points that we believe merit further attention in future studies. First, we showed that price factors played a large role in explaining the emerging wage gap between male and other jobs. Some of the changing price mechanics are already known in the extant literature (see e.g. Cha and Weeden (2014) on work hours). However, the trend of increasing prices in male jobs is so pervasive that it should raise our awareness. In classic studies on the gender wage gap, these price factors are interpreted as evidence for pay discrimination (Blau and Kahn 2017). In our case, talking about discrimination of individuals might not make much sense, as all are women. More fitting could be to allude to the devaluation hypothesis (England et al. 1988) which claims a structural disadvantage in female jobs due to norms that frame women's work as less valuable. Thus, it might be worthwhile to expand empirical strategies to detect devaluation, adding price factors that cannot be readily explained through other mechanisms. Second, the emerging wage inequality that we observe between women signals a somewhat ironic turn of events. While gender segregation has long been a driver of substantial inequality *between women and men*, recently

growing aspirations of women have also transformed segregation into a new source of inequality *between women*. Hence, we are interested to see if the success of women in male jobs will remain a phenomenon confined to a small "elite", or if those who are part of the elite are early-adopters in a more widespread movement towards less segregated work and more gender equality. Because although it is encouraging to see some women making progress in traditionally male lines of work, this progress, and its influence on inequality between women, could just as well be seen as a symptom of persistent gender inequality rather than its solution.

Appendix

FIGURE 4.5: Coefficients for skill types from fixed effects regression, 1992–2015: analytical, quantitative, verbal, creative



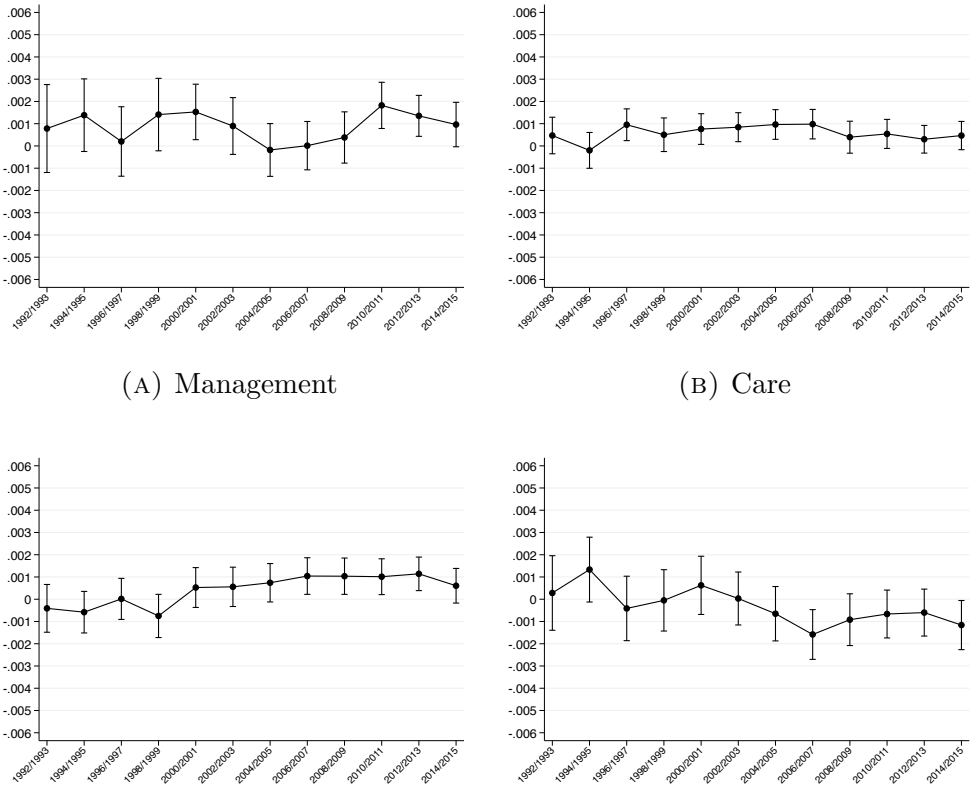
(A) Analytical

(B) Quantitative

(C) Verbal

(D) Creative

FIGURE 4.6: Coefficients for skill types from fixed effects regression, 1992–2015: management, care, computer, routine



(A) Management

(B) Care

(C) Computer

(D) Routine

Chapter 5

Conclusions

5.1 Findings

In chapter 1, I formulated two broad research questions to be addressed throughout the thesis. I briefly sum up the most central findings with respect to both of them.

> Question 1: *Are female-typed jobs paid lower wages than male-typed or gender-integrated jobs? If yes, to what extent and through which mechanisms?*

All three empirical chapters offer some insight to this first problem set. In chapter 2, I attempt to isolate the effect of occupational feminization on wages in the United States, from 1960 until 2010. There are various studies implementing a similar research design (e.g. Levanon et al. 2009) showing significant negative effects on wages. I was not able to replicate this finding. My results indicate that the devaluation of feminizing jobs was restricted to the bottom eighty percent of the wage distribution, and to the years between 1960 and 1980. Decreasing effect sizes over time made the devaluation effect diminish if not disappear completely. The largest negative effect of changes was found for jobs in the fourth wage quintile

in 1960. Hence, this is the *upper bound* for effect-sizes within the population. The size of this effect is approximately 1 percent in wages with a standardized change in the proportion of women in a job-cell.[1] Although estimated effects in the larger population are partly not trivial in size, their confidence intervals indicate that estimation involves a relatively large amount of uncertainty. Furthermore, although I speak of "effects" in chapter 2, strong causal claims are not warranted with the given research design.

In chapters 3 and 4, I extend some of the previous chapter's ideas to the German case. Germany has previously been found to exhibit comparatively small disadvantages for female or feminizing jobs (Murphy and Oesch 2016), but segregation is still rather high in international comparison (Hausmann and Kleinert 2014). Furthermore, the German case is interesting due to methodological and other substantive reasons. In chapter 3, I was able to exploit unique survey data on gender stereotyping of occupations. To my knowledge, there exists no comparable data source for any other country. The central claim throughout the chapter is that demographic accounts on sex compositions in occupations are not equal to cultural accounts on gender stereotypes in occupations (see also section 5.2.2). The latter should be more important in processes of devaluation, as these are based on cultural stigmata that can deviate from objective gender compositions in job-cells. Results of multivariate regressions with cross-sectional data show that the association between %Female and wages is indeed negative, but that this is not the case with stereotypes. However, stereotypes and wages correlate negatively in jobs with low wages, and in particular for women. For men, stereotypes are associated positively with wages above the median wage threshold. There are several take-aways from this chapter within the thesis' context.

[1] The effect size on wages for this sub-population is estimated to be about -0.25 percent, which I multiply with the within-standard deviation in percent F of 3.9 between 1960 and 1970.

First, if modeling and measurement strategies are valid, then it partly undermines the idea that stereotypical views of occupations function as a mechanism through which the proportion of women in jobs is connected with wages. In my view, this is a critical assumption of devaluation theory. Second, I show that the idea that stereotypes correlate with wages is still valid for theoretically relevant sub-populations (mostly women and low-wage jobs). Third, I concede that part of the analysis is explorative in nature because of data limitations. Although I probably capture an important part of occupational stereotypes, my measure is skewed too heavily on gendered perceptions of ability. In this way, chapter 3 questions the basic assumptions of devaluation theory in the German case, and it hopefully stimulates refined research in the same direction.

Finally, chapter 4 shows that wage disparities between male and female jobs in Germany can indeed be explained via differences in the occupations' underlying skill structure. This undermines assertive findings on devaluation in Germany based on studies with similar research designs that, yet, paid less attention to operationalizing variation in specific skills through multi-dimensional measures (Holst and Busch 2009; Murphy and Oesch 2016).

> Question 2: *Does women's occupational sorting by gender-type lead to wage inequality between women? If yes, to what extent and through which mechanisms?*

The second topical question addresses how women navigate in segregated labor markets, and how this relates to discrepancies in wages. The previous discussion has largely ignored details about group compositions and focused on occupation-level mechanisms. In chapter 4, I attempt to draw a more complete picture of segregation by asking how changing selection mechanisms into male jobs impacted

the wage distribution between women. By looking at individual- and job-level mechanisms jointly, I deliver a much broader account of how segregation and inequality are linked within the female population. Today, women in male jobs have about 30 (10) percent higher hourly wages than women in female (mixed) jobs. These *female* wage gaps have not existed some 25 years ago, and I show that they rose due to increasing cumulative advantage of women in male jobs. These advantages are cumulative because they are based on several independent mechanisms that unfolded during the same time. First, changes in educational compositions are the largest contributor to current inequality between women. Today, over fifty percent of women in male-typed jobs have a tertiary degree. Second, climbing marginal payoff to personal characteristics have played a role in furthering their advantage. This includes, e.g., the catch-up effect in East Germany, and increasing rewards for working very long hours. Third, male jobs have increasingly paid higher wages than female jobs due to their underlying skill structure. In line with previous results in the field (e.g. Liu and Grusky 2013), I found that managerial, computer, and care activities promote wages, while routine tasks result in lower remuneration. Fourth, our findings support the narrative that discrimination of token women in male jobs has declined substantially since the 1990s. This also contributed to the widening of wage gaps observed between women. Overall, the chapter shifts focus onto the growth of social inequality in the female population. There are several mechanisms at the basis of this trend, but the single most important one is the selection of highly-educated women into traditionally male lines of work.

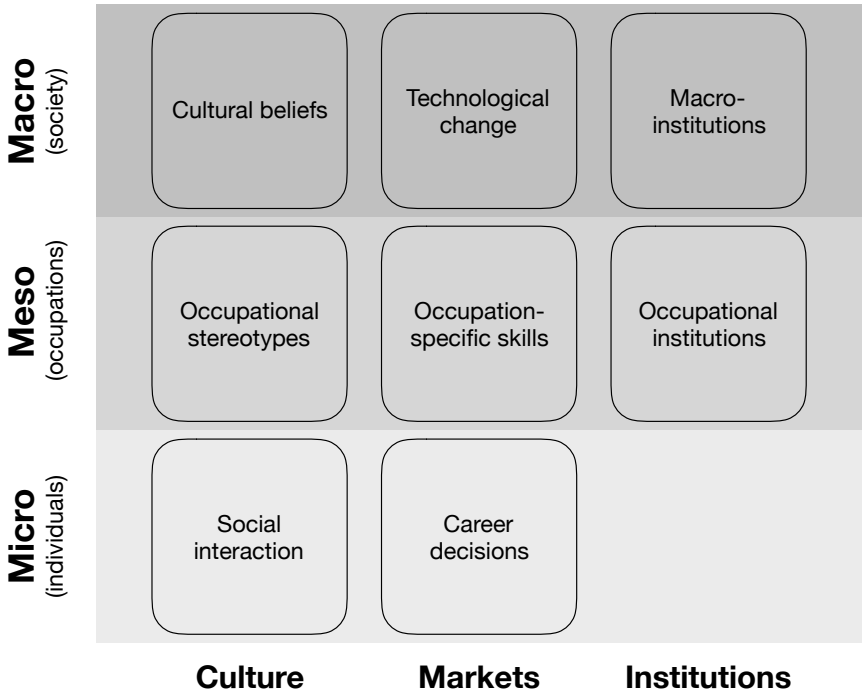
5.2 Contributions

This dissertation is centrally concerned with the question how social inequality links back to occupational gender segregation. In figure 5.1, I depict the space of variables that play a role in establishing this link. The table is a convenience tool to address findings in this dissertation and to put them into broader context; it is not designed to cover all relevant topics in the sociological literature. On the vertical axis, the figure shows the level of analysis. This includes individual, occupational, and societal variables. On the horizontal axis are topical references. Specifically, I discuss features of culture, markets, and institutions. What could be a third axis (omitted for simplicity) are the temporal dynamics at work, as changes over time were particularly important in chapters 2 and 4 of this thesis. In the following sections, I briefly discuss the topics in table 5.1 and how my research contributes to each field.

5.2.1 Social interaction

A central theme in this thesis is that cultural features in a society can be very persistent. And by extension, this makes the discrimination of women and the devaluation of female jobs persistent, too. Social psychology has laid out a convincing framework that teaches us about the micro-foundations of this persistency. At the basis of this framework are social interactions in which humans automatically, and mostly subconsciously, categorize the other by sex (Ito and Urland 2003). This leads to an activation of widely shared gender beliefs (stereotypes) that help us to coordinate amongst each other (Cuddy et al. 2007; Diekman and Eagly 2000). These gender beliefs are associated with beliefs about status, underpinning the emergence and continuance of status hierarchies (Fisk and Ridgeway

FIGURE 5.1: Exploratory variable space linking gender segregation in the labor market with social inequality



2018, 161ff.). Now, where does the persistency of discrimination stem from? First, gender status beliefs are also based on differences in resources, and resources are conversely based on status beliefs (Fisk and Ridgeway 2018, 165). This interplay between resources and cultural beliefs functions as a self-reinforcing mechanism (Ridgeway 2011, 13ff.). Second, humans are subject to confirmation bias, which means that they are more prone to accepting beliefs that confirm their status quo beliefs (Fisk and Ridgeway 2018, 165f.). Third, cultural change produces friction in social relations by undermining the common ground on which such relations are built. This makes people stick to conventional belief patterns that enable communication. Fourth, structural change requires the negotiation of a new set of beliefs to be applied to changed circumstances. However, in the light of missing institutional guidelines, humans often resort to existing beliefs which

then transfers them to the new setting (Ridgeway 2011). In this thesis, the attempt was made to incorporate these ideas into sociological research on labor market segregation. Cultural "stickiness" is an underlying problem that can stifle progress in de-segregation. This is not to say that a further integration of women and men in similar occupational fields will not eventually break common patterns of culturally infused inequality. But this process will probably be significantly harder than many would assume.

5.2.2 Occupational stereotypes

How comes that we speak of a "female" job, a "male" task or a "gender neutral" sector? Sociological debates on segregation have always relied on arguments built on notions of perceived gender of objects or activities. However, this was done more implicitly than explicitly. The debate widely ignored that gender compositions–what we can easily measure–are not the same as gender stereotypes. In chapters 2 and 3, I outlined these ideas and their underlying theoretical details.

Table 5.1 helps me to point out some practical implications for studies that are interested in occupational segregation. In principle, research can categorize occupations in two different ways, demographic or cultural. Both are legitimate concepts per se, but they each serve a different purpose. The demographic concept is best operationalized by the sex ratio within occupations, because it is most concerned with individuals' *physical sex*. Trends in this statistic are obviously determined by the in and outflow of women and men into an occupation. In chapter 3, I claimed that although people generally have an idea about the approximate sex ratios in occupations, their access to information on *precise* levels and *trends* is very limited. From a sociological standpoint, we thus must be careful when

using trend data in sex ratios as measured for occupational feminization. In my opinion, sex ratios are best used in research as a tool to describe the demographic composition of groups. This is e.g. the case in studies on sex segregation in the labor market (Blau and Kahn 2017).

TABLE 5.1: Discerning male and female jobs: the demographic and cultural approaches

	Demographic	**Cultural**
Category	sex	gender
Operationalization	sex ratio	gender stereotype
Trend	varies with in/outflow of women and men	sticky
Social relevance	mostly invisible	culturally learnt, omnipresent
Sociological relevance	aggregate measure of group composition, proxy for stereotypes	e.g. career choices, discrimination

Conversely, if we are interested in the way that segregation impacts people's decisions, then we might best look at cultural conceptions of *gender* and the gender stereotype of occupations. In this way, we take into account that individuals rely on culturally learnt gender beliefs when they make decisions (see previous section). There is a number of research strands in which this complication is relevant and yet mostly ignored via the default use of demographic sex compositions. This includes, for instance, research on career choices (e.g. Cech 2013), occupational switching (Jacobs 1989b; Chan 1999), work-time regimes (Cha 2013), or female devaluation. In these cases, the decisive force structuring social outcomes are mostly cultural features of gender segregation, shaping individual behavior or underpinning institutional setups. Of course, one could say that demographic accounts are at least reasonable approximations for cultural stereotypes and that

their use can be well justified for pragmatic reasons. Although this is true, making progress in the research on some important questions with regard to gender segregation could be tied to a more accurate conceptualization of what we mean when we speak of "male" or "female" jobs.

5.2.3 Cultural beliefs

The previous two sections include some central points about how cultural beliefs shape gender inequalities. In chapter 2, I argued that gender egalitarian values have been on the rise in the past several decades. Empirical findings on this trend are pervasive (Brewster and Padavic 2000; Ciabattari 2001; Davis and Greenstein 2009; Inglehart and Norris 2003; Knight and Brinton 2017; Lueptow et al. 2001; Mason and Lu 1988; Rindfuss et al. 1996). With that, it is logical that pay discrimination and the devaluation of female jobs would have been undermined, too. Indeed, findings in chapter 2 suggest that this is true. If such decline in devaluation had not happened, then this would have needed an additional mechanism creating gender inequality, strong enough to upset the reforming impact of changing gender norms. I am aware about a few studies that produce evidence on *increasing* devaluation effects.[2] Underlying mechanisms for this findings, are, however, less well explored. Mandel discusses several mechanisms that could have led to a *decline* in the devaluation effect (in particular Mandel 2018, 672ff.), also mentioning cultural change towards gender equality (Mandel 2013, 1186). The single argument for the *strengthening* of the devaluation effect is that women entered higher-status male jobs that were particularly susceptible to an entry of low-status female workers.[3] Although both papers present, indeed, evi-

[2]See also Levanon et al. (2009) whose results I do not further mention in this section.
[3]See also theory section chapter 2.

dence for increasing effects, this seems to stand on a relatively weak theoretical foundation. Furthermore, in chapter 2, I have found contrary evidence, singling out high-paying occupations and showing that they have not been subject to the devaluation effect at any point in time. Overall, I believe the debate on discrimination would profit from a stronger appreciation of the change in cultural beliefs that we have witnessed in many developed countries since the post-war period. Such change necessarily would have had a big impact on the way that female work is remunerated, and it would require strong countervailing forces to further increase discriminatory pressure on women.

5.2.4 Career choices

Apart from demand-side mechanisms,[4] gendered career choices are one of the main forces behind the persistence of occupational segregation. Of course, gender beliefs play an enormous role in this process because they shape individuals' views about themselves and their abilities (Cech 2013; Correll 2001, 2004). This directly connects with previous and more recent claims that the largest cause of ongoing segregation is to be found in essentialist beliefs (Charles and Grusky 2004; Levanon and Grusky 2016). Even if women proceed to follow a typically male educational degree, they are still less likely to enter a male-typed job afterwards (Shauman 2016).

Overall, we have reached a relatively good understanding of how selection into male and female jobs works. Conversely, we know much less about the outcomes of such selection in later work lives. A few interesting studies show how women and men navigate in segregated labor markets over the life-course (Jacobs 1989b;

[4] I do not discuss demand-driven factors of segregation here. Some good ideas can be found e.g. in Levanon and Grusky (2016).

Chan 1999), but recent examinations of similar ideas rare (Glass et al. 2013; Hägglund and Bächmann 2017). In chapter 4, I have discussed that this is an important field where some of our focus is required. Studies discussing the effects of segregation on individual outcomes often assume that effects are stable over time. However, I show that women have strongly adapted their job-sorting behavior, which fundamentally changed the wage structure in the female population. Furthermore, I highlighted that the distribution of unobserved factors plays a large role in determining wage outcomes for women in male-typed jobs. These are just two examples of the way that changes in occupational segregation patterns impact later career outcomes of individuals. We need to gain more insight into this topic in future research.

5.2.5 Occupation-specific skills & technological change

Studies quantifying the impact of occupation-specific skills on the wage gaps produced via segregation are not abundant. Research designs often require us to look at long time-series, which usually preempts the possibility to include detailed data on relevant skills. Murphy and Oesch (2016) acknowledge this shortcoming, devising a strategy to control for variation in the amount of job-specific training. Although this is a way to start, it ignores the diversity of skills in different fields. In chapter 4, I show that in Germany, a few types of skills (management, care, computer skills) are relatively well paid, and increasingly so, but that other skills do not have a measurable impact on wages (e.g. quantitative or verbal skills). Furthermore, there has been change in the payoff to skills, which showed to be particularly relevant to explain wage gaps between male and female jobs. Hence, what is required to properly control for variation in skills and their prices is an operationalization of different skill *types*, not just their cumulative amount.

Of course, these points are not necessarily news if we look at the literature on structural change and payoff to skills over time (Liu and Grusky 2013). Now, however, is a good time to also incorporate these findings into research on wage disparities in gender segregated markets.

5.2.6 Occupational institutions

One topic that has received little attention in this thesis is the role that occupation-level institutions play in shaping inequalities between male and female-typed jobs. In general, when attempting to dissect the causal mechanisms through which segregation produces social inequalities, then we should pay more attention to social closure mechanisms. At the basis of social closure theory is the rent-seeking behavior of groups via non-market based regulation of occupational demand and supply (Sørensen 1996; Weeden 2002). One of the restrictions to model closure-based mechanisms is the lack of data on different channels of closure. Hence, this feature of social inequality is mostly ignored in the studies quoted throughout my empirical chapters. In table 5.2, I depict data by Weeden (2002) on the bi-variate cross-correlations between the percentage of women and closure variables on the occupational level. Although %Female does not correlate very highly with closure variables, I think there are a few interesting points to mention: First, educational credentialing has been and will be very important in female-typed occupations. In particular, women's outperformance of men with respect to educational attainment, and the feminization of some professional jobs has strengthened the link between credentialing and segregation. One of the main mechanisms through which women were able to raise their income was, hence, their increased educational levels. In fact, this trend explains a large proportion of the decreasing correlation between the percentage of women in jobs and their wages (Mandel

2013, 2018). Beyond credentialing and the productive value of education, Mandel (2018) argues that women's high educational standards can also decrease gender discrimination at work. This is a) because women will be seen as more competent over time as stereotypes of inferior ability will disappear with women's strong results in formal education, and b) because credentials-based recruiting standards in the professions will undermine suspicions that women are less productive (Ibd., 673).

TABLE 5.2: Cross-correlations of percent Female and closure variables

	1	2	3	4	5	6
1. %Female	1.00					
2. Licensing	0.06	1.00				
3. Educ. credentialing	0.23	0.48	1.00			
4. Volunt. certification	0.07	0.26	0.29	1.00		
5. Assoc. representation	−0.01	0.26	0.49	0.35	1.00	
6. Unionization	−0.18	0.01	−0.11	−0.12	−0.06	1.00

Source: Weeden (2002, 76)

Second, although the effect of licensing on wages is a contested issue (Bol and Weeden 2015; Redbird 2017; Weeden 2002), we should consider that female jobs are often protected by licenses. In the United States, regulation through licensing has increased since the early 1980s in particular in a few professional fields where women have strongly increased their incumbency (Redbird 2017, 2). To my knowledge, the effect of this change on wage gaps is largely unknown. Third, the fact that unionization rates are particularly high in male-typed craft and industrial jobs is well-known. Data on union membership is more widely available than on licenses, but their use in research on segregation is still not too common. Murphy and Oesch (2016) are an exception, although they do not find that union membership can explain lower wages in female-typed jobs. Overall,

closure mechanisms are a potential source of inequality between occupations. Their absence in the models of my empirical chapters are a weakness of this thesis.

5.2.7 Macro-institutions

The last point in this larger section is about institutional settings on the macro-level. Political and economic institutions not only affect women's propensity to be economically active, but also their tendency to work in specific sectors (Mandel and Semyonov 2006). To my knowledge, Murphy and Oesch (2016) provide the only study that makes systematic predictions about the devaluation effect in different institutional settings. Their idea is that coordinated market-economies, with stronger regulation and coordination of wages, will diminish de-valuing effects on wages (Ibd., 6f.), which is confirmed in their results. However, this analysis does not go very far to test such institutional effects. Mandel and Semyonov (2006) deliver several additional ideas how segregation itself is shaped by the state's intervention as a provider of regulatory policy and as an employer. One of the main paradoxes in macro-level analyses of policy and segregation is that policies deemed as most progressive and gender-egalitarian often produce the strongest levels of segregation. Expansive family policies increase women's propensity to enter the labor market (Esping-Andersen 1999; Korpi 2000; Mandel and Semyonov 2006), which is also true for large public employment sectors (Kolberg 1991; Mandel and Semyonov 2006). On the other hand, the state's intervention often promotes women's sorting into lower-authority positions in particularly female-typed jobs (Mandel and Semyonov 2006). This must have a large effect on social outcomes between genders and between male- and female-typed jobs: Clearly, if segregation is larger, then the devaluation of women's work has a big-

ger aggregate effect in society. Furthermore, women "being stuck" in service and semi-professional jobs in the public sector are less likely to repeat recent advances of women into the professions that have proven to be an important entry point for women into high-salary and status jobs. Potential to address these issues in the future truly lies in cross-country research or discontinuity designs that leverage variation in political-institutional contexts.

5.3 Going forward

In the final part of this thesis, I look forward to evaluate the prospects of a few central issues that have emerged in the previous chapters. This includes topics that are important to understand where research is headed, and how segregation can change in the future.

5.3.1 Devaluation theory: under construction

With the framing of devaluation as "a new doctrine of sex discrimination" (England and Norris 1985), research in this area made its moral claims clear early on. However, to evolve as a broader scientific strand, some fundamental questions with respect to its conceptual basis, real-world implications, and underlying mechanisms had to – and still have to be – answered. A central problem within the field is the estimation of causal effects. This is an obvious shortcoming which partly is due to data limitations. Occupational devaluation is a process that works over decades and looking at short time intervals will probably not yield very strong results (England et al. 2007). Hence, researchers have often chosen to look at long time-series data (Levanon et al. 2009; Mandel 2018), which often precludes having a larger quantity of control variables. Even standard measures

in labor market studies (e.g. labor market experience) are sometimes missing from research designs, not to speak of less available observed or even unobserved variables. Adding to this lack of control variables, questions of bi-directional causality complicated causal reasoning. This led to the use of dynamic regression models that were employed to solve this problem, yet relying on statistical techniques that are often quite sensitive to endogeneity and specific details about their implementation (Karlin et al. 2002; England et al. 2007; Levanon et al. 2009; Mandel 2018).

Experimental research designs in the field are rare, but they show promise in offering causal explanations: For instance, Doering and Thébaud (2017) provide experimental evidence on the micro-mechanics of devaluation, and Auspurg et al. (2017) apply a multifactorial survey design showing the bias in fair-pay evaluations towards men and women. There is certainly room to further exploit such causal designs, and researchers seem increasingly enthusiastic to do so.

The second big question faced by the proponents of devaluation theory is the clarification of its conceptual basis. Chapter 1 of this thesis has explored this problem in detail, but I also want to raise it in a specific context: Devaluation theory is based on cultural mechanisms, making it very attractive for application in culturally differentiated contexts. But this requires a careful conceptualization of culturally induced mechanisms and cross-cultural variation. After all, "the social structure of gender is virtually always specific to a particular societal and historical context" (Ridgeway 2011, 7). Recent studies, in particular presenting European data, have barely shown any interest to pick up this debate. A few of them briefly discuss cultural mechanisms between countries (e.g. Murphy and Oesch 2016, 6), but this does not go very far.[5] In this sense, these studies have

[5]Murphy and Oesch (2016) state that "rather than ideology, [they] expect institutions, and

been both, interesting applications of the devaluation hypothesis in a new context, and a missed chance to critically advance our knowledge in the field. It would be interesting to see future research addressing these concerns.

5.3.2 Work & family

The work-family conflict features prominently in the debate on segregation. Future advances of women in the world of paid work will certainly require that this conflict is attenuated, but the pathway towards this goal is less obvious. In essence, the tension between work and family arises due to limited time budgets: we can only do one thing at a time, care for the family or be productive at work (Coser 1974). And despite ongoing change, women still carry most of the burden to decide for one or the other (Sullivan et al. 2018). Early on, women's involvement in the household and family were identified as a key force behind their reluctance to select into jobs that require long work-hours (Hochschild 1989) and low frequencies of career interruptions (Becker 1964). Several studies have confirmed that particularly "greedy" work arrangements, that require a complete devotion of time, have a substantial part in stifling the career advancement of women (Bianchi et al. 2000; Epstein et al. 1999; Stone 2007). Women's retention rate is particularly low in male-typed jobs requiring long work hours (Cha 2013). This problem has intensified over the second half of the 20th century as the rate of very long work hours went considerably up (Jacobs and Gerson 2004; Kuhn and Lozano 2008).

It almost seems like having a family and working successfully is an impossible thing for women. So what can we hope for? Three things: First, work in

notably the extent of coordination in wage-setting institutions, to be more consequential for the impact that gender devaluation may have on wages" (p. 6).

the family is nowadays more equally distributed between woman and man (Gershuny 2000). Hook (2006) analyzes 20 countries from the early 1960s to the 2000s, estimating that men's contribution in diverse work in the family (household, child caring, shopping, etc.) increased from 20 percent to about 35 percent. Although some scholars have expressed their doubts about recent and future trends of further convergence, it is plausible that change continues, even if at a slower rate (Sullivan et al. 2018). Hence, the basis of fundamental differences between women's and men's ability to commit to work is slowly eroding. Second, occupations can adapt to accommodate workers who are less able to devote very long hours to work. In their remarkable case study, Goldin (2006) show how the pharmacy sector has slowly changed to become a very gender-equal domain where wages between men and women are very similar, employees are flexible to work shorter hours, and part-time work is not penalized nearly as much as in other jobs. Of course, part-time work as a model *within a restricted set of occupations* is no means to decrease segregation. However, it is important to acknowledge that flexible work regimes in specialized high-skill and high-status jobs are key to decrease the tension between career and family goals for women and men alike (Yu and Kuo 2017). Third and lastly, policy. Programs that increase the availability of childcare and lower their cost are generally believed to activate women for paid work (Blau and Currie 2006). Furthermore, early childhood interventions have positive effects on the social outcomes of children, in particular for those from disadvantaged households (Heckman et al. 2013). Once again, which one of these options people prefer strongly depends on their cultural beliefs. While out-sourcing childcare to service providers might be efficient in many cases, this is not a widely accepted model in rather traditionally leaning societies. In these cases, work sharing between women and men in the household seems to be the

most promising way to contribute to de-segregation in the labor market, and to avoid further wage discrepancies between the genders.

5.3.3 The future of segregation

Much scholarship is concerned with the trends in segregation, and its persistence over time. This is, of course, critical within this dissertation that looks at the social and economic outcomes of segregation. If we credibly could predict that much of today's segregation would vanish over the next several decades, then many of the identified problems that derive from it would be solved, too. So where do we stand and what can be expected in the future? To answer this question, I do not provide critical new evidence, but I raise a few points that merit some attention: Segregation is not governed by a single mechanism that would support or throttle further convergence between the sorting of women and men into jobs. It is more accurate to think of de-segregation as an aggregate outcome of various, partly independent, partly intertwined mechanisms that can evolve at different times. Each mechanism has a given potential to spur further de-segregation, but none of them will do the job on their own. In order to facilitate an evaluation of how such mechanisms will contribute to de-segregation, I classify them into three groups:

First, some mechanisms are based on one-off historical events that led to de-segregation in the past, but that promise little potential for further de-segregation in the future. These mechanisms can be viewed as singular external shocks, having a contemporaneous and partly lagged effect. But despite their initial impact, they depleted most of their potential to lead to further progress by themselves. The introduction of the contraceptive "pill" can be thought of such an external shock. In the United States, the pill was introduced in 1960 and access to it

was further facilitated through legislation up to the early 1970s. This had a profound impact on women's labor supply and career planning (Goldin 2006, 14). There is no reason to believe that there will another invention in birth-control that would have a similar impact on the way women and couples can negotiate the conflict between work and family. Another example is the passage of public policy that was directed towards eliminating gender discrimination in hiring and employment. A major milestone in the U.S., for instance, was the passage of the 1964 Civil Rights Act, that ruled illegal many discriminatory standards in law, public regulation, and company practices (Reskin and Hartmann 1986, 44ff.). While this must have had a important impact on segregation, I believe that these effects have faded out over time. In other words, we should not expect further de-segregation due to the passage of laws some fifty years ago. Another source of de-segregation that may also have had its largest effect *in the past*, is women's increasing success in education. Previous studies found that the emergence of highly educated cohorts of women contributed much to de-segregation in the 1970s and 1980s, but that this was not much the case thereafter (Blau et al. 2013). Women have already out-performed men with respect to education since the 1980s (England and Li 2006), and this strongly limits the potential that increasing educational performances of women have on de-segregation. Overall, my argument here is that there have been singular events or trends in past decades that markedly changed the segregated landscape of jobs. The effect of these phenomena, however, should not be expected to last much longer than a few years after the fact. Further progress towards de-segregation, hence, must be achieved through other channels.

Second, there are mechanisms working on a more permanent basis, and, in my view, several of them promise further potential to decrease segregation. These

mechanisms include the change in broad gender beliefs that, as I discussed earlier, underly social interactions as a primary frame (Ridgeway 2011). Although, we have seen strong upward trends in gender-egalitarian values over the 20th century (Davis and Greenstein 2009), there are persistent views that women should earn less money, all else being equal (Auspurg et al. 2017). This still hinders women from being successful in positions of high authority, pay, and status. Furthermore, gender-essentialism and gendered self-expressions continue to be a major source of differentiation when it comes to horizontally segregated patterns of career choice (Cech 2013; Charles and Grusky 2004; Levanon and Grusky 2016). Despite progress in the past with respect to both attitudinal dimensions, vertical and horizontal, there remains potential for cultural change to impact the degree of segregation. Furthermore, de-segregation in education, the household, and in employment, has mostly been achieved by women's behavioral changes (Blau et al. 2013; England and Li 2006; Sullivan et al. 2018; Torre 2018). Men, on the other hand, have been much less inclined to pick up tasks, paid or unpaid, that are traditionally female-typed. It is difficult to imagine at this point through which channels men will be stimulated to contribute more to a decline in segregation, but it appears that there is much untapped potential for further behavioral changes on their part.

Third and last, there are mechanisms that are not yet in place, but that might change patterns of occupational segregation *in the future*. Obviously, it is very hard to predict the birth of events that will at some point fundamentally change social structure. Yet, one hotly debated issue that could well qualify as such an event is the emergence of advanced automated systems (artificial intelligence) to substitute a very wide spectrum of jobs. Up until now, computerized systems were mostly used in routine task-settings, which already had massive effects on

employment (Autor and Dorn 2013; Autor et al. 2003; Goos and Manning 2007). However, due to further technological advances, it is likely that many of the so far non-computerizable jobs will come under pressure from machines, too. Frey and Osborne (2017) estimate that within the next several decades, 47 percent of jobs in the United States are at risk of automation.[6] Crucially, the potential to automate a job depends on its underlying task requirements. Due to the complexity of stating and programming the process leading to creativity and social intelligence, for instance, it will remain a very difficult endeavor to teach machines how to fulfill creative and social tasks (Frey and Osborne 2017, 262). Although Frey and Osborne (2017) predict the larger job groups under risk of automation, they remain silent about potential effects on segregation. I fill this gap by providing a brief analysis of predicted probabilities of automation by gender and by the gender type of jobs.[7] I find that although mean probabilities of computerization are very similar between women and men, male jobs are under a slightly larger threat of automation than female and mixed jobs. This is a relatively crude analysis, but it underlines the potential of technological advances to undermine the current state of segregation in fundamental way.

Summing up, my main argument is that segregation has always been the product of multiple causal effects. Speaking of "the" gender revolution evokes the idea that de-segregation is governed by a single force that may either facilitate or hinder progress to be made. Contrary to that, I describe de-segregation as a multi-pronged process. The apparent stall in the way towards further de-segregation fits into the picture if we acknowledge that the second half of the 20th century

[6]The authors make no predictions about exact timing of such changes. Furthermore, they estimate the potential for jobs to replace jobs, not the actual event of job replacement. There are many reasons why a job would not be automated, even if technologically possible, e.g. government regulation geared to prevent job loss.

[7]I extract Frey and Osborne's probabilities of computerization by occupation and merge them with data from the 2010 to 2014 American Community Survey (ACS).

has seen a few historical events or trends that had a strong and unique impact on segregation in the 1970s and 1980s. However, these events should not be expected to give impetus for further change. Such change is thus dependent on the continuing force of broad societal change, and the unfolding of new social forces that undermine segregation.

Bibliography

Acemoglu, Daron and James A. Robinson. 2012. *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*. London: Profile Books.

Albrecht, Stan L, Howard M Bahr, and Bruce A Chadwick. 1977. "Public stereotyping of sex roles, personality characteristics, and occupations." *Sociology & Social Research* 61:223–240.

Allison, Paul D. 2009. *Fixed effects regression models*. Thousand Oaks, CA: SAGE Publications.

Alwin, Duane F and Jon A Krosnick. 1991. "Aging, cohorts, and the stability of sociopolitical orientations over the life span." *American Journal of Sociology* 97:169–195.

Auspurg, Katrin, Ksenija Gatskova, and Thomas Hinz. 2013. "Vorstellungen von Lohngerechtigkeit in West-und Ostdeutschland und in der Ukraine." *WSI-Mitteilungen* 66:77–88.

Auspurg, Katrin, Thomas Hinz, and Carsten Sauer. 2017. "Why Should Women Get Less? Evidence on the Gender Pay Gap from Multifactorial Survey Experiments." *American Sociological Review* 82:179–210.

Autor, D. and D. Dorn. 2013. "The growth of low skill service jobs and the polarization of the US labor market." *American Economic Review* 103:1553–1597.

Autor, David H, Frank Levy, and Richard J Murnane. 2003. "The skill content of recent technological change: An empirical exploration." *The Quarterly Journal of Economics* 118:1279–1333.

Becker, Gary S. 1964. *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. New York, NY: National Bureau of Economic Research.

Beggs, Joyce M and Dorothy C Doolittle. 1993. "Perceptions now and then of occupational sex typing: A replication of Shinar's 1975 study." *Journal of Applied Social Psychology* 23:1435–1453.

Bell, Linda. 2005. "Women-led firms and the gender gap in top executive jobs." Discussion Paper No. 1689, IZA Institute of Labor Economics.

Berger, Joseph, Hamit Fisek, Robert Z. Norman, and Morris Zelditch. 1977. *Status characteristics and social interaction: An expectation-states approach*. New York: Elsevier.

Bergmann, Barbara R. 1974. "Occupational segregation, wages and profits when employers discriminate by race or sex." *Eastern Economic Journal* 1:103–110.

Bertrand, Marianne and Sendhil Mullainathan. 2004. "Are Emily and Greg more employable than Lakisha and Jamal? A field experiment on labor market discrimination." *The American Economic Review* 94:991–1013.

Bianchi, S. M., M. A. Milkie, L. C. Sayer, and J. P. Robinson. 2000. "Is Anyone Doing the Housework? Trends in the Gender Division of Household Labor." *Social Forces* 79:191–228.

Blalock, Hubert M. 1967. *Toward a theory of minority-group relations*. New York: Wiley.

Blau, David and Janet Currie. 2006. "Chapter 20 Pre-School, Day Care, and After-School Care: Who's Minding the Kids?" In *Handbook of the Economics of Education*, pp. 1163–1278. Elsevier.

Blau, Francine D., Mary C. Brinton, and David B. Grusky. 2006. *The declining significance of gender?* New York: Russell Sage Foundation.

Blau, Francine D., Peter Brummund, and Albert Yung-Hsu Liu. 2013. "Trends in occupational segregation by gender 1970–2009: Adjusting for the impact of changes in the occupational coding system." *Demography* 50:471–492.

Blau, Francine D. and Jed DeVaro. 2007. "New evidence on gender differences in promotion rates: An empirical analysis of a sample of new hires." *Industrial Relations: A Journal of Economy and Society* 46:511–550.

Blau, Francine D. and Lawrence M. Kahn. 1997. "Swimming Upstream: Trends in the Gender Wage Differential in the 1980s." *Journal of Labor Economics* 15:1–42.

Blau, Francine D. and Lawrence M. Kahn. 2017. "The gender wage gap: Extent, trends, and explanations." *Journal of Economic Literature* 55:789–865.

Bohan, Janis S. 1993. "Essentialism, constructionism, and feminist psychology." *Psychology of women quarterly* 17:5–21.

Bol, Thijs and Kim A Weeden. 2015. "Occupational closure and wage inequality in Germany and the United Kingdom." *European Sociological Review* 31:354–369.

Bolzendahl, Catherine I and Daniel J Myers. 2004. "Feminist attitudes and support for gender equality: Opinion change in women and men, 1974–1998." *Social Forces* 83:759–789.

Brewster, Karin L. and Irene Padavic. 2000. "Change in Gender-Ideology, 1977–1996:The Contributions of Intracohort Change and Population Turnover." *Journal of Marriage and Family* 62:477–487.

Brynin, Malcolm and Francisco Perales. 2016. "Gender Wage Inequality: The De-gendering of the Occupational Structure." *European Sociological Review* 32:162–174.

Budig, Michelle J. 2002. "Male Advantage and the Gender Composition of Jobs: Who Rides the Glass Escalator?" *Social Problems* 49:258–277.

Budig, Michelle J and Melissa J Hodges. 2010. "Differences in disadvantage variation in the motherhood penalty across white women's earnings distribution." *American Sociological Review* 75:705–728.

Bundesanstalt für Arbeit. 1988. *Klassifizierung der Berufe - Systematisches und alphabetisches Verzechnis der Berufsbenennungen*. Nuremberg: Bundesanstalt für Arbeit.

Busch, Anne. 2013. "Der Einfluss der beruflichen Geschlechtersegregation auf den "Gender Pay Gap"." *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie* 65:301–338.

Busch, Felix. 2018. "Occupational Devaluation Due to Feminization? Causal Mechanics, Effect Heterogeneity, and Evidence from the United States, 1960 to 2010." *Social Forces* 96:1351–1376.

Buss, David M and Douglas T Kenrick. 1998. "Evolutionary social psychology." In *The handbook of social psychology*, edited by D. T. Gilbert, S. T. Fiske, and G. Lindzey, volume 2, pp. 982–1026. Bosten: McGraw-Hill, 4th edition.

Cech, E. A. 2013. "Ideological Wage Inequalities? The Technical/Social Dualism and the Gender Wage Gap in Engineering." *Social Forces* 91:1147–1182.

Cejka, Mary Ann and Alice H Eagly. 1999. "Gender-stereotypic images of occupations correspond to the sex segregation of employment." *Personality and Social Psychology Bulletin* 25:413–423.

Cha, Youngjoo. 2013. "Overwork and the persistence of gender segregation in occupations." *Gender & Society* 27:158–184.

Cha, Youngjoo and Kim A. Weeden. 2014. "Overwork and the Slow Convergence in the Gender Gap in Wages." *American Sociological Review* 79:457–484.

Chan, Tak Wing. 1999. "Revolving Doors Reexamined: Occupational Sex Segregation over the Life Course." *American Sociological Review* 64:86.

Charles, Maria and Karen Bradley. 2009. "Indulging our gendered selves? Sex segregation by field of study in 44 countries." *American Journal of Sociology* 114:924–976.

Charles, Maria and David B Grusky. 2004. *Occupational ghettos: The worldwide segregation of women and men*. Stanford, CA: Stanford University Press Stanford, CA.

Ciabattari, Teresa. 2001. "Changes in Men's Conservative Gender Ideologies: Cohort and Period Influences." *Gender & Society* 15:574–591.

Clogg, Clifford C, Eva Petkova, and Adamantios Haritou. 1995. "Statistical methods for comparing regression coefficients between models." *American Journal of Sociology* 100:1261–1293.

Cohen, Lisa E, Joseph P Broschak, and Heather A Haveman. 1998. "And Then There were More? The Effect of Organizational Sex Composition on the Hiring and Promotion of Managers." *American Sociological Review* 63:711–727.

Correll, Shelley J. 2001. "Gender and the career choice process: the role of biased self-assessments." *American Journal of Sociology* 106:1691–1730.

Correll, Shelley J. 2004. "Constraints into Preferences: Gender, Status, and Emerging Career Aspirations." *American Sociological Review* 69:93–113.

Coser, Lewis. 1974. *Greedy Institutions: Patterns of Undivided Commitment*. New York, NY: Free Press.

Cotter, David A., Joan M. Hermsen, and Reeve Vanneman. 2004. "Gender Inequality at Work." In *The American People: Census 2000*, edited by Reynolds Farley and John Haaga, pp. 107–138. New York, NY: Russell Sage Foundation.

Cuddy, Amy J. C., Susan T. Fiske, and Peter Glick. 2007. "The BIAS map: Behaviors from intergroup affect and stereotypes." *Journal of Personality and Social Psychology* 92:631–648.

Davis, Shannon N. and Theodore N. Greenstein. 2009. "Gender Ideology: Components, Predictors, and Consequences." *Annual Review of Sociology* 35:87–105.

de Ruijter, Judith MP, Anneke van Doorne-Huiskes, and Joop J Schippers. 2003. "Size and Causes of the Occupational Gender Wage-gap in the Netherlands." *European Sociological Review* 19:345–360.

Diekman, Amanda B. and Alice H. Eagly. 2000. "Stereotypes as dynamic constructs: Women and men of the past, present, and future." *Personality and social psychology bulletin* 26:1171–1188.

Doering, Laura and Sarah Thébaud. 2017. "The Effects of Gendered Occupational Roles on Men's and Women's Workplace Authority: Evidence from Microfinance." *American Sociological Review* 82:542–567.

Dovidio, John F and Samuel L Gaertner. 2010. "Intergroup Bias." In *Handbook of Social Psychology. Vol. 2.*, edited by Susan T. Fiske, Daniel T. Gilbert, and Gardner Lindzey, pp. 1084–1121. John Wiley & Sons.

Duncan, Otis Dudley and Beverly Duncan. 1955. "A Methodological Analysis of Segregation Indexes." *American Sociological Review* 20:210.

Eagly, Alice H. 1987. *Sex differences in social behavior: A social-role interpretation*. Hillsdale, NJ: Lawrence Erlbaum.

Eagly, Alice H, Wendy Wood, and Amanda B Diekman. 2000. "Social role theory of sex differences and similarities: A current appraisal." In *The developmental psychology of gender*, edited by T. Eckes and H. M. Trautner. Mahwah, NJ: Lawrence Erlbaum.

Ehrenberg, Ronald G, George H Jakubson, Mirinda L Martin, Joyce B Main, and Thomas Eisenberg. 2012. "Diversifying the faculty across gender lines: Do trustees and administrators matter?" *Economics of Education Review* 31:9–18.

England, Paula. 1992. *Comparable Worth: Theories and Evidence*. New York: de Gruyter.

England, Paula. 2010. "The gender revolution: Uneven and stalled." *Gender & Society* 24:149–166.

England, Paula, Paul Allison, and Yuxiao Wu. 2007. "Does bad pay cause occupations to feminize, Does feminization reduce pay, and How can we tell with longitudinal data?" *Social Science Research* 36:1237–1256.

England, Paula, George Farkas, Barbara Stanek Kilbourne, and Thomas Dou. 1988. "Explaining occupational sex segregation and wages: Findings from a model with fixed effects." *American Sociological Review* 53:544–558.

England, Paula and Su Li. 2006. "Desegregation stalled: The changing gender composition of college majors, 1971-2002." *Gender & Society* 20:657–677.

England, Paula and Bahar Norris. 1985. "Comparable worth: a new doctrine of sex discrimination." *Social Science Quarterly* 66:629–643.

Epstein, Cynthia Fuchs. 2007. "Great Divides: The Cultural, Cognitive, and Social Bases of the Global Subordination of Women." *American Sociological Review* 72:1–22.

Epstein, Cynthia F, Carroll Seron, Bonnie Oglensky, and Robert Saute. 1999. *The part-time paradox: time norms, professional lives, family, and gender*. New York, London: Routledge.

Erikson, Robert and John H Goldthorpe. 1992. *The Constant Flux: A Study of Class Mobility in Industrial Societies*. Oxford: Oxford University Press.

Esping-Andersen, Gøsta. 1999. *The Three Worlds of Welfare Capitalism*. New York, NY: Oxford University Press.

Executive Office of the President of the United States, Office of Management and Budget. 2018. *Standard Occupational Classification Manual 2018*.

Fernández-Macías, Enrique. 2012. "Job Polarization in Europe? Changes in the Employment Structure and Job Quality, 1995-2007." *Work and Occupations* 39:157–182.

Firpo, Sergio, Nicole M Fortin, and Thomas Lemieux. 2009. "Unconditional quantile regressions." *Econometrica* 77:953–973.

Fisk, Susan R. and Cecilia L. Ridgeway. 2018. "Framing Gender." In *Handbook of the Sociology of Gender*, edited by Barbara J. Risman, Carissa M. Froyum, and William J. Scarborough, pp. 157–171. Cham: Springer.

Fiske, Susan T. 1998. "Stereotyping, Prejudice and Discrimination." In *Handbook of Social Psychology*, edited by D. T. Gilbert, S. T. Fiske, and G. Lindzey. New York: McGraw-Hill.

Frey, Carl Benedikt and Michael A. Osborne. 2017. "The future of employment: How susceptible are jobs to computerisation?" *Technological Forecasting and Social Change* 114:254–280.

Gangestad, Steven W and Jeffry A Simpson. 2000. "The evolution of human mating: Trade-offs and strategic pluralism." *Behavioral and brain sciences* 23:573–587.

Gerhart, Barry and Nabil El Cheikh. 1991. "Earnings and percentage female: A longitudinal study." *Industrial Relations: A Journal of Economy and Society* 30:62–78.

Gershuny, J. I. 2000. *Changing Times: Work and Leisure in Postindustrial Society*. Oxford: Oxford University Press.

Glass, Jennifer L, Sharon Sassler, Yael Levitte, and Katherine M Michelmore. 2013. "What's So Special about STEM? A Comparison of Women's Retention in STEM and Professional Occupations." *Social Forces* 92:723–756.

Goldin, Claudia. 2006. "The quiet revolution that transformed women's employment, education, and family." *American Economic Review* 96:1–21.

Goldin, Claudia Dale and Lawrence F Katz. 2009. *The race between education and technology*. Cambridge: Harvard University Press.

Goos, Maarten and Alan Manning. 2007. "Lousy and lovely jobs: The rising polarization of work in Britain." *The Review of Economics and Statistics* 89:118–133.

Greenwald, Anthony G and Mahzarin R Banaji. 1995. "Implicit social cognition: attitudes, self-esteem, and stereotypes." *Psychological Review* 102:4.

Greenwald, Anthony G, T Andrew Poehlman, Eric Luis Uhlmann, and Mahzarin R Banaji. 2009. "Understanding and using the Implicit Association Test: III. Meta-analysis of predictive validity." *Journal of personality and social psychology* 97:17.

Grönlund, Anne and Charlotta Magnusson. 2013. "Devaluation, crowding or skill specificity? Exploring the mechanisms behind the lower wages in female professions." *Social science research* 42:1006–1017.

Grusky, David B. and Jesper B. Sørensen. 1998. "Can Class Analysis Be Salvaged?" *American Journal of Sociology* 103:1187–1234.

Gupta, Nabanita Datta, Ronald L. Oaxaca, and Nina Smith. 2006. "Swimming Upstream, Floating Downstream: Comparing Women's Relative Wage Progress in the United States and Denmark." *ILR Review* 59:243–266.

Hägglund, Anna Erika and Ann-Christin Bächmann. 2017. "Fast lane or down the drain? Does the occupation held prior to unemployment shape the transition back to work?" *Research in Social Stratification and Mobility* 49:32–46.

Hakim, Catherine. 1994. "A century of change in occupational segregation 1891–1991." *Journal of Historical Sociology* 7:435–454.

Hall, Anja, Anke Siefer, and Michael Tiemann. 2015. *BIBB/BAuA Employment Survey of the Working Population on Qualification and Working Conditions in Germany 2012*. Bonn: BIBB, Federal Institute for Vocational Education and Training.

Hanson, Sandra L. 1996. *Lost Talent: Women in the Sciences*. Philadelphia: Temple University Press.

Hausmann, Ann-Christin and Corinna Kleinert. 2014. "Berufliche Segregation auf dem Arbeitsmarkt: Maänner- und Frauendomänen kaum verändert." IAB-Kurzbericht 9/2014, Institut für Arbeitsmarkt- und Berufsforschung (IAB), Nürnberg.

Hausmann, Ann-Christin, Corinna Kleinert, and Kathrin Leuze. 2015a. "Entwertung von Frauenberufen oder Entwertung von Frauen im Beruf?" *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie* 67:217–242.

Hausmann, Ann-Christin, Aline Zucco, and Corinna Kleinert. 2015b. "Berufspanel für Westdeutschland 1976-2010 (OccPan). Dokumentation zur Erstellung und Anonymisierung." FDZ-Methodenreport, Bundesagentur für Arbeit.

Heckman, James, Rodrigo Pinto, and Peter Savelyev. 2013. "Understanding the Mechanisms Through Which an Influential Early Childhood Program Boosted Adult Outcomes." *American Economic Review* 103:2052–2086.

Hochschild, Arlie Russell. 1989. *The Second Shift: Working Parents and the Revolution at Home*. New York, NY: Viking.

Hofmann, Wilhelm, Bertram Gawronski, Tobias Gschwendner, Huy Le, and Manfred Schmitt. 2005. "A meta-analysis on the correlation between the Implicit Association Test and explicit self-report measures." *Personality and Social Psychology Bulletin* 31:1369–1385.

Holst, Elke and Anne Busch. 2009. "Der "Gender Pay Gap" in Führungspositionen der Privatwirtschaft in Deutschland." SOEPpapers on Multidisciplinary Panel Data Research No. 169, DIW Berlin.

Hook, J. L. 2006. "Care in Context: Men's Unpaid Work in 20 Countries, 1965–2003." *American Sociological Review* 71:639–660.

Hout, Michael. 2018. "Americans' occupational status reflects the status of both of their parents." *Proceedings of the National Academy of Sciences* 115:9527–9532.

Hunt, Jennifer. 2016. "Why do women leave science and engineering?" *ILR Review* 69:199–226.

Inglehart, Ronald and Pippa Norris. 2003. *Rising tide: Gender equality and cultural change around the world*. New York: Cambridge University Press.

Ito, T A and G R Urland. 2003. "Race and gender on the brain: Electrocortical measures of attention to the race and gender of multiply categorizable individuals." *Journal of Personality and Social Psychology* 85:616–626.

Jacobs, Jerry A. and Kathleen Gerson. 2004. *The time divide: Work, family, and gender inequality*. Cambridge, MA: Harvard University Press.

Jacobs, Jerry A. 1989a. "Long-Term Trends in Occupational Segregation by Sex." *American Journal of Sociology* 95:160–173.

Jacobs, Jerry A. 1989b. *Revolving Doors: Sex Segregation and Women's Careers*. Stanford, CA: Stanford University Press.

Jacobs, Jerry A. 1999. "The sex segregation of occupations: Prospects for the 21st century." In *Handbook of gender and work*, pp. 125–144. Newbury Park, CA: Sage Publications.

Janssen, Simon and Uschi Backes-Gellner. 2016. "Occupational Stereotypes and Gender-Specific Job Satisfaction." *Industrial Relations* 55:71–91.

Jasso, Guillermina and Murray Webster Jr. 1997. "Double standards in just earnings for male and female workers." *Social Psychology Quarterly* 60:66–78.

Jonsson, Jan O., David B. Grusky, Matthew Di Carlo, Reinhard Pollak, and Mary C. Brinton. 2009. "Microclass Mobility: Social Reproduction in Four Countries." *American Journal of Sociology* 114:977–1036.

Juhn, Chinhui, Kevin M Murphy, and Brooks Pierce. 1991. "Accounting for the slowdown in black-white wage convergence." In *Workers and Their Wages. Changing Patterns in the United States*, edited by Marvin H Kosters, pp. 107–143. Washington, D.C.: AEI Press.

Karlin, Carolyn Aman, Paula England, and Mary Richardson. 2002. "Why Do" Women's Jobs" Have Low Pay for Their Educational Level?" *Gender Issues* 20:3–22.

Kennison, Shelia M and Jessie L Trofe. 2003. "Comprehending pronouns: A role for word-specific gender stereotype information." *Journal of Psycholinguistic Research* 32:355–378.

Kilbourne, Barbara, Paula England, and Kurt Beron. 1994a. "Effects of individual, occupational, and industrial characteristics on earnings: Intersections of race and gender." *Social Forces* 72:1149–1176.

Kilbourne, Barbara, Paula England, George Farkas, Kurt Beron, and Dorothea Weir. 1994b. "Returns to Skill, Compensating Differentials, and Gender Bias: Effects of Occupational Characteristics on the Wages of White Women and Men." *American Journal of Sociology* 100:689–719.

Killewald, Alexandra and Jonathan Bearak. 2014. "Is the motherhood penalty larger for low-wage women? A comment on quantile regression." *American Sociological Review* 79:350–357.

Kitagawa, Evelyn M. 1955. "Components of a difference between two rates." *Journal of the American statistical Association* 50:1168–1194.

Knight, Carly R. and Mary C. Brinton. 2017. "One Egalitarianism or Several? Two Decades of Gender-Role Attitude Change in Europe." *American Journal of Sociology* 122:1485–1532.

Kolberg, Jon Eivind. 1991. "The Gender Dimension of the Welfare State." *International Journal of Sociology* 21:119–148.

Korpi, Walter. 2000. "Faces of Inequality: Gender, Class, and Patterns of Inequalities in Different Types of Welfare States." *Social Politics: International Studies in Gender, State & Society* 7:127–191.

Krefting, Linda A, Philip K Berger, and Marc J Wallace. 1978. "The contribution of sex distribution, job content, and occupational classification to job sextyping: Two studies." *Journal of Vocational Behavior* 13:181–191.

Kuhn, Peter and Fernando Lozano. 2008. "The expanding workweek? Understanding trends in long work hours among US men, 1979–2006." *Journal of Labor Economics* 26:311–343.

Kurtulus, Fidan Ana and Donald Tomaskovic-Devey. 2012. "Do female top managers help women to advance? A panel study using EEO-1 records." *The Annals of the American Academy of Political and Social Science* 639:173–197.

Lalive, Rafael and Alois Stutzer. 2010. "Approval of equal rights and gender differences in well-being." *Journal of Population Economics* 23:933–962.

Lee, James D. 1998. "Which Kids Can 'Become' Scientists? Effects of Gender, Self-Concepts, and Perceptions of Scientists." *Social Psychology Quartely* 61:199–219.

Leuze, Kathrin and Susanne Strauß. 2016. "Why do occupations dominated by women pay less? How 'female-typical'work tasks and working-time arrangements affect the gender wage gap among higher education graduates." *Work, Employment & Society* 30:1–19.

Levanon, Asaf, Paula England, and Paul Allison. 2009. "Occupational feminization and pay: assessing causal dynamics using 1950-2000 US census data." *Social Forces* 88:865–891.

Levanon, Asaf and David B Grusky. 2016. "The persistence of extreme gender segregation in the twenty-first century." *American Journal of Sociology* 122:573–619.

Liebeskind, Uta. 2004. "Arbeitsmarktsegregation und Einkommen. Vom Wert "weiblicher" Arbeit." *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie* 56:630–652.

Lippmann, Walter. 1922. *Public opinion*. New York: Harcourt, Brace & Co.

Liu, Yujia and David B Grusky. 2013. "The payoff to skill in the third industrial revolution." *American Journal of Sociology* 118:1330–1374.

Lueptow, Lloyd B, Lori Garovich-Szabo, and Margaret B Lueptow. 2001. "Social change and the persistence of sex typing: 1974–1997." *Social Forces* 80:1–36.

Macpherson, David A and Barry T Hirsch. 1995. "Wages and gender composition: why do women's jobs pay less?" *Journal of Labor Economics* 13:426–471.

Magnusson, Charlotta. 2009. "Gender, Occupational Prestige, and Wages: A Test of Devaluation Theory." *European Sociological Review* 25:87–101.

Magnusson, Charlotta. 2013. "More women, lower pay? Occupational sex composition, wages and wage growth." *Acta Sociologica* 56:227–245.

Mandel, Hadas. 2013. "Up the Down Staircase: Women's Upward Mobility and the Wage Penalty for Occupational Feminization, 1970-2007." *Social Forces* 91:1183–1207.

Mandel, Hadas. 2016. "The role of occupational attributes in gender earnings inequality, 1970–2010." *Social Science Research* 55:122–138.

Mandel, Hadas. 2018. "A Second Look at the Process of Occupational Feminization and Pay Reduction in Occupations." *Demography* 55:669–690.

Mandel, Hadas and Moshe Semyonov. 2006. "A Welfare State Paradox: State Interventions and Women's Employment Opportunities in 22 Countries." *American Journal of Sociology* 111:1910–1949.

Mandel, Hadas and Moshe Semyonov. 2014. "Gender pay gap and employment sector: Sources of earnings disparities in the United States, 1970–2010." *Demography* 51:1597–1618.

Marecek, Jeanne. 1995. "Gender, Politics, And Psychology's Ways Of Knowing." *American Psychologist* 50:162.

Mason, Karen Oppenheim, John L Czajka, and Sara Arber. 1976. "Change in US women's sex-role attitudes, 1964-1974." *American Sociological Review* 41:573–596.

Mason, Karen Oppenheim and Yu-Hsio Lu. 1988. "Attitudes toward Women's Familial Roles: Changes in the United States, 1977–1985." *Gender & Society* 2:39–57.

Moore, Thomas S. 2018. "Occupational Career Change and Gender Wage Inequality." *Work and Occupations* 45:82–121.

Murphy, Emily and Daniel Oesch. 2016. "The feminization of occupations and change in wages: A panel analysis of Britain, Germany, and Switzerland." *Social Forces* 94:1221–1255.

Nembrini, Stefano. 2017. *UQR, Unconditional Quantile Regression, v1.00 [R Package]*.

Oesch, Daniel. 2006. "Coming to Grips with a Changing Class Structure." *International Sociology* 21:263–288.

Oesch, Daniel and Jorge Rodríguez Menés. 2011. "Upgrading or polarization? Occupational change in Britain, Germany, Spain and Switzerland, 1990–2008." *Socio-Economic Review* 9:503–531.

O'Keefe, Eileen S C and Janet Shibley Hyde. 1983. "The development of occupational sex-role stereotypes: The effects of gender stability and age." *Sex Roles* 9:481–492.

Operario, Don and Susan T Fiske. 2002. "Stereotypes: Content, Structures, Processes, and Context." In *Blackwell Handbook of Social Psychology: Intergroup Processes*, edited by Rupert Brown and Sam Gaertner, pp. 22–44. Blackwell Publishing.

Panek, Paul E., Michael C. Rush, and James P. Greenawalt. 1977. "Current Sex Stereotypes of 25 Occupations." *Psychological Reports* 40:212–214.

Parsons, Talcott and Robert F Bales. 1955. *Family, Socialization and Interaction Process*. Glencoe, IL: Free Press.

Parsons, Talcott, Robert Freed Bales, and Edward Albert Shils. 1953. *Working Papers in the Theory of Action*. Glencoe, IL: Free Press.

Perales, Francisco. 2013. "Occupational sex-segregation, specialized human capital and wages: evidence from Britain." *Work, Employment & Society* 27:600–620.

Percheski, Christine. 2008. "Opting out? Cohort differences in professional women's employment rates from 1960 to 2005." *American Sociological Review* 73:497–517.

Petersen, Trond and Thea Togstad. 2006. "Getting the offer: Sex discrimination in hiring." *Research in Social Stratification and Mobility* 24:239–257.

Polavieja, Javier G. 2008. "The effect of occupational sex-composition on earnings: Job-specialization, sex-role attitudes and the division of domestic labour in Spain." *European Sociological Review* 24:199–213.

Powell, Gary N, D Anthony Butterfield, and Jane D Parent. 2002. "Gender and managerial stereotypes: have the times changed?" *Journal of Management* 28:177–193.

Rabe-Hesketh, Sophia and Anders Skrondal. 2012. *Multilevel and Longitudinal Modeling Using Stata*, volume 1. College Station, TX: Stata Press.

Redbird, Beth. 2017. "The New Closed Shop? The Economic and Structural Effects of Occupational Licensure." *American Sociological Review* 82:600–624.

Reskin, Barbara F. 1988. "Bringing the men back in: Sex differentiation and the devaluation of women's work." *Gender & Society* 2:58–81.

Reskin, Barbara F. 2000. "The proximate causes of employment discrimination." *Contemporary Sociology* 29:319–328.

Reskin, Barbara F. and Heidi I. Hartmann. 1986. *Women's work, men's work: Sex segregation on the job*. Washington, D.C.: National Academy Press.

Ridgeway, Cecilia L. 2011. *Framed by Gender*. New York: Oxford University Press.

Ridgeway, Cecilia L. 2014. "Why Status Matters for Inequality." *American Sociological Review* 79:1–16.

Ridgeway, Cecilia L and Shelley J Correll. 2000. "Limiting inequality through interaction: The end(s) of gender." *Contemporary Sociology* 29:110–120.

Ridgeway, Cecilia L and Shelley J Correll. 2004. "Unpacking the gender system a theoretical perspective on gender beliefs and social relations." *Gender & society* 18:510–531.

Rindfuss, Ronald R., Karin L. Brewster, and Andrew L. Kavee. 1996. "Women, Work, and Children: Behavioral and Attitudinal Change in the United States." *Population and Development Review* 22:457–482.

Ruble, Thomas L. 1983. "Sex stereotypes: Issues of change in the 1970s." *Sex roles* 9:397–402.

Ruggles, Steven, Katie Genadek, Ronald Goeken, Josiah Grover, and Matthew Sobek. 2015. *Integrated Public Use Microdata Series: Version 6.0 [Machine-readable database]*. Minneapolis: University of Minnesota.

Shauman, Kimberlee A. 2009. "Are there sex differences in the utilization of educational capital among college-educated workers?" *Social Science Research* 38:535–571.

Shauman, Kimberlee A. 2016. "Gender Differences in the Early Career Outcomes of College Graduates: The Influence of Sex-Type of Degree Field Across Four Cohorts." *RSF: The Russell Sage Foundation Journal of the Social Sciences* 2:152–193.

Shin, Taekjin. 2012. "The gender gap in executive compensation: The role of female directors and chief executive officers." *The Annals of the American Academy of Political and Social Science* 639:258–278.

Shinar, Eva H. 1975. "Sexual stereotypes of occupations." *Journal of Vocational Behavior* 7:99–111.

Signorielli, Nancy, Douglas McLeod, and Elaine Healy. 1994. "Profile: Gender stereotypes in MTV commercials: The beat goes on." *Journal of Broadcasting & Electronic Media* 38:91–101.

Smith, Lois J. 1994. "A content analysis of gender differences in children's advertising." *Journal of broadcasting & electronic media* 38:323–337.

Solga, Heike and Lisa Pfahl. 2009. "Doing Gender im technischnaturwissenschaftlichen Bereich." In *Förderung des Nachwuchses in Technik und Naturwissenschaft*, edited by Joachim Milberg, pp. 155–219. Berlin: Springer.

Sørensen, Aage B. 1996. "The Structural Basis of Social Inequality." *American Journal of Sociology* 101:1333–1365.

Spitz-Oener, Alexandra. 2006. "Technical change, job tasks, and rising educational demands: Looking outside the wage structure." *Journal of Labor Economics* 24:235–270.

Statistisches Bundesamt. 1992. *Klassifizierung der Berufe – Systematisches und alphabetisches Verzeichnis der Berufsbenennungen*. Stuttgart: Metzler-Poeschel.

Stone, Pamela. 2007. *Opting out?: Why women really quit careers and head home*. Berkeley, CA: University of California Press.

Sullivan, Oriel, Jonathan Gershuny, and John P Robinson. 2018. "Stalled or Uneven Gender Revolution? A Long-Term Processual Framework for Understanding Why Change Is Slow." *Journal of Family Theory & Review* .

Tam, Tony. 1997. "Sex Segregation and Occupational Gender Inequality in the United States: Devaluation or Specialized Training?" *American Journal of Sociology* 102:1652–1692.

Torre, Margarita. 2018. "Stopgappers? The Occupational Trajectories of Men in Female-Dominated Occupations." *Work and Occupations* 45:283–312.

Tåhlin, Michael. 2007. "Skills and Wages in European Labour Markets: Structure and Change." In *Employment Regimes and the Quality of Work*, edited by Duncan Gallie, pp. 35–76. Oxford: Oxford University Press.

Violante, Giovanni L. 2008. "Skill-biased technical change." In *The new Palgrave dictionary of economics*, edited by Steven Durlauf and Lawrence E Blume. New York, NY: Palgrave Macmillan.

Wagner, David G and Joseph Berger. 1997. "Gender and interpersonal task behaviors: Status expectation accounts." *Sociological Perspectives* 40:1–32.

Wagner, Gert G, Joachim R. Frick, and Jürgen Schupp. 2007. "The German Socio-Economic Panel Study (SOEP) – Scope, Evolution and Enhancements." *Schmollers Jahrbuch (Journal of Applied Social Science Studies)* 127:139–169.

Walker, K F. 1958. "A study of occupational stereotypes." *Journal of Applied Psychology* 42:122–124.

Weeden, Kim A. 2002. "Why do some occupations pay more than others? Social closure and earnings inequality in the United States." *American Journal of Sociology* 108:55–101.

Weeden, Kim A. and David B. Grusky. 2005. "The Case for a New Class Map." *American Journal of Sociology* 111:141–212.

West, Candace and Don H Zimmerman. 1987. "Doing gender." *Gender & society* 1:125–151.

White, Michael J, Theresa A Kruczek, Michael T Brown, and Gwendolen B White. 1989. "Occupational sex stereotypes among college students." *Journal of Vocational Behavior* 34:289–298.

White, Michael J and Gwendolen B White. 2006. "Implicit and explicit occupational gender stereotypes." *Sex Roles* 55:259–266.

Williams, Christine L. 1992. "The glass escalator: Hidden advantages for men in the "female" professions." *Social Problems* 39:253–267.

Williams, Christine L. 2013. "The glass escalator, revisited gender inequality in neoliberal times." *Gender & Society* 27:609–629.

Williams, John E and Deborah L Best. 1990. *Measuring sex stereotypes: A multination study*. Newbury Park, CA: Sage.

Wood, Wendy and Alice H Eagly. 2002. "A cross-cultural analysis of the behavior of women and men: implications for the origins of sex differences." *Psychological bulletin* 128:699.

Wooldridge, Jeffrey M. 2010. *Econometric analysis of cross section and panel data*. Cambridge, MA: MIT press.

Yanico, Barbara J and Susan I Hardin. 1986. "College students' self-estimated and actual knowledge of gender traditional and nontraditional occupations: A replication and extension." *Journal of Vocational Behavior* 28:229–240.

Yu, Wei-hsin and Janet Chen-Lan Kuo. 2017. "The Motherhood Wage Penalty by Work Conditions: How Do Occupational Characteristics Hinder or Empower Mothers?" *American Sociological Review* 82:744–769.

Zhou, Xiang and Geoffrey T Wodtke. 2018. "Income Stratification among Occupational Classes in the United States." *Social Forces* .