

# Occupational Closure and Wage Inequality in Germany and the United Kingdom

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Submitted March 2014; revised November 2014; accepted November 2014

## Abstract

Rent-based accounts of inequality argue that institutionalized barriers to the access to labour market positions create artificial restrictions on the supply of labour and, in turn, generate wages for workers in protected positions in excess of the wages they would receive in a competitive labour market. In this article, we extend this argument to the comparative context, and elaborate a rent-based explanation of between-occupation wage inequality in Germany and the United Kingdom. We test it with new and unique data on four institutionalized sources of closure (educational credentialing, licensure, unionization, and apprenticeships), matched to newly constructed measures of occupational skills and to national labour force survey data. We show that in both countries, between-occupation wage inequality is substantial, and much of it can be traced to variations across occupations in closure and to the positive association between closure and wages. We also show that the prevalence and the payoff to each of the four closure institutions differ across the two countries: Specifically, vocational credentialing and unionization have a particularly high payoff in Germany, while tertiary credentialing and licensure have a particularly high payoff in the United Kingdom. These results have important implications for understanding between-occupation wage inequality and cross-national differences in aggregate levels of wage inequality.

## Introduction

In accounting for dramatic differences between countries in wage inequality, liberal market economies in which inexorable inequality-generating forces of market competition are unfettered, are often contrasted against economies in which these forces are tempered by post-market redistribution or by labour market institutions (e.g. unions, minimum wage laws) that protect workers and ensure that they receive a greater share of the fruits of market capitalism. Recently, some scholars have argued that *all* market-based economies, even liberal market economies, are rife with labour market

institutions that generate social closure around labour market positions, prevent the supply of labour in those positions from keeping up with demand, and create rents for their incumbents, where rents are the portion of wages in excess of the wages that would be observed in a (hypothetical) competitive labour market (Sørensen, 2000; Weeden, 2002; Weeden and Grusky, 2014). By the logic of this argument, differences in inequality across countries arise not only from variations in the prevalence and strength of institutions that generate rents for lower skilled workers ('bottom-end' rents), but also from variations in the prevalence and strength of

institutions that generate top-end rents for higher skilled workers.

To date, the rent-based approach has been cast in universal terms, without regard for potential cross-national variations in the institutionalized sources of rents. Likewise, the existing empirical assessments of the closure story have focused on a single labour market, most often the United States (Weeden, 2002; Tomaskovic-Devey and Lin, 2011; contra Giesecke and Verwiebe, 2009). Other analyses focus on one closure institution in isolation, as in studies of declining union wage returns, collective bargaining, licensure, or the college wage premium (e.g. Humphris *et al.*, 2011; Western and Rosenfeld, 2011; Hout, 2012; Giesselmann, 2014). These studies provide important evidence of the institutional sources of inequality, but gloss over potential variations across countries in the prevalence of, and wage payoff to, different rent-generating institutions.

This article offers systematic empirical evidence of the association between closure and positional wage inequality in the German and UK labour markets. As has often been noted, Germany is characterized by relatively high levels of coordination between employers, the state, unions, and the education system; relatively strong protections for employed workers (in the form of, for example, prohibitions against the dismissal of workers); and a vocationalized education system that tracks students into particular occupations (e.g. Shavit and Muller, 1998; Breen, 2005). The United Kingdom, by contrast, has low central coordination, weak protections against dismissal, and a fragmented and decentralized education system that provides general training with comparatively weak pathways to particular occupations. We argue that the UK labour market is not nearly as barrier free as it is often made out to be, and its labour market barriers, like those in Germany, generate rents for the incumbents of protected positions. However, the sources of closure and magnitude of rents differ across these countries, generating quite different patterns of between-occupation wage inequality.

We first elaborate the general mechanisms by which closure affects positional wages, and discuss how the contours of closure differ across our two empirical contexts. We then describe our data, which feature unique data on closure matched to data on occupational skills and individual-level labour force survey data from 2006 to 2007 (United Kingdom) and 2006 (Germany). From these data, we estimate the rents associated with occupational closure through licensure, credentialing, unionization, and apprenticeships (with and without adjustments for occupational skills). We conclude with a discussion of the implications of the observed patterns

of between-occupation inequality for understanding aggregate levels of inequality.

## Closure in Comparative Perspective

Closure occurs wherever legal and normative barriers restrict the supply of labour to a labour market position and protect its incumbents from external competition (e.g. Weber, 1922/1978). These restrictions on labour supply can occur in two ways. First, closure may restrict access to opportunities to receive training or skills specific to that labour market position. Because of these barriers to skill acquisition, workers cannot respond to the market signal of high wages, the supply of trained workers remains less than demand for them, and the wages of workers in the closed occupations exceed the wages they would have received in the absence of such barriers to skill acquisition. Second, closure may restrict the supply of labour that can legally practice the tasks that are under the particular jurisdiction of that occupation or other labour market position. Such barriers to skill application also generate rents for the incumbents of the closed positions not because they alone have the requisite skills but because they are allowed to apply those skills.

We analyse four ‘closure institutions’, each of which creates barriers to skill acquisition, skill application, or both: educational credentialing, licensure, apprenticeship, and unionization. All of these institutions figure prominently in theoretical statements about closure (or, in the case of licensure, in the ‘professionalization’ literature). Among the four institutions, three (licensure, educational credentialing, and unionization) have been shown to have a positive association with occupational wages in the United States (Weeden, 2002),<sup>1</sup> and the fourth one, apprenticeship, figures prominently in recent empirical scholarship on the German labour market (e.g. Bol, 2014; Riphahn and Zibrowius, 2013). We do not mean to imply that these are the *only* means through which closure is secured, merely that if the closure argument has any merit as an explanation for wage inequality, it should be revealed in patterns of association between these institutions and occupation wages.

## Educational Credentialing

Educational credentials, meaning the degrees and certifications earned in the formal education system, have market value insofar as they signal job-relevant skills or other underlying traits (e.g. ambition, cultural capital) valued by employers. If opportunities to obtain educational credentials are unrestricted, workers will

presumably invest in education up to the point where the anticipated wage returns to an educational credential equals the cost of obtaining the credential. The supply of credentialed labour will increase to meet the demand for it, and any quasi-rents generated by a temporary shortage of educated labour will disappear. If, however, opportunities to obtain credentials are restricted, whether because opportunities to obtain adequate preparatory training are limited (e.g. by low-quality primary schools) or because the number of slots in degree programmes are limited, workers will be unable to respond to market signals and supply will fall short of demand (Sørensen, 2000: p. 1554; Weeden and Grusky, 2014). This will raise not only the individual-level wages of those who obtain degrees but also mean wages in an occupation in which employers believe the credential to be necessary (for productivity, to signal value to clients, for status). The wage returns to credentialing can accrue even to uncredentialed workers in an occupation, if employers are swayed by norms of equity (Western and Rosenfeld, 2011) or use compensation practices (e.g. benchmarking) that homogenize pay within an occupation.

Education systems vary in the extent to which they are closed or open, and also in the extent to which they offer degrees that track workers into particular occupations. In countries like the United Kingdom, the education system emphasizes general learning rather than specific vocational preparation. In this system, bottlenecks to the acquisition of credentials are strongest at the tertiary level, where deficiencies in preparatory training, access to credit and other financial resources, and the number of available slots<sup>2</sup> can prevent some young adults who might seek a tertiary degree to secure higher wages to obtain that degree. Bottlenecks to the acquisition of intermediate degrees, by contrast, are relatively weak, given that the secondary education system is open and free to all.

In the highly vocationalized German education system, the content of educational credentials, and not just its level, drives future job placements (Solga and Konietzka, 1999: p. 28). Tertiary education is divided between the state universities, which offer professional and general degrees, and the *Fachhochschule*, which offer occupation-specific degrees. Access to tertiary degrees is limited by the number of available slots in the relevant universities (Mayer, Müller and Pollak, 2007: p. 251); indeed, German Länder (states) and universities are able to request a *numerus clausus* to restrict entrants, if demand for slots exceeds the supply in universities or in particular occupational training programmes (e.g. banking). Below the tertiary level, vocational credentials

train workers for particular occupations, and in some cases, the demand for spots in the relevant vocational programme exceeds the availability of these spots (Bremser *et al.*, 2012).

These barriers to access to the acquisition of skills in Germany are further reinforced by state mandates that specify the educational credentials that are required to enter an occupation. To become a self-employed baker in Germany, for example, one must obtain a ‘master craftsman’ diploma in baking or the equivalent qualification (Bol, 2014). These requirements can be understood as restrictions to skill application, in that even most talented baker could not (legally) become a self-employed baker without the associated educational credential.

These differences in the two countries’ education systems have two implications for the observed patterns of wage returns. In the United Kingdom, weak restrictions on the acquisition of intermediate degrees and greater bottlenecks in the acquisition of tertiary degrees anticipate low wage returns to intermediate credentialing (at the occupation level) compared with wage returns to tertiary credentialing. In Germany, by contrast, both tertiary and intermediate (vocational) credentialing are associated with higher wages.

### Apprenticeships

Apprenticeships have long been understood as a source of closure that generates rents in the skilled trades, primarily by restricting access to the acquisition of skills. Weber, for example, notes that through apprenticeship systems, ‘only those are admitted to the unrestricted practice of the vocation who [...] have completed a novitiate’ (1922/1978: p. 344). If access to apprenticeships is restricted, whether because there are too few slots in apprenticeship systems or because too few students have sufficient preparatory training, the supply of labour in the apprenticed trades is also restricted. Assuming the demand for workers in these occupations exceeds the supply of workers who have successfully completed apprenticeship programmes, rents will accrue to the occupations where training typically occurs through apprenticeships.

In the United Kingdom, as in the United States and many other countries with general education systems, apprenticeships are underdeveloped. Approximately 190 apprenticeships are offered in the United Kingdom, but they are a heterogeneous array of programmes with no explicit coordination with employers, no agreed-upon meaning of the ‘apprenticeship’ label, and no centralized oversight (Ryan and Unwin, 2001). One result is that

apprenticeships in these systems have relatively little impact on access to occupation-specific training, and exert only weak barriers to entry into occupations. As such, we anticipate that their effect on mean occupation wages will be relatively modest.

In Germany, by contrast, the apprenticeship system is quite well developed, and embedded in the formal education system through the ‘dual apprenticeship system’ (Shavit and Müller, 1998). This system is regulated by regional governmental agencies, which set requirements for apprenticeships and monitor employers who offer them. Apprenticeship programmes are often implemented in consultation with occupational groups (Busemeyer, 2009), which allows these groups to exert indirect control over the number and training of new entrants. If occupational groups use this control to restrict the supply of apprenticeship slots, or if the supply of apprenticeship slots is otherwise restricted, the result will be higher average wages in occupations where apprenticeships are the primary gateway to entry. The caveat, however, is that because of the dual system, the correlation between vocational credentialing and apprenticeships is likely quite high in Germany, making it difficult to identify independent effects of each.

### Licensure

Whereas educational credentialing and apprenticeships generate rents by restricting access to skills, occupational licences affect wages by restricting opportunities to apply skills. Licences are certificates issued and backed by the state that allow licence-holders exclusive right to practice a set of skills or to use an occupational title. Many occupational licenses require that the licensee holds a particular educational credential, but the credential is not sufficient: Typically, the licensee must also pay a fee; meet residency, citizenship, or ‘moral turpitude’ requirements; and in some cases demonstrate competence to a licencing agency. The standards for licensure are often set by occupational agents or to an organization that directly represents the occupation (e.g. a lawyer’s bar association); as with occupational control over apprenticeships, this gives occupational representatives indirect control over the number and qualities of licensees.

Licensure is comparatively prevalent in the United Kingdom, although not as prevalent as in the United States (Humphris *et al.*, 2011). This is ironic, given that licensure directly and explicitly intervenes in the market (by acting as a patent on a practice) and seems to violate a central principle of ‘liberal’ markets. The key to understanding this seeming incompatibility is the

widespread belief—often promulgated by occupational representatives—that licensure overcomes information asymmetries, protects consumers from incompetent and malfeasant practitioners, and, in so doing, greases the wheels of economic exchange and makes markets more efficient.

In Germany, where educational credentials are highly differentiated and their quality and content are subjected to strong oversight by major economic actors, incompetent or malfeasant practitioners can be weeded out in training programmes, and there is consequently less justification for occupational licensure. Only few occupations in Germany, mainly in health care and other professions, require licenses similar to those in the United Kingdom. By the logic of closure theory, these licences should generate wage premia for members of the licenced occupations. We anticipate, however, that in Germany, licensure will not only be less prevalent than other forms of closure, but also generate more modest wage returns than closure through the strong and centralized education system.

### Unionization

As others have argued, unions can be understood as rent-redistributing institutions that rely on collective bargaining to capture a greater share of firm profits for unionized workers and for nonunion workers in heavily unionized occupations or industries, where nonunion employers pay union rates to pre-empt against unionization in their own firms. All else equal, then, a heavily unionized occupation will have higher mean wages than a nonunionized occupation. The caveat here is that unions that represent particular occupations (e.g. teachers’ unions, airline pilots’ unions) are rare compared with unions that represent industries or sectors. These broad-based unions may still affect occupational wages, but only insofar as occupations are unevenly distributed across the represented industries: line repairers, for example, may accrue rents by virtue of the fact that most line workers are found in the heavily unionized telecommunications industry. In our empirical models, we fit individual-level effects of industry to minimize any spurious correlation between unions, industries, and wages. We note, however, that this may absorb some of the ‘true’ closure effects of unions that represent a large share of an (industry-specific) occupation.

Many earlier research points to the decline of unionization and union power, especially in liberal and ‘liberalizing’ market economies, and to the effect of deunionization on wage inequality. In the United Kingdom, unions face strong anti-union sentiment (often

linked to pro-market rhetoric) and a comparatively weak structural position: Collective bargaining in the United Kingdom is decentralized, usually taking place at the company or plant level, and unions lack the ‘seat at the table’ that they enjoy in systems with stronger regional and national economic coordination (Ebbinghaus and Visser, 2000). Because unions in the United Kingdom have only limited ability to restrict access to the acquisition of skills (through union-controlled apprenticeship systems) or the application of skills (through closed shop arrangements, collective bargaining, and the threat of the withdrawal of labour), we anticipate that the wage returns to unionization will be modest compared with other sources of occupational closure.

In the German context, by contrast, we anticipate that wage returns to unionization will be strong compared with other closure institutions. As noted, some of the wage effect of closure through unionization may be mediated through apprenticeship programmes, which German unions are heavily involved in developing and implementing (Busemeyer, 2009). However, German unions still have a central role in wage negotiations, which culminate in legally binding and enforceable collective labour agreements (CLAs), and their bargaining power remains comparatively strong (OECD, 2004: p. 151). Although trade union membership rates are lower in Germany than in the United Kingdom, CLA coverage in Germany is relatively high (OECD, 2004: p. 145). Most of these CLAs govern wages at the industry or company level, meaning that their effect on occupational wages is driven by the uneven distribution of occupations across industries. Still, the comparative strength of Germany unions implies large wage premiums for heavily unionized occupations in Germany, even in the presence of controls for industry, apprenticeships, and vocational credentialing.

The preceding discussion implies, firstly, that in both countries, occupations that are characterized by closure through one or more of the four institutionalized barriers to access will have higher mean wages than occupations that are not, even after adjusting occupational wages for individual-level measures of human capital. We also anticipate, however, that wage returns to vocational credentialing, unionization, and apprenticeships will likely be especially high in Germany, with the caveat that the apprenticeship effects may be absorbed by vocational credentialing in the ‘dual education’ system; in the United Kingdom, by contrast, we expect these institutions to have relatively modest associations with wages compared with tertiary credentialing and licensure.

## Methods and Data

Our core analytic challenge, common to all data-based analyses of rents, is that competitive market wages are unobserved, and hence rents must be inferred. Weeden (2002) skirts this problem by estimating the closure–wage association after adjusting for individual-level measures of human capital and occupation-level measures of skills. We adopt a similar strategy here, but acknowledge that such models ‘give away’ some individual-level returns to closure (e.g. education) that are properly understood as rents. Our goal is to provide a conservative and defensible estimate of the wage returns to closure, not to claim that a competitive market equilibrium exists.

We estimate the association between occupational closure and wages with a series of standard multilevel random intercept models in which individuals are nested in occupations. By changing the occupation-level covariates in the model, we estimate the gross and skill-adjusted association between closure and mean occupation wages, adjusting for the observed wage-relevant attributes of the individuals within the models. We do not formally test for differences in the estimated coefficients between countries, both because of unavoidable limitations in the data and because the two countries differ markedly in the structure of their educational degrees and the occupational coding systems. We think it is more defensible to fit separate models to data that are tailored to the individual country and eschew formal comparisons than to force comparability and lose both precision and nuance in the country-specific results.

### Individual-level Data and Measures

The individual-level data are extracted from the scientific use file of the 2006 German Microcensus (German Federal Statistics Office, 2011) and the 2006/2007 UK Quarterly Labour Force Survey (QLFS; Office of National Statistics, 2011).<sup>3</sup> We restrict our analyses to respondents who are employed and aged 18 to 65 years. Because the QLFS only reports wages and salaries, we also restrict the German sample to respondents who report that their income is predominantly from wages and salaries. The final analytic samples consist of 151,474 German respondents and 75,906 UK respondents.

In all models, the dependent variable is the natural logarithm of net monthly earnings. In the QLFS, net earnings are reported as a continuous variable, whereas in the German Microcensus, net earnings are coded into 24 categories. In our main results, we approximate a continuous measure for the German data by assigning each earnings category its midpoint value. We also reanalysed the UK data using a 24-category ordinal measure

**Table 1.** Overview of individual level variables

Variable	Description
Both countries	
Gender	Male = 0, female = 1.
Marital status	Not married = 0, married = 1.
Ethnic minority <sup>a</sup>	No = 0, yes = 1. Ethnic minority is self-defined in the UK, and in Germany defined as all non-Western migrants with and without German citizenship.
Dependent children in home	No = 0, yes = 1.
Normal working hours	Hours normally worked per week.
Type of employment	Full-time = 0, part-time = 1.
Years of education <sup>b</sup>	Self-reported years of formal schooling.
Experience	Constructed by taking the difference between current age and the age in which the respondent left formal education.
Experience squared	Squared term of experience.
Industry <sup>c</sup>	Dummy variables for nine industries (see Tables 2 and 3).
Earnings	The natural logarithm of net monthly earnings.
UK specific	
Country of residence	Dummy variables for Scotland, Wales, Northern Ireland, using England as the reference category.
Highest level of education	Dummy variables for nine categories: no qualifications (the reference category), other qualifications, below National Vocational Qualification (NVQ) Level 2, NVQ Level 2, trade apprenticeships, NVQ Level 3, and NVQ Level 4 and above.
Germany specific	
Former Eastern Germany <sup>d</sup>	No = 0, yes = 1.
Highest level of education	Dummy variables for seven CASMIN categories: CASMIN 1ab (reference), CASMIN 1c, CASMIN 2b, CASMIN 2a, CASMIN 2c, CASMIN 3a, and CASMIN 3b.

<sup>a</sup>The QLFS asks respondents whether they belong to an ethnic minority. The best available analog in the German Microcensus flags respondents who were born in non-western countries.

<sup>b</sup>A few respondents reported 35 or more years of education, which we assume are errors. We exclude these respondents from the analysis.

<sup>c</sup>Models fit to the UK data that include an individual-level indicator of union membership showed comparable occupation-level coefficients with those we present here (results available from the first author). Union membership is not available in the German Microcensus.

<sup>d</sup>We do not fit separate closure effects for East and West Germany, given our main interest is on country-level associations between closure and occupational wages, not on within-country variations in these associations.

of earnings comparable with the German categories and obtained similar results (Supplementary Appendix).<sup>4</sup>

Table 1 gives an overview of the individual-level variables, and Tables 2 and 3 present the descriptive statistics for the United Kingdom and Germany, respectively. Our individual-level models also include education–experience interactions as well as interactions between gender and the individual-level covariates.

### Occupation-level Data

Our occupation-level measures are constructed using the occupational classification scheme codes native to each labour force survey. The German data are coded into the 369 categories of the 1992 *Klassifizierung der Berufe* (KldB-1992) and the UK data into the 353-category 2000 Standard Occupational Classification scheme (SOC-2000). We exclude 11 KldB-1992 categories for respondents who are in school or have

uncodeable occupations. We also exclude occupations that are too small to be represented in the survey (e.g. saddlers) or, less commonly, residual categories (e.g. ‘metal workers not elsewhere classified’) for which we could not collect reliable information on skills or closure. We are left with 330 occupations in the German data and 344 in the UK data.

### Occupational skills and demographic controls

Our occupation-level models adjust for the gender and racial composition of occupations, both known correlates of mean occupational wages. Occupational composition is measured with the percentage of women and the percentage of ethnic minorities in each occupation, calculated from the German Microcensus and the QLFS.<sup>5</sup>

We measure six occupational skills: physical abilities, technical skills, complex mental processing, mathematical skills, interaction skills, and presentation skills.

**Table 2.** Descriptive statistics for individual-level variables: United Kingdom

Variable	Mean	SD	Minimum	Maximum
Female	0.53	–	0	1
Married	0.71	–	0	1
Kids in home	0.38	–	0	1
Ethnic minority	0.10	–	0	1
Country of residence:				
England (reference)	0.83	–	0	1
Scotland	0.10	–	0	1
Wales	0.05	–	0	1
Northern Ireland	0.03	–	0	1
Highest educational qualification:				
No qualifications (reference)	0.09	–	0	1
Other qualifications	0.08	–	0	1
Below NVQ level 2	0.14	–	0	1
NVQ level 2	0.16	–	0	1
Trade apprenticeships	0.05	–	0	1
NVQ level 3	0.15	–	0	1
NVQ level 4 and above	0.34	–	0	1
Years of education	13.83	2.83	1	35
Experience	23.39	12.55	0	53
Experience squared	704.42	612.66	0	2,809
Normal hours in workweek	34.25	10.57	1	97
Part-time	0.24	–	0	1
Industry				
Agriculture and fishing (reference)	0.01	–	0	1
Energy and water	0.01	–	0	1
Manufacturing	0.14	–	0	1
Construction	0.05	–	0	1
Distribution, hotels, and restaurants	0.17	–	0	1
Transport and communication	0.07	–	0	1
Banking and finance	0.15	–	0	1
Public admin., health, education	0.35	–	0	1
Other services	0.05	–	0	1
<i>m</i> monthly earnings	6.90	0.65	3.81	10.57
Net monthly earnings (£)	1,216	886	45	39,133

Source: 2006 and 2007 Quarterly Labour Force Survey.  $N = 75,906$ .

We used factor analysis to construct scales (mean = 0, SD = 1) for each skill using component items from the 2006 BIBB/BAuA Employment Survey (Germany;  $n = 20,000$ ) and the 2001 and 2006 British Skill Survey (BSS; United Kingdom;  $n = 12,257$ ), which we aggregated to the occupation level. We note that the BIBB/BAuA items ask respondents about the frequency with which particular skills are used in the occupation, whereas the BSS items ask about the importance of a particular skill. We assume that frequency of use and importance are highly correlated, and that the latent skill factor can be interpreted similarly for the two countries. See the [Supplementary Appendix](#) for details about the six skill variables, their component items, and the results of the factor analysis.

### Occupational closure

We measure educational credentialing with two variables, one referring to the tertiary credentialing in an occupation and one to the intermediate/vocational credentialing. The BIBB/BAuA asks, ‘What qualification is normally required to do the job you have now?’ from which we calculated occupation-specific percentages of ‘vocational training or *Meister/Techniker* degree’ and ‘tertiary degree’ responses. The analogous question in the BSS asks, ‘If they were applying today, what qualifications, if any, would someone need to get the type of job you have now?’, from which we calculated percentages of ‘low or intermediate degree’ (i.e. GCSEs, NVQ 1-3) and ‘tertiary degree’ responses. An occupation can have nonzero percentages on both measures if it

**Table 3.** Descriptive statistics for individual-level variables: Germany

Variable	Mean	SD	Minimum	Maximum
Female	0.43	–	0	1
Married	0.60	–	0	1
Kids in home	0.52	–	0	1
Ethnic minority	0.08	–	0	1
Former Eastern Germany	0.21	–	0	1
Highest educational qualification				
CASMIN 1ab	0.06	–	0	1
CASMIN 1c	0.24	–	0	1
CASMIN 2b	0.03	–	0	1
CASMIN 2a	0.34	–		
CASMIN 2c	0.13	–		
CASMIN 3a	0.06	–	0	1
CASMIN 3b	0.12	–	0	1
Years of education	15.83	5.08	9	35
Experience	20.13	11.64	0	51
Experience squared	540.78	501.71	0	2,601
Normal hours in workweek	37.73	10.57	1	90
Parttime	0.19	–	0	1
Industry				
Agriculture and fishing (reference)	0.02	–	0	1
Manufacturing	0.23	–	0	1
Energy and water	0.01	–	0	1
Construction	0.07	–	0	1
Commerce, hotels, and restaurants	0.16	–	0	1
Banking and finance	0.06	–	0	1
Transport and distribution	0.14	–	0	1
Public administration, health, education	0.26	–	0	1
Other services	0.06	–	0	1
<i>ln</i> Monthly earnings	7.29	0.61	4.32	9.99
Net monthly earnings (€)	1,767.34	1,435.36	75	22,000

Source: Research Data Centres of the Federal Statistical Office and the statistical offices of the Länder, Mikrozensus 2006. N = 151,474.

combines jobs that require different levels of education, respondents disagree about educational requirements, or respondents interpret the questions differently. Given this ambiguity, we also constructed ‘behavioural’ measures of educational credentialing from the actual education level of occupational incumbents. The behavioural and subjective measures correlate highly,<sup>6</sup> and yielded the same substantive results.

We constructed country-specific measures of occupational licensure by searching legal codes (e.g. German Article §132a), lists of chartered occupations (United Kingdom), and other governmental sources on legal job protections. As noted above, we consider an occupation to be licenced if laws specify requirements other than (or in addition to) an educational credential. We found that the occupational titles listed in legal codes do not always align with the categories used in the QLFS or

Microcensus: For example, ‘osteopaths’ in the United Kingdom were licenced in 2006, but acupuncturists and other occupations that were also in the QLFS category of ‘therapists’ were not. Because a simple binary measure of licensure may grossly overestimate closure, we constructed a continuous measure of the extent of licensure in an occupation by identifying the actual number of individuals in licenced occupations (from government licencing bodies, professional associations, and government-issued job profiles), dividing by population estimates of the number of people in the QLFS or Microcensus occupation, and multiplying by 100.

Unionization is measured by the percentage of occupational incumbents who are union members. The German Microcensus does not ask union status, so we pooled data from the four German European Social Surveys (ESS, 2011) collected from 2002 to 2008, calculated union

membership in each three-digit ISCO occupation in the ESS, and matched ISCO codes to the KldB-1992. For the UK data, we aggregated individual-level data on union membership from the fourth quarter surveys of the 2006 and 2007 QFLS. We estimated supplementary models that substitute collective bargaining coverage for union membership for the United Kingdom; unfortunately neither the German Microcensus nor the ESS include analogous measures.

Finally, closure through apprenticeships is estimated by the percentage of occupational incumbents who have completed an apprenticeship programme. The German measure comes from the Microcensus, which asks if respondents have a vocational degree or any other apprenticeship. The UK measure comes from the QFLS, which asks if respondents have completed a recognized apprenticeship. This difference in question wording is unavoidable, and reflects 'real' differences in the structure of apprenticeship programmes.

### Patterns of Occupational Closure in the United Kingdom and Germany

Table 4 shows the prevalence of each of the four closure sources in Germany and the United Kingdom. Nearly 70 per cent of UK workers and 82 per cent of German workers are in occupations that they believe require an educational credential. Vocational credentialing is especially pronounced in Germany, where 61 per cent of workers are in such occupations; by contrast, 40 per cent of UK respondents believe that their occupation requires an intermediate degree. Conversely, tertiary educational credentialing is especially pronounced in the United Kingdom (30 per cent) compared with Germany (21 per cent). More than half (52 per cent) of the German workers have completed an apprenticeship, compared with 11 per cent of workers in the United Kingdom, and 29 per cent of UK workers are members of unions compared with 15 per cent in Germany. Licensure is also far more common in the United Kingdom, where 13 per cent of workers are in licenced occupations compared with 5 per cent of German workers.<sup>7</sup>

As Table 5 shows, our data reveal important similarities and differences across the two countries in the clustering of closure institutions across occupations and in the types of occupations characterized by different sources of rents. In both countries, licensure and tertiary credentialing tend to be found in the same occupations, with modest correlations between 0.31 and 0.35. This similarity breaks down, however, in the correlation between vocational credentialing and apprenticeships (strong in Germany, reflecting the dual system, weak in

the United Kingdom) and between unionization and other forms of closure (weak in Germany, stronger, especially with licensure, in the United Kingdom). Likewise, the two countries differ in the prevalence of the four forms of closure across occupational skill types. In Germany, vocational credentialing, apprenticeships, and unionization are positively correlated with technical skills, while tertiary credentialing and licensure are correlated with cognitive skills. In the United Kingdom, only apprenticeships tend to co-occur with technical skills ( $r=0.49$ ), whereas the other closure institutions are more often found in occupations with high cognitive and other 'non-technical' skills. The implication is that the occupations that are closed in the United Kingdom are not necessarily closed in Germany, a finding that challenges the long-standing practice in sociology of treating occupations as if they are cross-nationally invariant on the dimension of interest (e.g. prestige).

### Closure and Occupation Wages in the United Kingdom

Table 6 presents the occupation-level coefficients from multi-level wage models applied to the UK data (individual-level coefficients are in [Supplementary Appendix](#)). Model 1, which fits no individual- or occupation-level predictors, reveals that nearly 40 per cent of the variation in logged earnings in the United Kingdom occurs between occupations (Intra class correlation [ICC] = 0.398). This decreases to 28 per cent in a model (not shown) that adjusts only for individual-level predictors. Adding measures of occupational ethnic and gender composition reduces the residual between-occupation variance to 26 per cent (Model 2), and adding measures of closure and skills further reduces it by 17 percentage points to 9 per cent (Model 4). The relative contribution of closure and skills to this decline depends on the order in which the covariates are entered and, implicitly, on assumptions about the underlying causal processes. A low estimate of the closure effect, based on a model that conditions on occupational skills, is a 4.8 percentage point or 18 per cent ( $0.048/0.26 = 0.18$ ) reduction in the residual between-occupation variance; a high estimate, based on a model that does not also condition on occupation skills, is a 14.7 percentage point or 57 per cent ( $0.147/0.26 = 0.57$ ) reduction. These results demonstrate that between-occupation inequality remains strong in the United Kingdom (cf. [Williams, 2012](#)) and, moreover, much of the observed between-occupation inequality can be traced to closure.

Model 3 shows that educational credentialing, licensure, and unionization have the anticipated positive

**Table 4.** Descriptive statistics of occupation-level measures of closure, skills, and demographic composition: the United Kingdom and Germany

Variable	United Kingdom				Germany			
	Mean <sub>ij</sub>	SD <sub>ij</sub>	Mean <sub>j</sub>	SD <sub>j</sub>	Mean <sub>ij</sub>	SD <sub>ij</sub>	Mean <sub>j</sub>	SD <sub>j</sub>
Per cent requiring no degree	31	29	33	31	18	23	22	25
Per cent requiring intermediate (UK)/vocational (Germany) degree	40	20	37	23	61	31	60	32
Per cent requiring tertiary degree	29	26	30	27	21	32	18	31
Per cent licensed	13	32	18	36	5	22	5	21
Per cent unionized	29	23	28	22	15	8	16	10
Per cent with apprenticeship	11	15	15	16	52	22	53	21
Physical abilities	-0.05	0.56	0.05	0.61	0.05	0.61	0.20	0.61
Technical skills	-0.05	0.43	0.10	0.52	0.04	0.56	0.28	0.58
Complex processing skills	-0.01	0.47	0.04	0.48	-0.05	0.46	-0.10	0.48
Interaction skills	0.04	0.45	-0.05	0.52	-0.07	0.51	-0.18	0.53
Presentation skills	0.04	0.55	-0.03	0.57	-0.05	0.33	-0.14	0.35
Mathematical skills	0.00	0.49	-0.04	0.49	0.51	0.17	0.50	0.20
Per cent ethnic minority	10	6	9	6	8	7	9	7
Per cent female	51	32	38	30	44	32	34	29

Sources: QLFS 2006 and 2007; Research Data Centres of the Federal Statistical Office and the statistical offices of the Länder, Mikrozensus 2006. See text for sources of occupation-level measures.

Notes: *i* refers to individuals, *j* to occupations. The first two columns for each country give weighted means and standard deviations (mean<sub>ij</sub> and SD<sub>ij</sub>), and the last two give unweighted means and standard deviations. In the UK data N<sub>i</sub> = 344, and in the German data, N<sub>i</sub> = 330.

wage returns at the occupation level, and that these wage returns are substantial. A hypothetical occupation in which all incumbents require a tertiary degree earns an estimated 75 per cent ( $\exp[0.562] = 1.75$ ) wage premium relative to an occupation that does not require a tertiary degree. An occupation that requires intermediate qualifications has predicted mean wages that are 27 per cent higher ( $\exp[0.239] = 1.27$ ). Fully licenced occupations have an estimated wage premium of 8 per cent compared with unlicensed occupations, and fully unionized occupations offer an anticipated earnings premium of 20 per cent compared with nonunionized occupations, after adjusting for industry location.<sup>8</sup>

Whereas these results are in line with predictions, Model 3 also shows that apprenticeships in the United Kingdom have a *negative* association with wages (see Table 6). The source of this unanticipated result is partly revealed in Model 4, which adds measures of occupational skills. In this model, the negative effects of apprenticeship disappear, as does the positive association between intermediate credentials and wages. This pattern of results implies that the occupations that require intermediate credentials or apprenticeships also entail modest levels of skills (see also Table 5), but training for these skills is not restricted to secondary schools or apprenticeships.

Model 4 reveals that adjusting for occupational skills reduces, but does not eliminate, the positive associations between the other closure institutions and wages. The estimated effect of tertiary credentialing, for example, is still sizeable in Model 4, yielding an expected wage premium of 33 per cent ( $\exp[0.285] = 1.33$ ) for an occupation in which all incumbents need a tertiary degree. The positive net wage effect of licensure is also unaffected by adjusting for occupational skills (see Model 4).

These results are consistent with the core empirical predictions of the closure argument, namely that closure is a 'rising tide that lifts all boats' that contributes to between-occupation wage inequality. Occupations that are closed through educational credentialing, licensure, and unionization have higher observed wage returns than can be accounted for by individual-level measures of human capital or occupation-level measures of skills and demographics.

### Closure and Occupation Wages in Germany

Do similar relationships between closure and positional wages obtain in Germany? A null model fit to the German data (see Model 5, Table 7) shows that 26 per cent of the total variance in wages occurs between occupations, a lower share than the 40 per cent estimated for

Table 5. Bivariate correlations of all occupation-level covariates: UK and Germany

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
United Kingdom														
1 Per cent requiring no degree	1.00													
2 Per cent requiring intermediate degree	-0.53	1.00												
3 Per cent requiring tertiary degree	-0.70	-0.24	1.00											
4 Per cent licensed	-0.25	-0.03	0.31	1.00										
5 Per cent unionized	-0.16	0.10	0.10	0.33	1.00									
6 Per cent with apprenticeship	-0.05	0.14	-0.06	-0.08	-0.06	1.00								
7 Physical abilities	0.49	-0.11	-0.47	-0.13	0.04	0.31	1.00							
8 Technical skills	0.23	0.03	-0.29	-0.04	-0.02	0.49	0.66	1.00						
9 Complex processing skills	-0.65	0.19	0.58	0.23	0.11	0.15	-0.27	-0.02	1.00					
10 Interaction skills	-0.51	0.23	0.39	0.21	0.26	-0.24	-0.35	-0.39	0.62	1.00				
11 Presentation skills	-0.70	0.20	0.64	0.29	0.26	-0.24	-0.59	-0.52	0.68	0.76	1.00			
12 Mathematical skills	-0.47	0.19	0.37	0.06	-0.19	0.12	-0.35	-0.11	0.51	0.35	0.40	1.00		
13 Per cent ethnic minority	0.05	-0.25	0.15	0.08	-0.13	-0.30	-0.13	-0.07	-0.02	0.03	0.03	0.05	1.00	
14 Per cent female	-0.17	0.17	0.05	0.00	0.01	-0.58	-0.37	-0.38	-0.12	0.24	0.19	-0.08	0.16	1.00
Germany														
1 Per cent requiring no degree	1.00													
2 Per cent requiring vocational degree	-0.44	1.00												
3 Per cent requiring tertiary degree	-0.36	-0.68	1.00											
4 Per cent licensed	-0.09	-0.27	0.35	1.00										
5 Per cent unionized	-0.07	0.16	-0.10	0.00	1.00									
6 Per cent with apprenticeship	0.21	0.69	-0.88	-0.29	0.20	1.00								
7 Physical abilities	0.16	0.37	-0.52	-0.16	0.10	0.45	1.00							
8 Technical skills	-0.20	0.47	-0.33	-0.10	0.35	0.35	0.55	1.00						
9 Complex processing skills	-0.65	0.00	0.53	0.15	0.03	-0.49	-0.25	0.00	1.00					
10 Interaction skills	-0.46	-0.19	0.57	0.14	-0.09	-0.56	-0.25	-0.29	0.72	1.00				
11 Presentation skills	-0.43	-0.37	0.73	0.16	-0.15	-0.70	-0.55	-0.44	0.69	0.78	1.00			
12 Mathematical skills	-0.61	0.28	0.21	-0.02	0.08	-0.16	-0.07	0.36	0.48	0.26	0.25	1.00		
13 Per cent ethnic minority	0.52	-0.06	-0.36	-0.10	0.04	0.27	0.32	0.15	-0.61	-0.56	-0.55	-0.39	1.00	
14 Per cent female	0.10	-0.18	0.11	-0.01	-0.41	-0.20	-0.37	-0.67	-0.04	0.22	0.24	-0.29	-0.09	1.00

Sources: QLF5 2006 and 2007; Research Data Centres of the Federal Statistical Office and the statistical offices of the Länder, Mikrozensus 2006. See text for sources of occupation-level measures. Note: Correlations are based on unweighted data. Correlations in italics are not significant at the  $P < 0.05$  level, two-tailed tests.

**Table 6.** Selected coefficients from multilevel random intercept regressions of wages on individual-level and occupation-level covariates: the United Kingdom

	Model 1	Model 2	Model 3	Model 4
Demographic composition (× 100)				
Per cent ethnic minority		0.320 (0.205)	0.150 (0.139)	0.123 (0.126)
Per cent female		-0.116** (0.039)	-0.218*** (0.032)	-0.193*** (0.031)
Occupational closure (× 100)				
Per cent requiring intermediate degree			0.239*** (0.037)	0.040 (0.042)
Per cent requiring tertiary degree			0.562*** (0.030)	0.285*** (0.045)
Per cent licensed			0.079*** (0.023)	0.078*** (0.021)
Per cent unionized			0.179*** (0.037)	0.185*** (0.037)
Per cent apprenticeship			-0.176** (0.063)	-0.077 (0.064)
Occupational skills				
Physical abilities				-0.061*** (0.018)
Technical skills				0.010 (0.022)
Complex processing skills				0.100*** (0.028)
Interaction skills				0.055* (0.024)
Presentation skills				0.016 (0.029)
Mathematical skills				0.015 (0.018)
Constant	7.000*** (0.021)	6.025*** (0.041)	5.788*** (0.043)	5.927*** (0.045)
$\sigma^2_u$ (occupations)	0.150*** (0.006)	0.045*** (0.002)	0.016*** (0.001)	0.013*** (0.001)
$\sigma^2_e$	0.227*** (0.001)	0.126*** (0.000)	0.126*** (0.000)	0.126*** (0.000)
ICC (occupations)	0.398	0.263	0.115	0.091
-2LL	104,446	59,158	58,842	58,766

Source: 2006 and 2007 QLFS.  $N$  [occupations] = 344;  $N$  [individuals] = 75,906.

Notes: The dependent variable is the natural logarithm of monthly earnings. Standard errors are listed in parentheses. Models 2, 3, and 4 also fit all individual-level covariates; see [Supplementary Appendix](#).

\* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ , two-tailed tests.

the United Kingdom. The residual occupation-level variance is further reduced to 12 per cent in the model that fits individual-level effects and occupational demographic composition (see Model 6, [Table 7](#)). The residual occupation-level variance declines to 5.2 per cent, a 57 per cent reduction from the ‘occupational composition’ baseline ( $[0.121 - 0.052]/0.121 = 0.570$ ), when we adjust for closure and skills (see Model 8, [Table 7](#)). We again calculate low and high estimates of closure’s contribution to residual between-occupation variance: the low estimate is 1.2 percentage points, or 10 per cent, of the residual, and the high estimate is 5.4 percentage points, or 45 per cent of the residual. We find, then, that the baseline occupation-level variance in Germany is lower than in the United Kingdom, but the proportion attributable to closure is comparable and substantial.

The estimated relationships between closure and occupation wages also show a similar pattern in Germany as in the United Kingdom, with positive wage returns to educational credentialing, licensure, and unionization (see Model 7, [Table 7](#)). In Germany, a hypothetical occupation in which all incumbents need a vocational

degree would enjoy wages that are, on average, 11 per cent higher ( $\exp[0.108] = 1.11$ ) than one with no degree requirements, and an occupation in which all incumbents need a tertiary degree would have 45 per cent higher wages ( $\exp[0.375] = 1.45$ ). Fully licenced occupations in Germany receive an estimated wage premium of 9 per cent ( $\exp[0.082] = 1.09$ ) relative to unlicensed occupations. And, in a hypothetical occupation in which all workers are unionized, occupational earnings would exceed those in a nonunionized occupation by 32 per cent ( $\exp[0.275]$ ). These positive wage returns to closure are robust to the addition of measures of occupational skills (Model 8, [Table 7](#)).

As in the United Kingdom, our models do not show consistently positive wage returns to apprenticeships in Germany. In Model 7, which does not fit occupational skills, the apprenticeship coefficient is negative; in Model 8, the skill-adjusted coefficient is positive but with a large standard error. Additional analyses reveal that apprenticeships are associated with higher wages when the comparison set is restricted to manual occupations (see [Supplementary Appendix](#)). One interpretation

**Table 7.** Selected coefficients from multilevel random intercept regressions of wages on individual-level and occupation-level covariates: Germany

	Model 5	Model 6	Model 7	Model 8
Demographic composition (100 × )				
Per cent ethnic minority		-1.135*** (0.123)	-0.472*** (0.112)	-0.038 (0.115)
Per cent female		-0.065* (0.030)	-0.033 (0.025)	-0.133*** (0.030)
Occupational closure (100 × )				
Per cent requiring vocational degree			0.108** (0.033)	0.081* (0.039)
Per cent requiring tertiary degree			0.375*** (0.053)	0.203*** (0.052)
Per cent licensed			0.082* (0.033)	0.106*** (0.029)
Per cent unionized			0.275*** (0.072)	0.268*** (0.066)
Per cent with apprenticeship			-0.057 (0.069)	-0.010 (0.066)
Occupational skills				
Physical abilities				-0.055*** (0.014)
Technical skills				-0.069*** (0.019)
Complex processing skills				0.058* (0.024)
Interaction skills				-0.007 (0.021)
Presentation skills				0.083* (0.040)
Mathematical skills				0.095* (0.042)
Constant	7.293*** (0.017)	6.303*** (0.029)	6.077*** (0.059)	6.095*** (0.058)
$\sigma^2_u$ (occupations)	0.091*** (0.004)	0.023*** (0.001)	0.012*** (0.001)	0.009*** (0.000)
$\sigma^2_e$	0.261*** (0.000)	0.168*** (0.000)	0.168*** (0.000)	0.168*** (0.000)
ICC (occupations)	0.259	0.121	0.068	0.052
-2LL	227,575	160,814	160,618	160,550

Source: Research Data Centres of the Federal Statistical Office and the statistical offices of the Länder, Mikrozensus 2006.  $N$  [occupations] = 330;  $N$  [individuals] = 151,474.

Note: The dependent variable is the natural logarithm of monthly earnings. Standard errors are listed in parentheses. Models 6, 7, and 8 also fit all individual-level covariates; see [Supplementary Table A2](#).

\* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ , two-tailed tests.

is that apprenticeships exacerbate between-occupation wage inequality within the manual sector by creating a protected and relatively well-compensated manual ‘elite’, even if pay in these elite manual occupations is low compared with the pay in occupations protected by other forms of closure (Bol, 2014).

## Discussion and Conclusion

In this article, we analyse four closure institutions—educational credentialing, licensure, apprenticeships, and unionization—and their wage effects in the United Kingdom and Germany. In so doing, we add to the growing body of empirical research on closure, rents, and inequality in advanced industrialized economies. We have also sought to elaborate the rent-based approach to inequality to the comparative context, thereby acknowledging that patterns of closure and the rents generated by closure can vary across nation states more often compared in terms of the characteristics of their welfare states, taxation and redistribution policies, or forms of economic coordination.

We show, firstly, that between-occupation wage inequality is substantial in both the United Kingdom and Germany, and that occupational closure can account for much of the residual between-occupation inequality. These findings are at odds with contemporary ‘relational’ approaches to inequality, which tend to treat occupations as epiphenomena of negotiation processes occurring within organizations (e.g. Avent-Holt and Tomaskovic-Devey, 2013).<sup>9</sup> Our results suggest that this is unwarranted, and that labour market institutions outside of the organization, some of which are explicitly ‘occupational’ (e.g. licensure), affect the distribution of status and power within organizations and high-power actors’ ability to hoard opportunities.

We have also shown that in the United Kingdom and Germany, occupational closure generates wage returns in excess of those anticipated by the demographic and ‘human capital’ attributes workers in closed occupations or the skills characteristic of those occupations. This central finding is consistent with the hypothesis at the heart of the closure argument: Closed occupations pay higher wages than open occupations. It is also consistent

with the claim with which we began the article, namely that institutionalized barriers to the acquisition of skills (e.g. educational credentialing) or the application of skills (e.g. licensure) remain prevalent, and affect patterns of wage inequality, in even so-called 'liberal market economies'. This offers a useful corrective, we think, to comparative inequality research that emphasizes rent destruction and the decline of protective labor market institutions as the primary source of high and growing wage inequality in liberal market economies (e.g. [Rueda and Pontusson, 2000](#); [Western and Rosenfeld, 2011](#)).

At the same time, we also found substantial differences between the two countries in the prevalence of each closure institution, its distribution across occupations, or its wage returns. For example, vocational educational credentialing is more common in Germany than in the United Kingdom, and only has a positive association with wages in Germany. Licensure, by contrast, 'pays off' in both countries, but is more prevalent in the United Kingdom and more likely to be concentrated in high-skill occupations ([Table 5](#)). More generally, in the United Kingdom, the closure institutions that protect manual occupations are either less well developed (e.g. apprenticeships) or their associated rents are less substantial than the closure institutions characteristic of elite nonmanual occupations. The result is a pattern of 'top-end' rents that favour workers in higher skilled and nonmanual occupations. In Germany, closure is distributed across the occupational structure, and the wage returns to closure institutions that are more prevalent among low-skilled or manual sector workers are on par with wage returns to closure institutions more prevalent in the professions. The relative strength of 'bottom-end' rents in Germany may do little to suppress the within-occupation wage inequality, but it suppresses the between-occupation wage inequality relative to a system where 'top end' rents prevail.

We have framed these findings in terms of their implications for patterns of wage inequality between occupations, but we think they are also relevant for understanding differences across countries in levels of aggregate wage inequality. Logically, the impact of closure on aggregate inequality depends on (i) the closure effect on mean occupational wages, (ii) the closure effect on within-occupation wage inequality, (iii) the distribution of closure across occupations, and (iv) the magnitude of closure-based rents across occupations. If closure is primarily found in, or generates the greatest wage premia in, high-skilled occupations, it will tend to exacerbate aggregate levels of wage inequality. Conversely, if closure is primarily found in, or has the greatest benefits for, occupations that would *ex ante* fall

at the bottom of the wage distribution, it will suppress aggregate levels of inequality.

Although a formal test of the consequences of closure on aggregate inequality in the two countries exceeds the scope of this article, the observed patterns in our data are consistent with this reasoning. As we have shown, rents in the United Kingdom exacerbate wage inequality (by driving up top-end wages) more than in Germany, where rent-generating institutions are more likely to also protect low-wage or low-skill workers. Future research that focuses on institutionalized rents and their distribution across the occupational structure may help us understand cross-national differences in aggregate levels of wage inequality, just as we have shown that institutionalized closure is an important source of between-occupation wage inequality in the United Kingdom and Germany.

## Notes

- 1 [Weeden \(2002\)](#) also analysed voluntary certifications and professional associations. Neither had a significant effect on wages in the United States, perhaps because these institutions primarily try to raise demand for an occupation rather than affect its supply. We focus here on institutionalized barriers that plausibly affect the labour supply.
- 2 In 2011, the University and College Admissions Services (UCAS) reported that 70 per cent of UK applicants to tertiary education were accepted to at least one university, a decline from 80 per cent earlier in the decade. The UCAS is a charitable organization that helps young people navigate college applications and, as such, its data are likely on a pool of applicants with unusually low admissions prospects. The percentage of all UK applicants who are not admitted to any university is probably less than the 30 per cent implied in the UCAS report, but it is not zero.
- 3 We limit our analytic sample of the QFLS to respondents from the first and fifth waves in 2006 and the first wave in 2007 so that households do not appear in our data set multiple times.
- 4 For the sake of comparability, we use net earnings in the United Kingdom, although gross earnings are available in the QLFS and show similar results as those presented in the main text (see [Supplementary Appendix](#)). We are aware that the income measure in the German Microcensus, a categorical variable measuring the net monthly income, is imperfect, but the Microcensus is unique in that it offers sufficient sample sizes to analyse occupations at this level of detail.

- 5 Following a reviewer's suggestion, we tested models that include the square of per cent female. This had no appreciable effect on the point estimates of the closure variables, although in our skill-adjusted (i.e. conservative) models the point estimate for vocational credentialing in Germany fell below standard significance levels. Vocational credentialing is negatively correlated with per cent female and its square, raising the possibility that female-dominated occupations have low mean wages because of the absence of closure, not because of devaluation.
- 6 The correlation between the behavioural and subjective measures is 0.97 in Germany and 0.90 in the United Kingdom for tertiary training, and 0.90 in Germany for vocational training. It is only 0.41 for intermediate training in the United Kingdom, where more respondents have intermediate degrees and believe intermediate degrees are necessary.
- 7 Haupt (2014) estimates that 14.5 per cent of German workers are licenced, but his definition of licensure includes educational credentials that are required to practice an occupation. Models using Haupt's licensure measure reveal similar skill-adjusted wage returns to licensure (9 per cent) as our models.
- 8 A measure of the percentage of occupation members in the United Kingdom who are covered by a collective labour agreement (CLA) shows a smaller, but still significant, wage premium (9 per cent).
- 9 Our data do not allow us to model organizational attributes or within-organization relations, or to parse variance between these two overlapping labour market structures.

## Acknowledgements

The authors thank Richard Breen, Valentina Di Stasio Martin Diewald, Mirjam Fischer, Daniela Grunow, David Grusky, Andreas Haupt, Markus Klein, Silke Schneider, Donald Tomaskovic-Devey, Herman Van de Werfhorst, Felix Weiss, and the anonymous ESR reviewers for their helpful comments on an earlier version of this paper. Support for Dr. Bol was provided by the Amsterdam Centre of Inequality Studies. Support for Dr. Weeden was provided by Cornell University's Center for the Study of Inequality, a Visiting Fellow grant from the SFB-882 project at the University of Bielefeld, and by a Fernand Braudel Senior Fellowship from the European University Institute.

## Funding

This research is supported by VIDI grant no. 452-07-002 from the Netherlands' Organization for Scientific Research.

## Supplementary Data

Supplementary data are available at ESR online.

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